

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILES 8672
1543 SCOMM 57: SENATE SPECIAL COMMITTEE ON OIL & GAS, 1987-1988

1340

4-7-87

HEDGING
with Oil
FUTURES &
OPTIONS



ALASKA STATE LEGISLATURE

SENATE SPECIAL COMMITTEE ON OIL AND GAS

Senator Bettye Fahrenkamp,
Chairman
Senator Jack Coghill
Senator Paul Fischer

P.O. Box V, State Capitol
Juneau, Alaska 99811
(907) 465-3834

M E M O R A N D U M

TO: Members, Senate and House Finance Committees

FROM: Senator Bettye Fahrenkamp, Chairman *BKF*
Senate Special Committee on Oil and Gas

RE: Proposal for hedging oil price risks with crude futures and options.

DATE: April 6, 1987

I would like to invite you to attend tomorrow's hearing of the Senate Special Committee on Oil and Gas.

On Tuesday, April 7, at 3:30 pm in the Beltz Room, the Senate Special Committee on Oil and Gas will receive a briefing on a proposal for hedging oil price risks with crude futures and options.

The continued uncertainty and volatility of oil prices have made budget planning difficult for states and private companies that are highly dependent on oil revenues. Using the crude oil futures and options market, it may be possible to reduce the risk of potential price decreases and more accurately plan future revenues.

Andy Lebow, an energy futures specialist from Shearson Lehman Brothers in New York, and Jim Colburn, from the New York Mercantile Exchange, will be speaking before the committee via the teleconference network. They will be discussing a proposed risk management strategy for the State of Alaska using options on crude oil futures. They will also present another risk management tool called "Exchange of Futures for Physicals", which would allow the state to secure prices for its royalty oil in advance of actual sales.



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MEMORANDUM

TO: Members, Senate Special Committee on Oil and Gas
FROM: Committee Staff
RE: Committee Meeting, April 7, 1987
DATE: April 3, 1987

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April 7, 1987

Senate Special Committee on Oil and Gas

Briefing on a proposal for hedging oil price risks with crude futures and options.

TO TESTIFY:

ANDY LEBOW, an energy futures specialist from Shearson Lehman Brothers in New York,

JIM COLBURN, from the New York Mercantile Exchange,

Allen Haysen

ALSO LISTENING:

Johns

JIM SHEY and JAMIE ROSENFELD, Cambridge Energy Research Associates (in Cambridge, Massachusetts)

JOSEPH STANISLAW, Cambridge Energy Research Associates
(in London, England)

JIM EASON, Division of Oil and Gas

Mary Lindquist - Fols Arch

Mr Phillips Sec of oil + gas

Andy we do have

Basics of ~~the~~ options - price insurance
on Crude oil futures
for a fixed price out in the future
cost

Premium call hedge -

Call ~~puts~~ Wether limited at 100

Buy a Put + sell a call

Key word is versatility

Out of the money calls.

Environment is more favorable for hedging

Revenue projections are inadequate. $\left. \begin{array}{r} 1.032 \\ 1.086 \end{array} \right\} \underline{227.5m.}$

State could loose
hedge strategy

Crude futures has breadth depth & liquidity
State should reconsider

Monthly ~~contaminants~~ are better
- in King - longer term

Basics risk view -

price risk is always down side

Perfect hedge

future markets -

state long crude

cash go down futures go down - low on daily - -4.

state could lock into price market.

- Oil hedging -

ANS cash price -

price changes

WTI & -

most weighted averages -

In value - futures

basics risk of futures relative
state as a short hedger could
not lock into the price.

could be workable - but risky

options on energy futures - limited risk -

failure of futures to move in tandem is problem

biggest risk is basis risk to Alaska

EFP transaction - agreement.

Recommend state putting out some of its
oil for sale on the market.

1 to 6 months hedge.

Time is right now for hedging - Mary Ringall

**SHEARSON
LEHMAN
BROTHERS**

An American Express company



Swap market is beginning to become permanent.

June 17 Calgary

Succession - J. Conking at it.
Haw

Many trans - heating oil future market
S. Early trans - heating oil future market
N. Trans - heating oil future market

PROPOSAL ON HEDGING
OIL PRICE RISKS WITH CRUDE
FUTURES AND OPTIONS

3,000 lots per day
March 8,000 lots a day
Underlying curve

1987 - Crude 49,000 contracts
49m bbls.
38 year-lager
16 year

Alaska's effect. Market would effect very little.
2,000 bbls per day -

\$1,000 per contract
Commission fee
Exchange fee

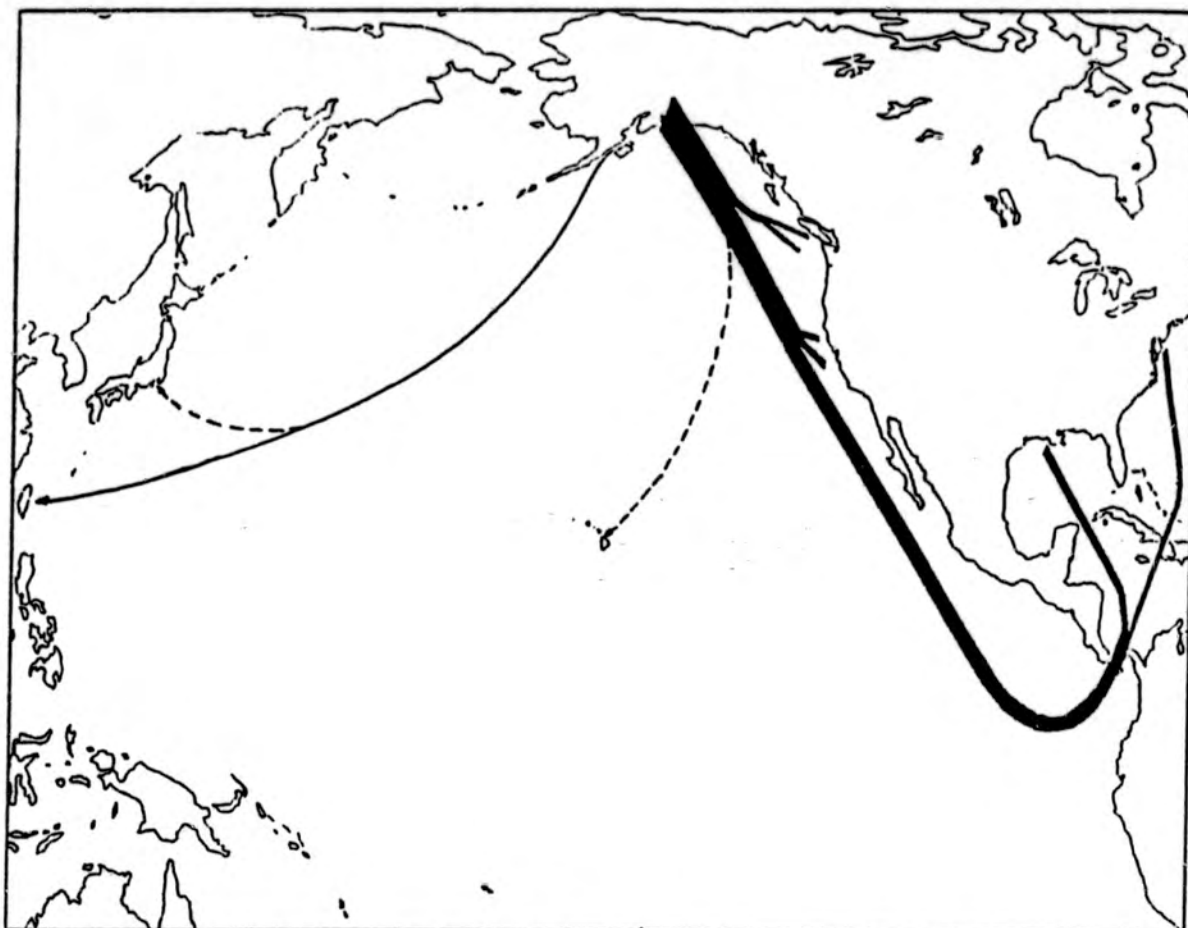
Opportunity cost
in placing marginal
2 x 3,000 premium
in the spot market.

Andrew Lebow
VP - Energy Futures Specialist

Should be altered
volumes were 57,000 bbl daily
futures + puts

Dec '87

PETROLEUM PRODUCTION REVENUE FORECAST



QUARTERLY REPORT
MARCH 1987

DEPARTMENT OF REVENUE
STATE OF ALASKA

STEVE COMPER, GOVERNOR

Table 6.
Actual and Expected Crude Oil Prices
For Alaska North Slope Crude and OPEC Marker
Monthly Data (\$/bbl)

Mo/Yr	ANS West	ANS Gulf	Saudi Gulf	Mo/Yr	ANS West	ANS Gulf	Saudi Gulf
Jul 82	28.30	30.28	33.68	Jul 85	24.04	26.93	26.84
Aug	28.12	30.31	34.00	Aug	24.02	26.92	27.01
Sep	28.00	30.62	32.76	Sep	24.15	26.94	27.60
Oct	27.67	30.55	30.81	Oct	24.20	26.91	28.25
Nov	28.02	30.06	31.12	Nov	24.26	26.90	28.43
Dec	27.35	29.36	29.94	Dec	24.25	26.50	26.89
Jan 83	26.87	28.29	28.45	Jan 86	23.28	23.21	24.35
Feb	25.59	27.50	28.90	Feb	17.73	18.32	20.14
Mar	25.16	27.16	28.90	Mar	13.65	15.07	18.28
Apr	25.21	27.36	29.21	Apr	11.31	13.27	16.04
May	25.32	27.36	29.10	May	10.73	12.54	16.29
Jun	25.34	27.42	29.25	Jun	10.62	11.81	14.69
Jul	25.32	27.51	29.25	Jul	9.15	10.48	12.17
Aug	25.45	27.86	29.25	Aug	9.42	11.29	14.55
Sep	25.65	28.04	29.11	Sep	11.37	11.67	16.60
Oct	25.71	27.95	29.07	Oct	11.62	13.07	15.26
Nov	25.73	27.93	29.19	Nov	11.54	13.08	14.85
Dec	25.73	27.89	29.16	Dec	11.77	14.33	15.38
Jan 84	26.05	28.06	29.03	Jan 87	13.79	15.33	17.46
Feb	25.57	27.87	28.99	Feb	15.30	16.32	18.78
Mar	25.59	27.91	28.90	Mar	15.14	16.16	18.64
Apr	25.49	27.93	29.08	Apr	14.96	15.99	18.47
May	25.64	27.95	27.15	May	14.74	15.77	18.26
Jun	25.70	28.04	27.28	Jun	14.52	15.55	18.05
Jul	25.81	27.95	27.66	Jul	14.38	15.41	17.93
Aug	25.66	27.92	27.71	Aug	14.15	15.19	17.72
Sep	25.75	27.90	28.06	Sep	14.04	15.09	17.62
Oct	25.36	27.92	27.25	Oct	13.50	14.55	17.09
Nov	25.73	28.01	27.13	Nov	13.49	14.51	17.09
Dec	25.23	27.38	26.85	Dec	13.47	14.53	17.09
Jan 85	24.72	27.00	25.61	Jan 88	14.41	15.47	18.04
Feb	24.29	26.98	25.26	Feb	14.38	15.46	18.04
Mar	24.31	26.97	26.72	Mar	14.37	15.45	18.04
Apr	24.27	26.97	26.95	Apr	14.33	15.41	18.01
May	24.10	26.94	26.70	May	14.31	15.40	18.01
Jun	24.15	26.94	25.70	Jun	14.30	15.39	18.01

Table 7.
Actual and Expected Crude Oil Prices
For Alaska North Slope and OPEC Marker
Annual Data (\$/bbl)

Year	ANS West	ANS Gulf	Saudi Gulf
1978	12.30	14.60	13.46
1979	13.70	15.50	14.41
1980	26.50	27.68	24.75

Table 7.(cont.)
Actual and Expected Crude Oil Prices
For Alaska North Slope and OPEC Marker
Annual Data (\$/bbl)

<u>Year</u>	<u>ANS West</u>	<u>ANS Gulf</u>	<u>Saudi Gulf</u>
1981	31.43	33.67	29.45
1982	29.50	31.07	32.99
1983	26.75	28.86	30.51
1984	25.64	27.91	28.79
1985	24.95	27.40	26.80
1986	19.35	21.28	22.90
1987	12.78	14.09	16.54
1988	14.09	15.16	17.72
1989	14.87	16.00	18.70
1990	15.68	16.89	19.74
1991	16.81	18.11	21.15
1992	18.07	19.40	22.65
1993	19.45	20.82	24.28
1994	20.93	22.37	26.03
1995	22.65	24.25	28.11
1996	24.58	26.29	30.37
1997	26.65	28.52	32.82
1998	28.94	30.93	35.47
1999	31.24	33.59	38.34
2000	34.28	36.66	41.61
2001	37.42	39.91	45.17
2002	40.85	43.46	49.04
2003	44.59	47.33	53.25

The weighted average sales prices of ANS on the West Coast and Gulf Coast, and the weighted average wellhead prices for the last twelve months according to producer reports are shown in Table 8.

Table 8.
Average ANS Sales Prices
(\$/bbl)

<u>Month</u>	<u>Wellhead</u>	<u>West Coast</u>	<u>Gulf/East Coast</u>
January 1986	15.86	23.28	23.21
February	10.74	17.73	18.32
March	7.23	13.65	15.07
April	5.38	11.31	13.27
May	4.82	10.73	12.54
June	4.18	10.62	11.81
July	3.12	9.14	10.48
August	3.69	9.42	11.29
September	6.14	11.54	12.87
October	5.83	11.62	13.07
November	5.74	11.54	13.08
December	6.46	11.77	14.33

4/7/87 3:38

~~Oil Price~~
Hedging Oil Price

Andy Lehouc

Jim Colburn

Options —

begin trading 11/14/86 —

(1) Flexibility —

downside price protection
put options on futures
premium allows to sell future

buying price insurance —

premium 1.50/bbl

for right to sell at \$15 —

good for 3 months.

As prices decline —

put floor at 13.50

Subsequent hedging costs at 1.50.
Total downside protection

The most it will cost is 1.50

will participate in market rally's -

"put" strategy.

call writer -

"Insurance Co"

receive premium

receive 1.50 as price declines.

long position -

as price

Protection is limited to 1.50.

set floor -

long "put" to finance put
sell "call"

downside protection —
\$0 cash outlay. —

can't participate in rallies —

has protection

oil producers like "calls"

Andy Lehman.

3/85 before Senate Finance Com.

rec. That hedge program would be
difficult —

could future options lessened problems

could protect some losses —

Exchange of Futures for Physicals.

more favorable now than 3/85

Revenue projections may be made

in 1984 — 86-87 1.02
projection 1.063

amounting 200 million £

hedge strategy —

contribute to better forecasting —

options —

to manage prices —

buyers of ANS crude are used to

every segment of industry is using options —

hedging —

equal & opposite position in futures market.

AK always "long crude"

if prices decline, we decline.

futures follow

if "short futures" —

look into wanted -

gains on futures > losses on crude = perfect hedge.

ANS. is lower. -

different quality, different prices.

Basis Risk - correlation coefficient -

monthly is closer than daily.

In-kind contracts

in-value - net back from -
or posted or weighted average.

→ WTI futures do not nec move w/ ANS price
could mean losses
netback in-value

options do not remove "basis risk"
but limited to the cost of the premium

57,000 bbl/day -

"short hedger"

futures rise
3rd quarter 86
1.6
while in-value (main cost) loss 11 million

sometimes future prices fall faster
than in-value prices -

in 1st quarter - gained.

2nd quarter. loss 29.3.
62.

future 600,000
option 1,400,000

7/85 - 6/86 -

future 38.6 price
option 2.19/cu
40.9 mills

did provide protection for 67% of loss.

neither provided total protection -

major drawbacks - is "basis risk".

EEP

could link sales to futures -

- 1) protect revenue from drops &
- 2) lock into known prices.

based on differential above or below
futures price -

set aside 7% to competitive bid w/ different
place hedge

can place to go in advance.

rec. further study.

3-8,000 lots/day.

1957 - 49,000/day

49 million barrels/day

200th contracts/day

would not effect market.

hedge
if all of states oil flow.

~~Index~~ would only want to hedge
a certain amount.

SWAP MARKET —

agreement w/ Bank.

get fixed price —

use bank in middle.

too much exposure

too much volume.

Market

costs —

margins, commissions & exchange fees.

opportunity costs in placing margin calls

excess margin for spot market.

There are fees —

Trade

how far out? how many years?

April 7-

open interest 2

how many open contracts

July

Dec 87

mostly nearby months.

Traders "stock" hedge.

F Boone Pickens. all of 87

continue to roll over from north to north.

Phile

risk of not delivering? —

→ June 17, Calgary

Other states? Jim.

Louisiana — discussed

Texas — looking at it.

Public transportation authorities.

Transit authorities —

Southern Cal Rapid Transit.

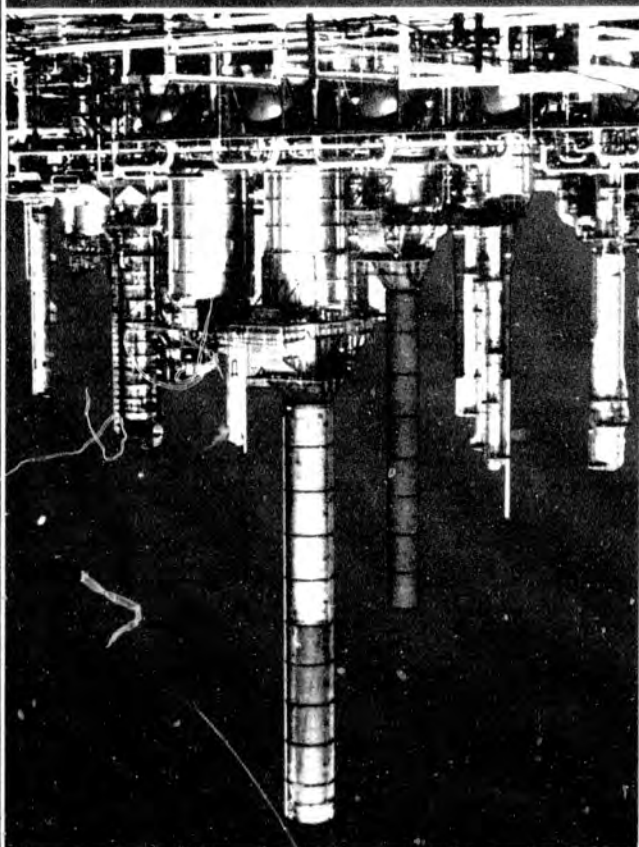
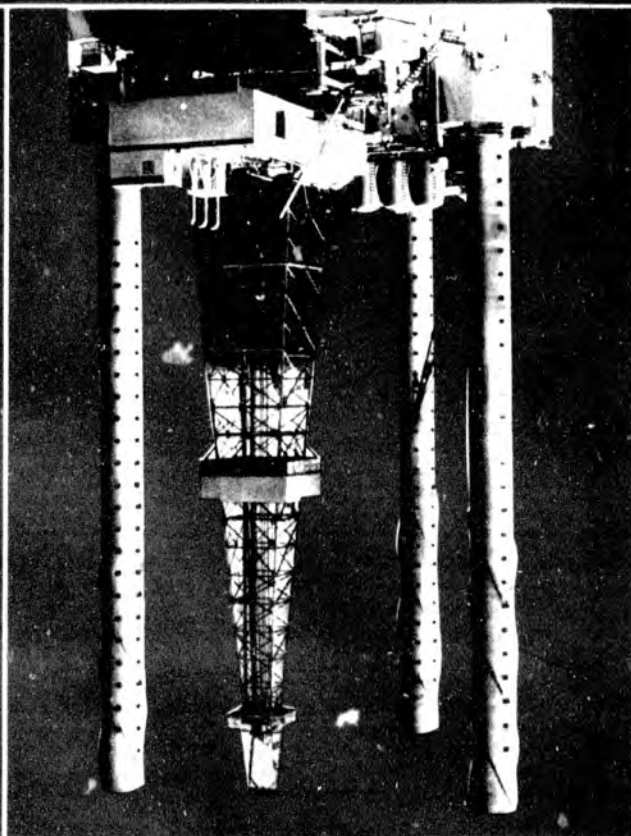
in heating oil to hedge diesel cost.

NY Transit

Buffalo transit.

adjourned.

4:42



ENERGY



SPECIAL SUPPLEMENT

ENERGY *in the news*

Since the beginning of trading crude oil options on November 14, 1986, there has been significant interest in options articles and information. Requests for recent issues of Energy in the News have depleted our inventories. To meet current demand, this compendium of options articles was developed. Most of the following articles were taken from previous issues of Energy in the News. Look for future articles on options to appear in regularly scheduled quarterly issues of Energy in the News.

- 3 Options for a Volatile Market — Crude Comes of Age**
- 4 NYMEX Position Limits for Options**
- 4 Crude Oil Option Contract Specifications**
- 4 Crude Oil Options Vendor Symbols**
- 5 A Promising Start for Crude Oil Options**
- 8 The Allure of NYMEX Petroleum Options**
- 9 Options: Hedging Alternatives for Oil Refiners**
- 11 The Role of the Market Maker**
- 13 Option Hedges for Oil Producers**
- 16 Crude Oil Options: A Risk Management Tool**
- 18 Volatility and Option Valuation**
- 20 NYMEX Public Customer Margins**
- 21 How to Interpret Option Deltas**
- 24 Crude Oil Options: The Energy Speculator's New Tool**
- 26 Time and Volatility**
- 28 Six Basic Options Strategies**
- PRESS ARTICLES:**
- 31 The Hot New Low-Stakes Play in Oil (Business Week)**



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24-Hour Market Information

The following telephone numbers are being used to disseminate NYMEX market information:

Prices and Trading Volume	
Heating Oil Futures	212/938-8011
Gasoline Futures	212/938-8012
Crude Oil Futures	212/938-8013
Crude Oil Options	212/524-0614
Platinum, Palladium, Potatoes	212/938-8014
Open Interest	
Crude Oil, Heating Oil Futures	212/938-8016
Gasoline Futures	212/938-8017
Crude Oil Options	212/938-2625
Platinum, Palladium, Potatoes	212/938-8020
Membership	
Current Quote	212/938-2211



Options for a Volatile Market—Crude Comes of Age

The rapidly changing environment in the oil industry has created the need for more sophisticated risk management techniques. As OPEC price leadership has eroded and oil pricing has become determined by market forces, an increasing number of oil traders are using the energy futures markets to control price exposure. Crude oil futures volume on the New York Mercantile Exchange (NYMEX) totalled 8.3 million contracts (the equivalent of 8.3 billion barrels) in 1986, as compared with 3.98 million for all of 1985. This growth is a manifestation of highly volatile oil prices. Last November, NYMEX introduced yet another financial management tool to complement its energy futures complex: options on crude oil futures.

Crude oil options offer traders and risk managers more flexibility in attaining hedging goals. With options, traders can buy price insurance at a fixed cost to protect against adverse price moves without giving up the potential to profit from favorable price moves. Or, a trader might sell options against oil inventories to earn premium income. Options have the versatility to accommodate any strategy or market opinion.

Evidence of the popularity of futures options is indicated in volume performance. During 1986, over 32 million options on fu-

tures contracts were traded on metals, financials and agricultural products. And, options on futures have only been trading since 1982 (the first were on treasury bonds, sugar, and gold). If one considers just a few option strategies, the wide appeal of these instruments becomes clear.

A key feature of options is that buy option strategies have a limited, quantifiable risk regardless of where the underlying futures trade. A put buyer pays a premium for the right to sell futures at a specific price (strike price) for a specific period of time. The maximum loss for this strategy is the cost of the option, the premium.

An oil producer could purchase put options to protect a cash or futures position against a price decline below, for example, \$13 per barrel. The cost of this insurance will depend on where futures are trading, the amount of time the option is valid and the level of market volatility. If prices decline below \$12, the producer has already contracted to sell futures at \$13; cash positions are covered. If prices rally, the put hedge can lose at most the amount of the premium, while the cash position appreciates. No additional margin is required. Downside price protection is achieved at a fixed cost, without giving up profit potential during market rallies.

Some traders may feel that premiums are

too high. Selling (writing) call options against oil inventories or future production is a way to take advantage of rich premiums. A call writer, in return for the premium, is obliged to sell futures to a call buyer at a specific price for a specific period of time. For example, with futures at \$15, an oil producer could sell \$16 (strike price) calls for, say, \$1 per barrel. As long as futures remain at or below \$16, the producer earns the entire premium, \$1 per barrel. An ideal outcome would be if prices rallied to \$16. The producer still earns \$1 from the call write, and his cash position appreciates by \$1. If prices rally above \$16, the producer's effective sale price remains at \$17, because additional gains on the cash position are offset by losses on the written call option. This strategy earns premium income and achieves downside protection equal to the premium. However, upside profit potential is constrained if prices rally above the strike price. Unlike the purchase of options, writing options carries unlimited risk. Therefore, option writers must post margins.

A third strategy which illustrates the versatility of options is a long straddle. A long straddle is also referred to as a long volatility trade because profits are earned when the market moves dramatically in either direction. The trade involves buying a put and a call with the same expiration date and strike price. Total risk is limited to the premiums paid, while profits are unlimited if the market moves boldly up or down. A straddle could be a popular trade ahead of an OPEC meeting or before the release of new information such as an API report. Traders might buy a straddle days before an OPEC meeting with the expectation that market volatility will increase afterwards.

Options trading will add to the liquidity of the oil futures market. Because of their limited risk feature, crude oil options will be used by a much broader industry and speculative population. As market participants enter option orders, market makers and arbitrageurs taking the other side will lay off market risk by buying or selling futures contracts.

For example, if a large number of buy put orders enter the market, an arbitrageur will simultaneously sell the puts, buy calls, and sell futures. The arbitrageur takes advantage of puts being bid higher without having an exposed market position. As a result, additional liquidity in the options and futures markets is created. (Arbitrage strategies are described in "The Role of the Market Maker" on pages 11-13 in this issue.)

Option strategies can be as simple as a buy put or more complex, like straddles and spreads. The above examples illustrate only a few approaches, as option strategies are limited only by the trader's creativity. ■

NYMEX Position Limits for Options

The position limits for crude oil options are calculated on a gross, rather than a net, position basis. These limits, in all months combined, are 2,000 contracts for each of: 1) long puts, 2) long calls, 3) short puts, 4) short calls.

Speculative position limits for options may be increased to a maximum of 4,000 contracts, so long as any option contracts in excess of the 2,000-contract limit are part of a conversion, a reverse conversion, or a box spread, in which all component positions expire on the same date. Authorization from

the President of the New York Mercantile Exchange is required for this. Persons must apply by filing an Options Strategy Notice within five days after assuming the above limit position. However, prior approval is required to surpass limits during a contract's last three trading days.

Speculative position limits may also be increased to a maximum of 4,000 contracts if those options in excess of 2,000 are part of a one-for-one option vs. future spread (i.e., an inter-option spread), or a one-for-one option vs. option spread (i.e., an intra-option spread). Such exemptions for inter-option spreads and intra-option spreads shall not require approval of the President.

Option position limits may also be expanded to 4,000 contracts for bona fide hedge positions, on condition that a Hedge

Notice is filed within the same limits as for Options Strategy Notices, above.

A proposal to base speculative position limits on a net delta system is pending CFTC approval (contact the Exchange for further information).

Crude Oil Option Contract Specifications

CONTRACT UNIT

1,000 U.S. barrels (42,000 gallons)

TRADING HOURS

9:45 a.m.-3:10 p.m. (New York time)

TRADING MONTHS

Six consecutive futures months.

PRICE QUOTATION

Prices are quoted in dollars and cents per barrel.

MINIMUM PRICE FLUCTUATION

\$.01 (1 cent) per barrel
(\$10 per contract)

MAXIMUM DAILY LIMIT

Trading in crude oil option contracts will not be subject to price fluctuation limitations.

LAST TRADING DAY

Trading terminates at 3:10 p.m. (New York time) on the first Friday of the month preceding the delivery month. For example, options on February crude oil futures expire the first Friday in January.

STRIKE PRICES

Trading will be conducted for options with increments of \$1.00 per barrel.

EXERCISE NOTICE

Notice of exercise must be received by a Clearing Member from a customer not later than 4:30 p.m. on any business day on which an option contract is trading up to and including the date of expiration. On the same day it receives a notice of exercise from the Clearing Member, the Exchange's Clearing Department will assign the notice of exercise randomly to a seller of an option of the same series. Prior to the opening of trading on the next business day, the Exchange will notify the seller of such exercise and assignment. On the last day on which an option may be exercised, each option held by a Clearing Member having an in-the-money value of \$300 or more will be automatically exercised by the Exchange unless the Exchange receives written notification from the Clearing Member.

ASSIGNMENT

The Exchange will establish, by book entry, positions in the underlying futures contract for both the purchaser and seller of the option, the price of which will be the exercised option's strike price.

Crude Oil Options Vendor Symbols

Commodity Exchange Center	LO
ADP	
Bunker Ramo	QLO
Comtrend	QL
FIS	CULO
Bonneville Telecomm./RDS	CL
Bridge Market Data Systems	CL
Commodity News Service	
CNS Data Quote	CL
Money Center	CL
Market Information, Inc.	CL
Market Vision Corp.	CL
Quotron Systems, Inc.	LO
Reuters U.S., Inc.	
Quote mode	LO
Full screen mode	Group 111
Standard & Poors/MWIS	CL
Telerate: access pgs.	8460-86 8470-74
Tradecenter	LO





A Promising Start For Crude Oil Options

The efforts of NYMEX members, staff, and industry advisors to launch crude oil options have paid off handsomely. Since the opening on November 14, options trading results have been excellent. Notably, open interest increased sharply to reach 54,909 on December 31. After intensive preparations, Exchange clearing and price-reporting systems functioned smoothly, while trading proceeded in an efficient manner.

On opening day, a total of 5102 contracts were traded, of which 4541 were call options and 561 put options. During the first six weeks of trading, average daily contract volume was 4,509 with 2,702 calls and 1,807 puts traded. Therefore, in 1986, during a total of 30 trading days, a total of 135,266 options contracts were traded; 81,057 calls and 54,209 puts. Each call represents an op-

tion to assume a long position in one crude oil futures contract (1,000 barrels) and each put represents an option to assume a short position in a crude oil futures contract.

Open interest in crude oil options, a measure of the market's size and liquidity, has expanded steadily. Open interest rose from 4220 at the close of trading on November 14 to reach 54,909 contracts by the end of the year. This performance indicates that new positions have continually been created, and thus the crude oil options market has broadened substantially.

Six consecutive futures months, from February to July 1987, were initially listed for the options, but the greatest trading activity has thus far occurred in the first three months. In terms of the premiums, or prices, of NYMEX crude oil options, a meaningful

yardstick is the implied volatility. This can be calculated from an exact options pricing model (see box on page 7). During the first four weeks of trading, the implied volatility of at-the-money options has been 30-40 percent. These levels are at the low end of 30-day volatilities as measured earlier in 1986; i.e., a range of 30 to 100 percent.

Comparisons with the opening record of major options contracts demonstrate very favorable results. Currently, options on Treasury bonds and Deutschemark futures are among the largest such contracts. The charts on page 4 show that volume and open interest in NYMEX crude oil options has expanded quickly relative to these key contracts. Indeed, the crude oil option contract is, so far, the fastest-growing options contracts ever introduced in the futures industry.

With uncertainty virtually the only certainty in today's oil markets, this new contract can be expected to gain steadily in importance after its auspicious start.

OPTIONS

Educational Materials From NYMEX

Educational materials explaining the NYMEX crude oil option contract and options strategies are available from the

NYMEX Marketing Department. These include a crude oil options brochure, a video course with an accompanying workbook, and a slide show plus script.

The NYMEX crude oil options brochure

was published in August. It defines options terms, describes the determinants of options premiums, discusses options trading and hedging applications, and lists the contract's specifications.

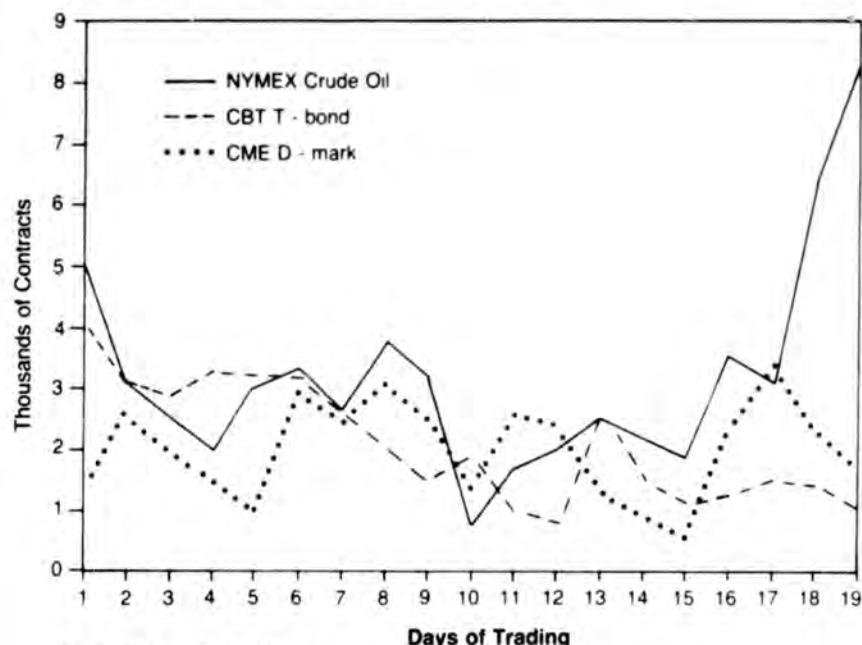
The videotape (VHS) is of lectures conducted by Joseph Sullivan, a partner of The Options Group, during a three-day seminar offered by the Exchange last June. The lectures cover the basics of options as well as advanced trading techniques such as spreads, straddles, fences, and conversions. The video is accompanied by an extensive workbook of all visuals used in the seminar.

The 48-slide presentation on crude oil options covers basic options terms and definitions, plus options pricing factors and trading strategies. The slideshow comes with a script.

The cost of the video is \$100 (\$50 for NYMEX members) and the cost of the slide show is \$70. These prices are exclusive of taxes (applicable to New York residents) and shipping costs.

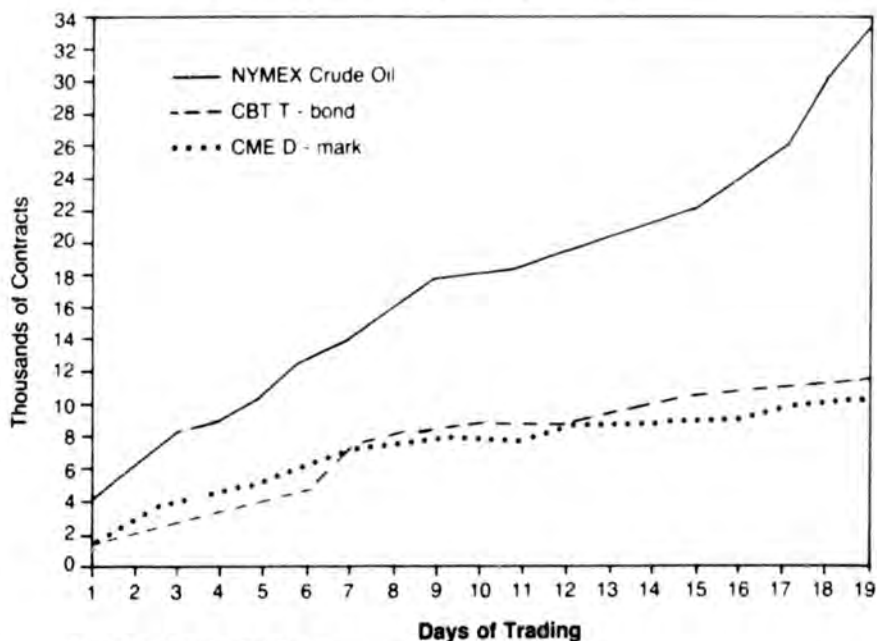
Please return the following coupon and enclose a check for these educational materials.

Crude Oil Option Volume Comparison*



* in the first month of trading

Crude Oil Option Open Interest Comparison*



* in the first month of trading

New York Mercantile Exchange

Four World Trade Center
New York, N.Y. 10048
Attn: Marketing Department
212 938-2879

- ☐ Please send me ____ copies of the NYMEX option brochure. (First 100 copies are free, \$0.25 per copy thereafter.)
- ☐ Please send me the VHS videotape course, at a cost of \$100.00 plus \$8.25 sales tax (N.Y. residents only) and \$5.00 shipping and handling cost.
- ☐ Please send me the options slide show, at a cost of \$70.00 plus \$5.78 sales tax (N.Y. residents only) and \$5.00 shipping and handling cost.

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Daily Options Fact Sheets

The Exchange generates options fact sheets each day, complementing the daily reports on NYMEX futures trading. The daily statistical package, including both the options and the futures reports, is available at a subscription cost of \$100 per year (domestic) and \$150 per year (foreign). The options report includes data for each contract and strike price: open interest, premiums, trading volumes, and the number of contracts exercised. Also listed is the NYMEX risk factor (delta) which is used in calculating floor trader and clearing member margins.

To order the daily fact sheets, contact Carol Romberg at the NYMEX Marketing Department, 4 World Trade Center, New York, N.Y. 10048. Telephone: 212/938-2879.

A sample format for one contract follows:

Sample Daily Options Fact Sheet

Crude Oil Light Sweet (LO) — Calls for February 1987 (Wednesday, December 17, 1986 / Open Interest: 40,394 (R) / Volume: 6,675)

	Open Interest	Open	High	Low	Last	Settle Price	Delta	Volume	Exercises	Contract	
										High	Low
12.00	—	—	—	—	—	—	0.00	—	—	—	—
13.00	—	—	—	—	—	—	0.00	—	—	—	—
14.00	82 + 1	2.10	2.12	2.10	2.12	2.15 - 30	0.98	6	—	2.40	1.24
15.00	1,008 - 8	1.35	1.39	1.22	1.22	1.25 - 25	0.86	62	—	1.80	.51
16.00	4,295 + 160	.57	.63	.50	.56	.56 - 12	0.55	786	—	1.10	.18
17.00	4,061 + 1327	.25	.26	.19	.22	.22 - .06	0.21	1,618	—	.50	.07
18.00	1,587 - 119A	.09	.09	.07	.07	.07 - .01	0.04	40	—	.25	.04
19.00	400 + 5	.03	.03	.03	.03	.02 - .01	0.00	7	—	.15	.03
20.00	—	—	—	—	—	—	0.00	—	—	—	—
	11,433 + 1366						Total	2,519			

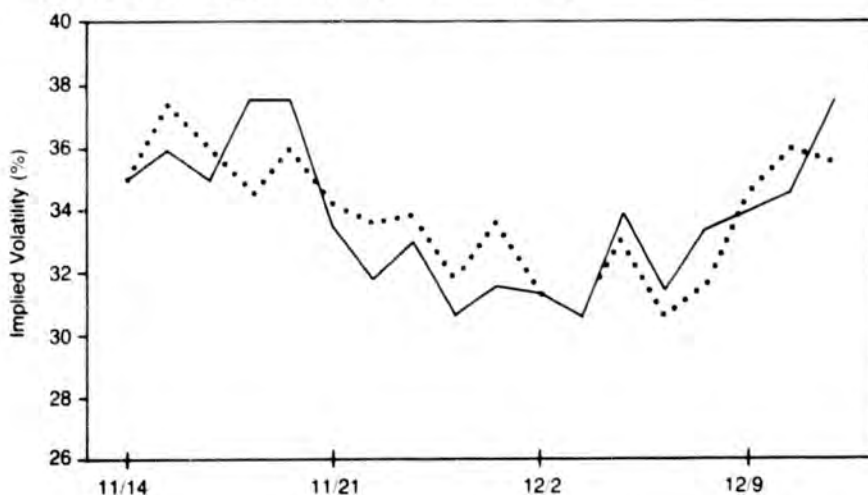
R = new record

A Note on Implied Volatility

Option traders look at implied volatility for an indication of the market's expectation of future price volatility. It is a derived figure, based on the market-traded option premium. Exact option pricing models calculate implied volatility from inputted data on the option premium, the time to expiration, the underlying futures price, the strike price, and the risk-free interest rate.

Computed from crude oil option premiums, the implied volatility of crude oil prices has ranged between 30 to 38 percent from November 14 to December 11 (chart). It increased ahead of the December 11 OPEC meeting, reflecting an anticipation of greater volatility in the oil markets.

NYMEX February Crude Oil Option Implied Volatility: Calls (line) and Puts (dot)



Date (November 14, 1986 to December 11, 1986)

The Allure of NYMEX Petroleum Options

MICHAEL F. McDERMOTT
Vice President, Drexel Burnham Lambert

The New York Mercantile Exchange (NYMEX) introduced options on Crude Oil Futures on November 14, 1986. Options on Heating Oil Futures will commence in 1987. While the introduction of these contracts is being warmly received by many in the financial community, there are a number of questions being put forward by the petroleum industry. Namely, what is an option contract and what are the mechanics in buying and selling options? But more importantly, what is the allure of options and conversely what are the risks and costs? And finally, why should NYMEX Crude and Heating Oil options succeed?

To begin with, there are two types of options: a *Call* option and a *Put* option. A *Call* option gives the holder the right to purchase a futures contract at a specified price during the life of the option, while a *Put* option gives the holder the right to sell a futures contract at a specified price during the life of the option. Thus, an option contract is fundamentally different from a fu-

tures contract in that the holder of the option is not obligated to take or make delivery but rather has the option to buy or sell a futures contract. The price for which a futures contract can be bought (in the case of a *Call* option) or sold (in the case of a *Put* option) is referred to as the option's *Strike Price* or exercise price. The date on which an option expires — that is, the date after which it can no longer be exercised — is referred to as the option's *Expiration Date*. The market price to purchase or sell an option is its *Premium*. Finally, options are classified as either "In the Money," "At the Money," or "Out of the Money." An "At the Money" option occurs when the strike price and the futures price are equal. An option is "Out of the Money" when the strike price exceeds the futures price in a call option or is below the futures price in a put option. The opposite is the case in the "In the Money" option. Obviously, the cost or the premium to purchase the right to buy or sell a futures contract at a specified strike price is the highest when the option is "in the money" and is the lowest when an option is "out of the money."

As a way of illustration, a December \$15.00 "at the money" call option gives the buyer the right (but not the obligation) to buy a December WTI futures contract at \$15.00 per barrel. The premium for such an option might run \$.75 per barrel. If the price

of December WTI rises to \$17.00, the investor would exercise the option at a net profit of \$1.25 (\$17.00-\$15.00-\$.75) per barrel. On the other hand, if December oil trades at \$13.00, the investor would let the option expire worthless and only lose the initial \$.75 premium. The grantor (or seller of the option), in this latter case, earns the option premium. In the opposite case, a December \$15.00 put option at a premium of \$.90 per barrel gives the buyer the right to sell a futures contract at \$15.00 per barrel. If the price of oil falls to \$13.00 a barrel, the trader would exercise the option at a net profit of \$1.10 (\$15.00-\$13.00-\$.90) per barrel. If the December WTI price rises to \$17.00 per barrel, the option expires worthless and the grantor earns the initial \$.90 per barrel premium.

A major appeal of buying options is that the downside risk is limited to the initial investment (the premium) while the potential gain is unlimited. Stated differently, a commercial hedger can not only fix a future price at a known cost (the premium) but also participate in a favorable price move. For example, an oil producer recognizes that the futures price of crude oil, say \$15.00 per barrel, is slightly above his firm's cost of production. By purchasing the \$15.00 put option, the producer is insured of a \$15.00 selling price (thus preventing shut-in) but can also participate in a price rally (by letting the option expire worthless). Conversely, a refiner of crude oil can also use the options market to his advantage. By purchasing a crude oil call option, the refiner is insured of a fixed price for its crude oil needs should prices move higher but is not locked into a specific price should prices move lower. Options, in these two cases, are analogous to traditional insurance premiums allowing institutional investors a mechanism to professionally manage price risk.

Another advantage of options is on the sell side (although more risky). Suppose a refiner expects prices to remain steady. By selling a call option, the refiner earns premium income or a return on his physical inventory of oil. A trader with a "short" physical position (i.e., agrees to sell crude oil at a specified price in the future) who wishes to earn a return on his "short" physical position and also perceives a steady market, could earn premium income by selling a put option.

But selling options carries with it an associated risk. Since the buyer of the option has limited risk/unlimited return, the seller assumes the other side of the equation. In the above examples, the risk occurs in the physical positions when prices move against the seller. In the first example, the refiner would incur significant losses if oil prices fell



sharply. Although the option would provide some premium income, the value of the refiner's inventories would plummet with the fall in prices — i.e., the refiner is unhedged against a substantial fall in prices. In the latter case, the trader with a "short" physical position is at risk if prices rise sharply higher. Although the trader earns some offsetting premium income from the put option, he would be forced to purchase expensive oil in the physical market to meet his previously negotiated lower priced sales contract. Although there is this element of risk associated with selling options, in some respects, options writing is less risky than taking an outright futures position or holding an unhedged physical position. The reason: losses are reduced somewhat by premium income in the option position. In addition, this risk can be managed.

Besides the relatively straightforward buying and selling of "at the money" option, commercial users and producers of oil can also purchase less costly price-risk insurance by buying "out of the money" options. Also, by combining an option and a physical position with a futures contract, an offsetting option position, or a similar option position at an alternative strike price, the option mechanism can be specifically tailored to precisely reflect the individual investor's market view and needs.

It is this versatility which underscores the success of earlier options on futures. The underlying allure of the option contract is that it can be used to reduce or increase market exposure, can be profitable in any kind of market (bear, bull, or even non-trending), is relatively inexpensive, has a favorable risk-reward ratio, and can be used to lock in a profit or insure against a loss. Because of the multiple option strategies, varied investor needs, and less than certain economic environments, options will be appealing to producers, users, refiners, traders, and to the speculative community.

NYMEX will also provide other benefits to option traders. First and foremost is that NYMEX is the primary market for energy futures trading and as such will provide a structured centralized market, financially backed by the NYMEX Clearing Members. Premiums will be competitive, bids and offers will be recorded electronically and disseminated instantaneously, and transaction costs should be low. In short, it is a combination of the versatility of options, the individual risk profiles and financial objectives of investors, the less than certain business climate, and the unique situation of NYMEX which should ensure the success of the crude oil and heating oil option contracts. ■

Options: Hedging Alternatives for Oil Refiners

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Oil producers, refiners, and traders have the opportunity to learn what equity, fixed-income, and metal market investment managers already know: options represent a tremendously versatile risk-management tool for the knowledgeable professional.

Futures contracts based on crude oil and heating oil have become a well-accepted component of many oil companies' risk-management programs. The introduction of options on crude and heating oil futures promises to add flexibility, permitting energy concerns to closely tailor risk and reward to preferred levels.

Changing the Nature of Risk

From time to time, producers, refiners and traders share the risk of sharply rising or falling oil prices in volatile markets.

Futures are often thought of as tools which may be used to negate this risk. Or, more precisely, to substitute a lessor basis risk for a greater market price risk. Options offset risk as well, but also change the nature of the risk. Comparing alternative options strategies to the use of futures illustrates this.

Assumptions. A refinery borrows crude in Time Period One with the promise to replace it in Time Period Two, say January and March respectively. They now anticipate larger than previously planned for production in January. It is unclear whether their normal supply stream will be sufficient to supply the replacement in March, and spot market purchases may be necessary. While their market view remains neutral, if they are unhedged, they risk the possibility prices will rise, and cut into profit margins. Consequently, management dictates a hedged position.

Traditional Futures Hedge

By buying crude oil futures contracts to hedge this exposure, the refiner eliminates the risk of a rising market before the borrowed crude is replaced. Assuming no basis risk, a refiner who buys crude oil futures at \$16.00 per barrel, when spot oil is at \$16.00, locks in an effective purchase price of \$16.00. Thus, by buying futures, the refiner removes himself from the market and gives up the ability to profit from potentially falling prices. Futures, therefore, may be used to lock in a fixed or specific purchase price.

But many refiners might be dissatisfied

with the prospect of locking-in today's price and giving up the opportunity to cover their short exposure at possibly lower oil prices. In that case, options could be used to lock-in either a minimum or a maximum price for the purchase of oil.

Buying Insurance with Long Calls

Buying a call option against the short exposure of the borrowing refinery is analogous to the purchase of a price insurance policy. The owner of a call option holds the right, but not the obligation, to buy crude oil futures at a fixed price no matter how high the market soars. In return for that privilege, the buyer pays the seller a one-time premium, which may be likened to the insurance premium. For the holder or owner of the option there are no margins calls.

EXAMPLE 1

Assume that spot and futures are trading at \$16.00 per barrel. A refiner buys a call with two months to expiration and a \$16.00 a barrel strike price for \$1.50 per barrel. The strike is the price at which the call holder may buy the futures. Assuming away basis risk, the hedger has locked in an effective maximum purchase price of \$17.50, the \$16.00 strike price, plus the \$1.50 premium.

If oil remains stable at \$16.00, the effective purchase price equals \$16.00 plus the \$1.50 premium, or \$17.50.

If oil rises to \$20.00, the refiner can exercise the call, buying crude oil futures at \$16.00, the strike price, when they are actually trading at \$20.00. The effective purchase price for this hedge is \$17.50, the \$16.00 strike plus the \$1.50 premium paid.

If oil falls to \$12.00, the refiner retains the ability to profit in a bear market, and this is the beauty of this option hedge. If oil drops to \$12.00, the refiner simply elects not to exercise his option. The effective purchase price for the crude equals \$13.50, \$12.00 plus the \$1.50 option premium.

The analogy between this strategy and buying insurance is strong. By paying the call premium, the refiner insures he will be able to buy oil futures at the strike price. At the same time, the refiner retains the ability to benefit substantially in a bear market.

Selling Insurance with Short Puts

Despite the merits of the long call hedge, some refiners may balk at the idea of paying \$1.50 per barrel to purchase price insur-



ance. This would be particularly true when the refinery's outlook suggests the market may remain relatively stable. Under those circumstances, a refiner may instead consider selling the insurance in the form of put options to earn the option premium.

By accepting the oil premium, the refiner augments his current income but gives up the ability to participate in price declines.

A very significant area may be identified in the immediate vicinity of the strike price. Between crude prices of \$14.50 and \$17.50, the hedged returns are positive and exceed those of an unhedged position. This suggests the short put hedge is most appropriate when the market is likely to trade within a relatively narrow range over or under the strike price.

Which Strategy is Best?

Before looking at the reward of each individual strategy it's appropriate to look at the very different risks of the two option strategies. The long call's risk is limited to the original premium payment. The short put, however, involves unlimited risk, once prices exceed \$17.50 for the refiner who has borrowed.

All three hedging strategies outlined above, long futures, long call and short put, are essentially bullish. That is, they may be used to offset, at least partially, the risk associated with a possible bullish turn in the

market. Still, the reward profiles of all three strategies vary greatly.

Which strategy is preferred? That depends on the market situation. Table 1 provides the effective purchase prices for our hypothetical hedging examples under three different market scenarios.

Continuing with the original example of a refiner who borrows, but allowing for flexible hedging guidelines from management, a short put hedging strategy is somewhat more sophisticated than the straightforward long call. This strategy offers a superior hedge under certain market conditions.

EXAMPLE 2

Again, assume that spot and futures are at \$16.00 and track each other precisely. A refiner grants/sells a \$16.00 put for \$1.50 per barrel. As a writer, the refiner accepts the 1.50 premium and agrees to buy crude at \$16.00. If the option is exercised in the future this locks in a minimum price of \$14.50, the \$16.00 strike price less the \$1.50 premium earned.

If oil remains stable at \$16.00, the effective purchase price equals \$16.00 less the \$1.50 premium, or \$14.50.

If oil rises to \$20.00, the put will not be exercised, and the refiner earns the full \$1.50 premium. The refiner will have to purchase futures at \$20.00 but this higher price is

cushioned by the receipt of the original option premium. Thus, the effective purchase price equals \$18.50.

If oil falls to \$12.00, the put will be exercised, obligating the refiner to buy crude futures at \$16.00 when they are actually trading at \$12.00. Thus, the effective purchase price for the crude equals \$14.50, the \$16.00 less the \$1.50 option premium.

Table 1: Effective Purchase Price

Hedge Strategy	Market Scenarios Spot Crude Prices		
	\$12.00	\$16.00	\$20.00
Unhedged	\$12.00	\$16.00	\$20.00
Long Futures	\$16.00	\$16.00	\$16.00
Long Call	\$13.50	\$17.50	\$17.50
Short Put	\$14.50	\$14.50	\$18.50

Most refiners will agree there is no substitute for a bearish market when you're short crude as in our time swap example. If the market falls to \$12.00, the refiner's effective purchase price is lowest when he remains unhedged. But also note that the unhedged alternative yields the highest effective purchase price when the market advances. None of the hedge alternatives produces such extreme results.

If you consider only the hedging strategies, it is clear the long call hedge dominates when the market falls, the short put hedge dominates when the market is stable, and the long futures hedge is optimal if the market should advance.

Table 2: Preferred Hedges

Ranking	Declining Markets	Neutral Markets	Advancing Markets
1	Long calls	Short puts	Long futures
2	Short puts	Long futures	Long calls
3	Long futures	Long calls	Short puts

Of course, it's often difficult to call the direction of the market. But if you do harbor a market view, you can put that forecast to work by implementing one or another of the hedging alternatives available.

Options open up vast new dimensions in the oil business. These are opportunities which cannot be trivialized. Granted, options are not the simplest risk-management tools to get a handle on. Like all other tools, if they are improperly used, they will produce poor results.

Still, the experience of equity, fixed income market, and metal market professionals strongly suggest energy companies will find the rewards associated with the ability to tailor the risk/reward profile vastly outweigh the efforts expended in mastering energy options. ■

The Role of the Market Maker

JAMES COLBURN

Options Product Manager, New York Mercantile Exchange

The success of any new futures or options contract depends greatly on its ability to show consistent economic relationships between the contract and the underlying instrument. Arbitrageurs and market makers constantly monitor specific relationships for profit opportunities through temporary inefficiencies. This function is crucial to an orderly market because it provides liquidity and maintains stable economic relationships between futures, options and the underlying commodity. In this article, the role of the arbitrageur, as it pertains to options, is discussed.

Futures contracts are tied to the underlying cash commodity through the delivery process. If November crude oil futures rise much above the September spot oil quote, traders can simultaneously buy spot oil and sell November futures, locking in a profit. The trader can either liquidate the trade if futures prices decline relative to spot prices or deliver the spot oil against the futures position on the delivery date. Recently, this kind of arbitrage has been widely reported as it pertains to stock index futures, i.e., program buying and selling. The overall effect is that the futures price remains within certain economic boundaries of the cash market.

Options are related to the underlying futures contract through the exercise feature. The simplest example of options arbitrage illustrates the relationship. Arbitrage opportunities exist if a September \$10 strike price crude oil call option is trading at \$.75 and September futures are trading at \$11.00. A trader would buy the call option, sell the futures and immediately exercise for a profit of \$.25:

Short futures	\$11.00
Exercise option: long futures	10.00
Profit	\$ 1.00
Cost of \$10 call option	-.75
Net profit	\$.25

Call options will continue to be bid higher and futures offered lower until no arbitrage profits remain. This activity forces options to trade at values at least equal to their exercise values (intrinsic values). More complex arbitrage strategies are based on the following relationship:

Futures Price - Strike Price =
Call Premium - Put Premium
Options and futures must be the same

month; puts and calls must have the same strike price.

This relationship is not quite an equality because it does not include financing or transaction costs (which will be excluded from the following examples).

Assume that on August 7, the following situation exists:

Oct. futures	\$15.07
Oct. \$16 put	1.60
Oct. \$16 call	.67

The relationship holds:

$$\begin{aligned} \$15.07 - \$16.00 &= -\$.93 \\ \$.67 - \$ 1.60 &= -\$.93 \end{aligned}$$

What would happen if a large supply of buy put orders enters the market suddenly, bidding up put premiums to \$1.70? The relationship is now:

$$\begin{aligned} \$15.07 - \$16.00 &= -\$.93 \\ \$.67 - \$ 1.70 &= -\$ 1.03 \end{aligned}$$

Arbitrage profits would then exist. A trader could sell puts, buy calls and sell futures to lock in the following profit:

Sell futures	\$15.07
Buy \$16 calls	\$.67 debit
Sell \$16 puts	\$1.70 credit
	\$1.03 net credit

Consider how this position locks in profits. If futures are trading at \$15 (Case I) at the time the option expires, the futures position gains \$.07, the call loses \$.67, and the put gains \$.70, for a total gain of \$.10; if futures are trading at \$16 (Case II) at option expiration, the futures loses \$.93, the call loses

\$.67 and the put gains \$1.70, for a total gain of \$.10. See Table I.

Regardless of where futures trade, the value of the arbitrageur's position is \$.10 at expiration. The strategy of selling futures, buying calls and selling puts is called a reversal or reverse conversion.

What happens if many buy call orders enter the market and bid premiums to \$.75? Arbitrageurs will then execute conversions by selling calls, buying puts and buying futures. See Table II.

This time the market maker has locked in \$.08 regardless of where futures trade. In both examples, arbitrage will continue until no profits exist. Note that conversions and reversals force the options/futures relationship to hold and increase liquidity in both the options and futures markets. Arbitrage profits are locked in without exposure to market moves. In reality, however, the arbitrageur must overcome some potential problems not addressed in our textbook examples.

Legging In And Out

Conversions and reversals have three components: two options and one futures contract. An arbitrageur must trade quickly, otherwise, the position could be exposed to a market move and expected profits could turn into losses. Many option traders address this problem by teaming up with a trader in the futures pit. However, even if the option trader does the option side of a conversion and signals to the futures trader, the market may have moved, eliminating an already slim profit margin.

Getting "Pinned"

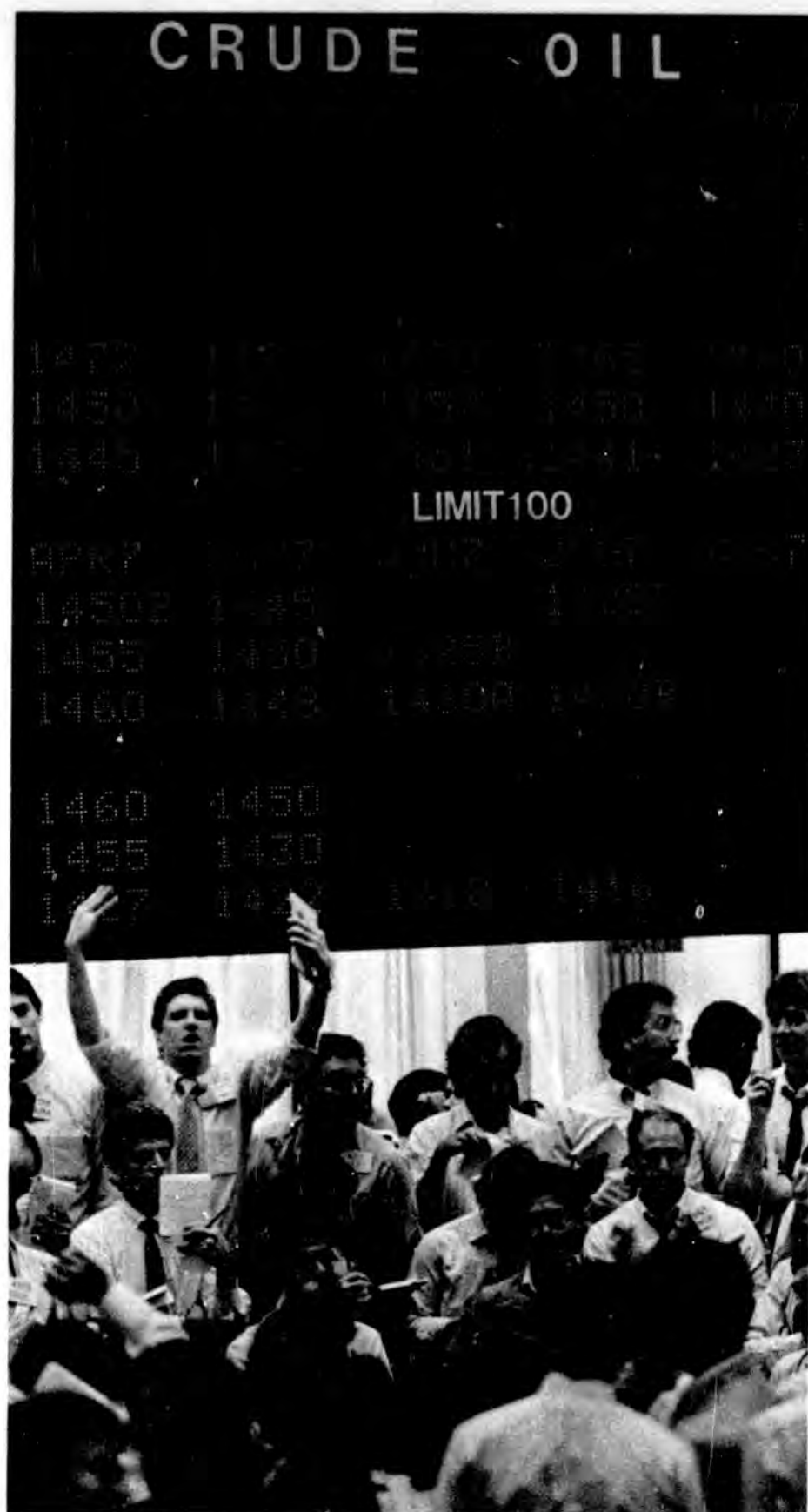
Market makers who take conversions and reversals into expiration run the risk of getting "pinned." If futures settle very close to the strike price on expiration day, a decision must be made whether to exercise the

Table I

		Case I		Case II	
		Expiration	Profit (Loss)	Expiration	Profit (Loss)
August 7					
Sell Futures	\$15.07	\$15.00	\$.07	\$16.00	(\$.93)
Buy \$16 Calls	\$.67	0	(.67)	0	(.67)
Sell \$16 Puts	\$ 1.70	1.00	.70	0	1.70
Net Result	\$ 1.03		\$.10		\$.10

Table II

		Case I		Case II	
		Expiration	Profit (Loss)	Expiration	Profit (Loss)
August 7					
Buy Futures	\$15.07	\$15.00	(\$.07)	\$16.00	\$.93
Sell \$16 Calls	\$.75	0	.75	0	.75
Buy \$16 Puts	\$ 1.60	1.00	(.60)	0	(1.60)
Net Result	(\$.85)		\$.08		\$.08



long option leg, while trying to guess what the trader holding the long side of the short option will do. A long option holder will have some time after the markets close before deciding about the exercise. If futures settle at \$16, a holder of a \$16 call or put might watch the cash market during that time before deciding. However, because crude oil options expire on Fridays, an exercise of options brings the risk of a substantially higher or lower opening Monday morning.

If futures settle at \$16 on expiration day, traders who hold, for example, conversions (long futures, short \$16 calls, long \$16 puts) must guess what the other side holding the short call will do. If a trader exercises the long puts to offset the long futures, the long call may decide to exercise also. This would leave that trader with a significantly exposed market position, i.e. a short futures position, from Friday to Monday morning.

Market makers will sometimes pay a little extra to unwind conversions and reversals, so as not to get "pinned." Traders unwind by offsetting option positions in the options market and futures positions in the futures market. For example, a conversion executed with a \$16 strike is liquidated by a reversal with the same \$16 strike. However, not all conversions and reversals require a trader to hold the position to expiration to earn profits, nor will futures always settle on a strike price at expiration.

Margin Calls

An option position is not margined like a futures position. Unlike a futures trade, the only cash exchanging hands between a buyer and a seller of an option occurs when the trade is put on and when the trade is taken off. If a trader buys a call for \$1.50 and the next day it settles at \$1.75, profits of \$.25 are not realized until the trade is liquidated. On the other hand, futures positions are marked to market on a daily basis — cash from market losses is transferred to those positions which have increased in value.

The problem facing an arbitrageur is that a potential negative cash flow from a futures margin is not offset by the option leg until the trade is liquidated. The arbitrageur, seeking to profit from a market inefficiency, may have to wait days or weeks before options and futures move back in line. If the market moves against the futures side of the conversion or reversal, considerable cash flow problems could develop.

Some traders simply borrow cash to pay margin and incorporate interest charges into their cost structure. Others will "tail" the conversion or reversal. The details of "tailing" are beyond the scope of this article,

but the general idea is to adjust the futures position to account for the disparity in cash flows. Discounting cash flows may reveal that buying 99 futures contracts will cover 100 long puts and 100 short calls. Using slightly fewer futures contracts than options addresses the discrepancy between futures cash flow which occurs daily versus option cash flow which occurs only at execution and liquidation.

In order to circumvent potential margin calls on reversals or conversions, arbitrageurs will complete a box trade. If a conversion is held on a \$16 strike, a reversal can be executed on a \$15 strike or a \$17 strike and the futures positions drop out. For example, a market maker is long futures, short \$16 calls and long \$16 puts (conversion). Selling futures, buying \$15 calls and selling \$15 puts removes the futures side and any corresponding margin issues.

conversion + reversal = box

long futures	short futures
sell \$16 calls	buy \$15 calls
buy \$16 puts	sell \$15 puts

The arbitrageur originally puts on the conversion to lock-in profits. The reversal is then executed to remove the futures side. The reversal may not necessarily earn profits, but it serves the trader by eliminating the futures leg and margin calls. The resulting position is called a box.

Arbitrageurs serve important market functions. They add liquidity to options markets and maintain economic relationships between options and futures. Futures markets also gain liquidity from risk transference of options positions. ■

Option Hedges for Oil Producers

JAMES COLBURN,
New York Mercantile Exchange

There are two kinds of options: puts and calls. A put buyer has the right, but not the obligation to sell futures at a specific price (strike price) during a specific period of time. A call buyer has the right but not the obligation to buy futures at a specific price during a specific period of time. While option buyers are buying rights, option sellers are selling rights and have obligations. A put seller (grantor, writer) has the obligation to buy futures from a put buyer at a specific period of time. A call seller has the obligation to sell futures to a call buyer at a specific



price for a specific period of time.

The cost of these rights is called the premium. Option buyers pay a premium to option sellers for the right to go long futures (call) or short futures (put). The most an option buyer can lose is the premium, regardless of where futures trade. The maximum profit to an option seller is the premium, but the seller faces unlimited risk and must post margins.

Long Options	Short Options
(Buy calls — Buy puts)	(Sell calls — Sell puts)
Pay premium	Receive premium
Maximum loss is limited.	Maximum loss is virtually unlimited.
Maximum profit is unlimited.	Maximum profit is limited to premium.
No margin is required.	Margin is required.

Long and short options is different from long or short the market. A call buyer wants prices to go higher (long the market), but a put buyer profits when prices decline (short the market). Conversely, a call seller is short the market and a put seller is long the market. By introducing simple buy and sell option strategies, a trader will have added two more ways to go long the market and two more ways to go short the market.

Long the Market	Short the Market
(Bullish)	(Bearish)
Buy futures	Sell futures
Buy calls	Buy puts
Sell puts	Sell calls

Options can be disposed of in 3 ways: offset, expiration, and exercise. Most options are disposed of by offsetting, like a futures contract, which means they are traded back into the market. A long August put \$10 strike, for example, can be offset by selling that same option. Options can also expire worthless. If, for example, August crude oil futures trade at \$12/barrel at the time August options expire, the August put with a \$10/barrel strike price would have zero value. The put holder would simply let the option expire worthless. Finally, option buyers may exercise their rights at any time before expiration. Sometimes it will be profitable for an option buyer to exercise and go long futures (call) or short futures (put) at the strike price. For example, an August put holder with a \$10 strike price exercises and receives a short futures position at \$10. An August put seller with a \$10 strike is obliged to take the other side, i.e., a long futures position at \$10.

The exercise feature in options is similar to the delivery mechanism in futures. Only a small percentage of crude oil futures volume actually results in delivery, but the possibility of delivery keeps cash and futures prices in line. Similarly, only a small percentage of option contracts are exercised, but the possibility of exercise maintains the connection between futures prices and options premiums.

Buy Put Strategy

A basic hedging strategy to protect against declining prices is to buy puts against a long cash position. Hedging losses are limited to the put premium, so that the hedger is still able to participate in market rallies. Two price scenarios are simulated: case A assumes sharply falling prices and case B assumes sharply rising prices.

On July 1st, two producers fear that oil prices will decline within the next few months and want to hedge their fourth quarter production. Each expects to produce 75,000 barrels during the fourth quarter. Producer 1 decides to hedge using November and December puts with \$12 strike prices. Producer 2 decides to hedge using November and December futures.

Assumptions

- Cash prices are \$1/barrel over the nearby futures price.
- Case A assumes that cash and futures prices both decline by \$4/barrel, so that cash market losses are offset by futures market gains.
- Case B assumes that cash and futures prices increase by \$4/barrel, so that futures losses offset cash market gains.
- Both producers lift their hedges on October 1.

Establishing the Hedges

The options premiums in the numerical examples were estimated from historical data using an exact option pricing model, courtesy of The Options Group.

Per barrel prices on July 1:

Cash	Futures	\$12 puts
\$14.00	Nov. \$13.00	\$0.82
	Dec. \$13.00	\$1.02

Producer 1

Buys 37 November puts at \$0.82	
37 × 1,000 barrels × \$0.82	= \$30,340
Buys 38 December puts at \$1.02	
38 × 1,000 barrels × \$1.02	= \$38,760
Total cash outlay for 75 contracts	= \$69,100

Producer 2

Sells 37 November futures at \$13.00	
Sells 38 December futures at \$13.00	
Total futures sold = 75 contracts	

Outcomes of Options and Futures Hedges

CASE A

Per barrel prices on October 1, when the producers lift their hedges:

Cash	Futures	\$12 puts
\$10.00	Nov. \$9.00	\$3.00
	Dec. \$9.00	\$3.01

Producer 1

Liquidates the option hedge:	
Sells 37 November \$12 puts at \$3.00	
37 × 1,000 barrels × \$3.00	= \$111,000
Sells 38 December \$12 puts at \$3.01	
38 × 1,000 barrels × \$3.01	= \$114,380
Total option receipts	\$225,380
Total option cost (July 1)	\$ 69,100
Total profit on options hedge	\$156,280
(Loss) on 75,000 barrel production	= \$(300,000)
Net (Loss)	= \$(143,720)

Producer 2

Liquidates the futures hedge:	
Buys 37 November futures at \$9.00	
37 × 1,000 × (\$13 - 9)	= \$148,000
Buys 38 December futures at \$9.00	
38 × 1,000 × (\$13 - 9)	= \$152,000
Total futures bought = 75 contracts	
Total profit on futures hedge	\$300,000
(Loss) on 75,000 barrels production	\$(300,000)
Net (Loss)	= 0

CASE B

Situation on October 1, when the producers lift their hedges:

Cash	Futures	\$12 Puts
\$18.00	Nov. \$17.00	\$0.00
	Dec. \$17.00	\$0.01

Producer 1

Liquidates the option hedge:	
November puts expire worthless	
37 × 1,000 × 0	= 0
Sell 38 December puts at \$0.01	
38 × 1,000 × \$0.01	= \$ 380
Total option receipts	\$ 380
Total options cost (July 1)	\$ 69,100
Total (loss) on options hedge	\$(68,720)
Gain on 75,000 barrels production	\$300,000
Net profit	\$231,280

Producer 2

Liquidates the futures hedge:	
Buy 37 November futures at \$17.00	
37 × 1,000 barrels × (\$13 - \$17)	= \$(148,000)
Buy 38 December futures at \$17.00	
38 × 1,000 barrels × (\$13 - \$17)	= \$(152,000)
Total futures bought = 75	
Total (loss) on futures hedge	= \$(300,000)
Gain on production	= \$300,000
Net profit	= 0

Summary of Results

CASE A

- Both futures and options strategies offer downside price protection to producers. Producer 1 has protected 52% (\$156,280 ÷ \$300,000) of the decline in cash prices with the long put hedge strategy. The put premiums did not rise in value by the full amount of the decline in cash and futures market prices because the options were purchased "out-of-the-money." That is, oil prices were above the options strike price at the time the hedge was established.
- Producer 2 has protected 100% of the decline in cash prices with the short futures strategy.
- Buying puts does not offer dollar for dollar protection like a futures hedge until oil prices move below the strike price

and cover the premium. At that point, options become "in-the-money" and premiums vary closely in line with the change in the underlying futures prices.

- Long options strategies require a cash outlay; futures strategies require margin deposits.

CASE B

- A major advantage of buying puts to hedge a long cash position is that puts offer the hedger downside protection (Case A) but allow participation in profits when prices rise (Case B).
- The maximum cost of the buy put hedge is known when the hedge is implemented (\$69,100) regardless of how cash prices move. There are no margin calls.
- The futures hedge requires additional margin as prices increase.

Conclusions

The availability of crude oil options will give hedgers a wider array of risk management strategies. This will raise many questions that the hedger must answer to determine the best way to control price risk:

- How much price risk can I live with?
- What is my opinion of the market?
- What protection do I need?
- What should I pay for that protection?
- What strike price should I use?

■ What is the best way to meet my goals?
Selling futures contracts insulates cash positions against declining prices by effectively fixing sales prices. If an oil producer wanted downside price protection without

Covered Call Strategy

Covered call strategies enable a hedger to take advantage of high option premiums. A covered call is a short call option covered by a long position in either the cash or futures markets. If prices decline, the hedger will have downside protection equal to the premium. If prices rally, the hedger's cash position will appreciate up to the call's strike price. After that, losses on the short call offset any cash market gains. Covered call strategies work best in markets which move sideways to slightly higher. Unlike buying puts, margins must be posted for covered call strategies.

In this example, two producers are slightly bullish and feel that crude oil option premiums are extremely high. They decide to write calls against fourth-quarter production of 75,000 barrels. Producer 1 sells \$14 calls. Producer 2 sells \$15 calls.

Assumptions

- Cash prices are \$1/barrel over the nearby futures price.
- Case A assumes that cash and futures prices both decline by \$4/barrel, so that cash market losses are offset by futures market gains.
- Case B assumes that cash and futures prices increase by \$4/barrel, so that futures losses offset cash market gains.
- Both producers lift their hedges on October 1.

Establishing the Hedges

Per barrel prices on July 1:

Cash	Futures	\$14 Calls	\$15 Calls
\$14	Nov. \$13.00	\$.92	\$.63
	Dec. \$13.00	\$1.13	\$.83

Producer 1

Sells 37 November \$14 calls at \$0.92	
$37 \times 1,000 \text{ barrels} \times \$0.92$	= \$34,040
Sells 38 December \$14 calls at \$1.13	
$38 \times 1,000 \text{ barrels} \times \$1.13$	= \$42,940
Total Options Sold = 75 contracts	
Total Premium Received	= \$76,980

Producer 2

Sells 37 November \$15 calls at \$.63	
$37 \times 1,000 \text{ barrels} \times \$0.63$	= \$23,310
Sells 38 December \$15 calls at \$.83	
$38 \times 1,000 \text{ barrels} \times \$0.83$	= \$31,540
Total Options Sold = 75 contracts	
Total Premium Received	= \$54,850

Outcome of Covered Call Strategies

CASE A

Per barrel prices on October 1:

Cash	Futures	\$14 Calls	\$15 Calls
\$10.00	Nov. \$9.00	0	0
	Dec. \$9.00	0	0

Producer 1

Total option premium received (July 1)	\$76,980
Value of options on October 1	0
Total profit on options trade	\$76,980
Loss on production	(\$300,000)
Net (Loss)	\$(223,020)

Producer 2

Total option premium received (July 1)	\$54,850
Value of options on October 1	0
Total profit on options trade	\$54,850
Loss on production	(\$300,000)
Net (Loss)	\$(245,150)

CASE B

Situation on October 1:

Cash	Futures	\$14 Calls	\$15 Calls
\$18.00	Nov. \$17.00	\$3.00	\$2.00
	Dec. \$17.00	3.09	2.26

Producer 1

Liquidates the options:	
Buy 37 November \$14 calls at \$3.00	
$37 \times 1,000 \times \$3.00$	= \$111,000
Buy 38 December \$14 calls at \$3.09	
$38 \times 1,000 \times \$3.09$	= \$117,420
Total outlay on option	\$228,420
Total premium received	\$76,980
Total (Loss) on options	\$(151,440)
Gain on production	\$300,000
Net profit	\$148,560

Producer 2

Liquidates the options side:	
Buy 37 November \$15 calls at \$2.00	
$37 \times 1,000 \times \$2.00$	= \$74,000
Buy 38 December \$15 calls at \$2.26	
$38 \times 1,000 \times \$2.26$	= \$85,880
Total outlay on options	\$159,880
Total premium received	\$54,850
Total (Loss) on options	\$(105,030)
Gain on production	\$300,000
Net profit	\$194,970

Summary of Results

CASE A

1. Both producers earn the entire option premium as prices decline.
2. Producer 1 has protected only 26% (\$76,980 ÷ \$300,000) of the decline in cash prices and Producer 2 has protected 18%. The maximum protection received from a short call position is the premium.
3. In a declining market, writing a call option with a lower strike price offers greater protection since it carries a higher premium.

CASE B

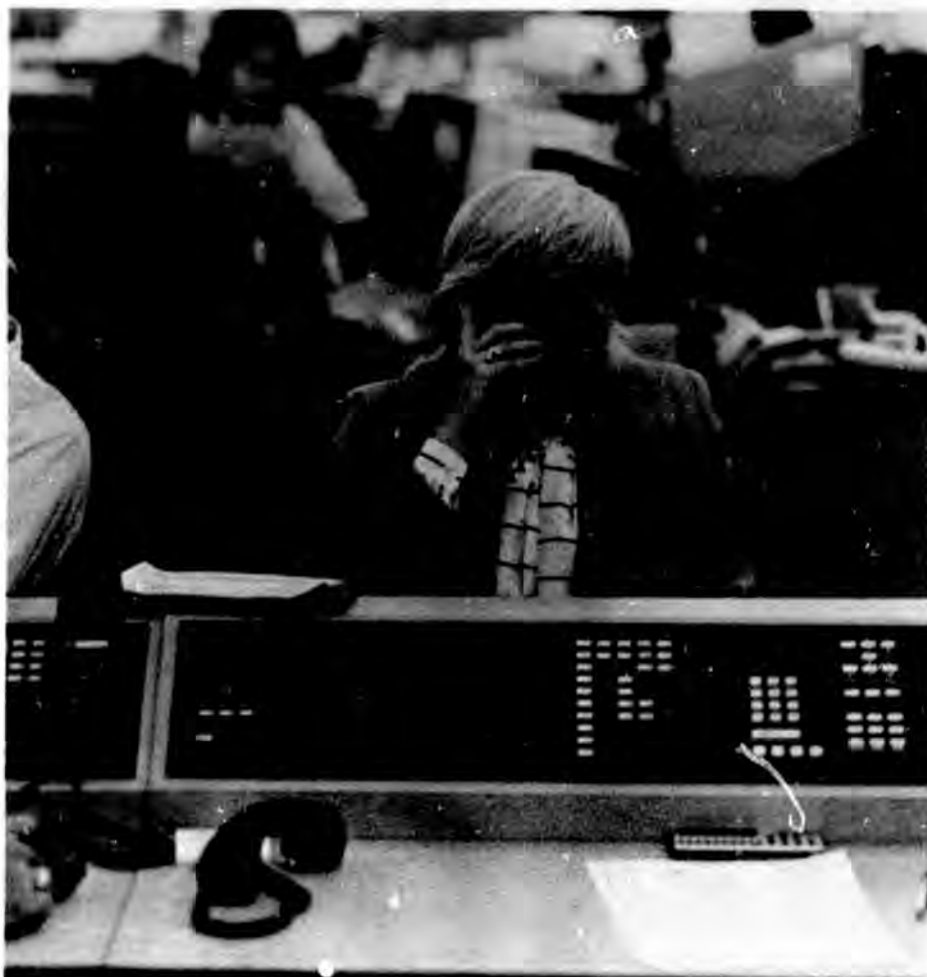
1. Covered call writing limits participation in a bull market because any gains on the cash or futures position are offset by losses on the written call positions. Short calls will begin to lose tick for tick with futures if prices continue to rise above the strike price.
2. Producer 2's strategy of writing \$15 calls is a better position than Producer 1's strategy of writing \$14 calls because prices must rally higher to reach the \$15 strike. Producer 2's cash position can appreciate up to \$15 whereas Producer 1's cash position is neutralized after prices reach \$14.

giving up upside profit potential, buy-put strategies would be appropriate. Various strike prices will be available to give risk managers flexibility as to levels of protection and option costs. Buy-put strategies

are most effective in markets that gain in volatility during the hedge period.

Short calls are least effective for downside protection because option profits are limited to the premium. Short option

strategies take advantage of high premiums and work best when markets move sideways. Producers can sell call options to earn premium income, and still participate in market rallies up to the strike price. ■



Crude Oil Options: A Risk Management Tool for Financial Institutions and Independent Petroleum Companies

R.A. WALKER

Vice President, The First National Bank and Trust Company of Tulsa

Following the initial downturn in oil prices in 1982 and the introduction of crude oil futures in early 1983, The First National Bank and Trust Company of Tulsa (First Tulsa) began evaluating the use of the futures market to reduce the risk associated with reserve-based oil and gas lending. The bank began to model the concept of independent oil companies hedging the oil reserves they pledge as collateral. After considerable review it was concluded that the hedging of reserve-based loans was possible, though certain problems were identified.

First, the maintenance of the hedge or mark-to-market costs could be considerable if a rising price environment occurred during the hedge period. Second, by hedg-

ing with a futures contract an independent was limiting, or locking in, the profit margin. Third, most independent firms were not staffed with individuals proficient in the futures market. And fourth, the use of the futures market at that time was not acceptable to those independents who were comfortable with the arrangements they had with first purchasers.

Based on discussions with customers and industry experts, it was concluded that the independent was more likely to use the futures market once options for crude oil futures were introduced. There were several reasons for this. First, the cost of price insurance could be less with a put option than with a futures short hedge. Second, options

are philosophically more compatible with the independent's risk-taking nature as they allow for participation in an upward price move but limit downside exposure. Third, with options, the independent does not need to be an expert in futures trading, nor require a buildup in staff and overhead to effect transactions.

Independents, in contrast to majors, multinationals and other vertically integrated companies, must make their profit at the wellhead through exploration and production efforts. Any price decline in the crude oil market cannot be passed along and made up through downstream operations.

Historically, independents have used their oil and gas reserves as collateral to finance the development of leasehold interests. The collateral value of these reserves is in large part a function of the current price being received and the expectation of what prices will be over the economic life of the reserves. As prices declined, the independents' ability to borrow deteriorated along with their ability to meet debt service requirements. Most recently, as prices dropped to levels of \$10-12 per barrel, some wells were deemed uneconomical. With operating expenses exceeding operating revenues, these wells were plugged. Against this backdrop, options may provide a risk management tool which allows financial institutions to continue providing capital to the energy industry under acceptable risk-return parameters.

The Concept of Hedging

Last fall, The New York Mercantile Exchange (NYMEX) introduced options on crude oil futures. The reason this instrument is of interest to producers is that the downside risk is limited to the option premium while the prospective gain is unlimited. Chart 1 illustrates how a put option provides a price floor. A put option is the right, not the obligation, to sell an underlying future, at a pre-determined strike price, for a specific period of time.

The line defined as physical position refers to the market most producers use to sell their production under a traditional first purchaser arrangement. The price range in this diagram is from \$10 to \$20 and is represented on the horizontal axis. The vertical axis represents the profit/loss range. This example assumes a current price of \$15 in the spot month futures price (the spot month futures price is the nearest trading month and generally correlates with the physical market spot price). The option with a strike price of \$15 is considered an "at the money" option because the strike price is equal to the futures price. The

shaded area defined as "cost of insurance" is the \$1 per barrel premium paid at the time the put option is purchased. If prices go below \$15 the producer pays nothing in addition but retains a price floor of \$14 per barrel (\$15 strike price - \$1 premium).

Applications

Options cannot cure the problems being experienced by independents and their banks but they can provide a support mechanism. Current prices are causing the oil and gas industry to contract and restructure. The following describes one use of options by independents — to hedge revenues from acquired properties.

Energy banks base their evaluations of the borrowing base, or loan value support, of oil and gas properties on many factors. But no factor is more volatile than the prices used to evaluate the collateral value of the reserves and the future cash flow stream to be realized for debt service.

If an independent is successful in the acquisition of reserves, it may ask its bank or bank group to assess the loan value of the acquired reserves in order to obtain financing. In conjunction with the engineering evaluation, software can be adopted to evaluate the use of an option price floor.

Consider the acquisition of \$100 million of oil reserves by an independent oil producer. Its bank group determines that these reserves have a borrowing base of \$75 million due to the structure of the facility and the nature of the properties. The facility stipulates that the principal be amortized under a 48-month schedule.

The bank group can evaluate the need of the option strike price through two means.

The first constructs a series of declining cash flow curves. Each curve is based on a different fixed oil price assumption and its shape reflects declining production. See Chart II.

Cash flow curves are net of overhead and discounted based on an interest rate factor held constant so as to best measure amortization capability. For purposes of illustration, a constant 48-month repayment schedule is assumed. In actuality, if debt service was as sensitive to repayment capacity under the \$15 base case, a greater degree of amortization would be imposed in years 1 and 2 under a sliding amortization schedule or a smaller loan amount would be provided.

In this framework, the independent can make a decision on what strike price to use in order to maintain debt service capacity, relative to his expectation or sensitivity to price declines. For example, the independent may initially establish a cash flow floor with slightly out-of-the-money options and

CHART I
Price Floor of Put Option

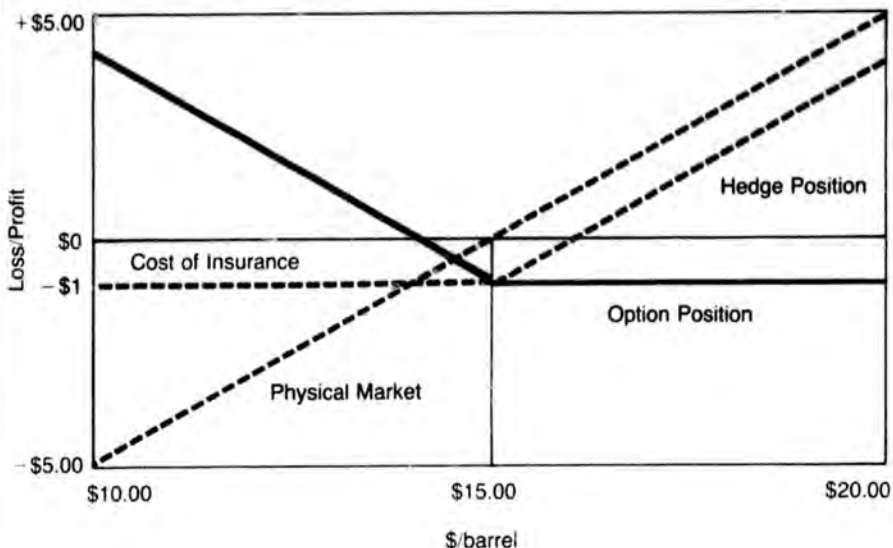
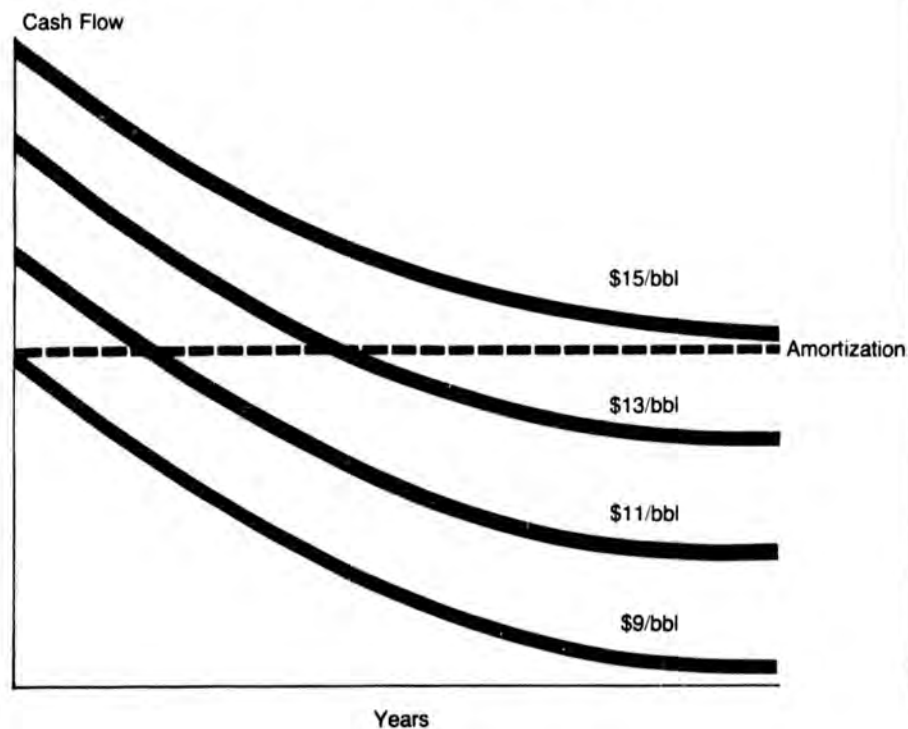


CHART II
Cash Flow Curves and Amortization (dashed line)



OPTIONS

then purchase a one-time put to protect the net present value of future cash flows in the sixth month.

A second method estimates how many option contracts will be required at various strike prices to ensure debt service. Under this evaluation, the engineered production profile is used as a benchmark for determining the contract barrels hedged. The multiplication of these engineered barrels to be produced by the various strike prices determines debt service capacity.

The strike price will vary monthly as the properties reflect their decline curves relative to debt service. Using this concept, a floor is created using monthly put options. Because options initially will only be available 6 months in advance, the hedging of the remaining loan term takes some thought. Under an inventory hedge versus a 6-month cash flow hedge, the customer can purchase options to cover the net present value of future cash flows or future debt service requirements. The details of this concept have only been modeled and to a large extent are proprietary for use by First Tulsa. However, other banks are reviewing the use of options and may have different concepts.

Current regulatory guidelines prohibit banks from acting as principals in crude oil futures transactions. Hedges are structured with banks maintaining an agency role and with the customers executing covered put option strategies. This means the option positions are only taken when an underlying cash market position is maintained, in order to avoid speculative investment.

Conclusion

The examples and concepts described here are still theoretical in nature until options trading begins. Many of the fundamental aspects of hedging energy loans, however, are no different than those developed a long time ago by major Midwest banks for hedging agricultural loans. The idea of basis risk has not been mentioned in this article, but is present in all futures transactions. Since crude oil on the NYMEX is delivered through Cushing, Oklahoma, based on a specific grade of crude, any crude grade difference or location variance to Cushing will create some basis risk. In the case of hedging with options, basis risk is generally not a tremendous problem, but it is one that cannot be eliminated.

Options should bring new participants to the NYMEX markets. Price volatility in the near future will require both independents and banks to continue to evaluate methods to reduce price risk. Options on crude oil futures could allow independents to continue to look to banks as a source of capital with acceptable levels of risk. ■

Volatility and Option Valuation

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The value of an option premium has four primary determinants: 1) time remaining until expiration; 2) the differential between the market price and the strike price; 3) prevailing risk-free interest rate (T-Bill rate), and 4) volatility of the underlying instrument. Mathematical models are available and commonly used to determine the premium using these four factors. Although the first three factors are easily quantifiable and objective, the fourth factor, volatility, has an element of subjectivity. Volatility in any option pricing model must represent future volatility of the underlying instrument. Since future volatility depends on future price action, choosing an appropriate volatility is akin to market forecasting.

Volatility of a commodity is a measure of price dispersion. The greater the price dispersion over a given period of time, the greater the volatility. Volatility can be related to a statistical measure called standard deviation. The standard deviation measures the variability of data from the mean of the distribution. It encompasses approximately two-thirds of all data over a specific period

of time. The calculated standard deviation is an estimate of price volatility.

One way to interpret volatility is shown in the following example:

A 50% volatility estimate on \$20.00 crude would mean that crude oil can be expected to trade 50% over or under \$20.00, two-thirds of the time, over a year's period. In this example this would be a \$10-30 range. If volatility was only 25% then the expected range would be \$15-25. However, a more technical measure of volatility is used industry-wide. It involves determining the standard deviation of the logs of percent changes in daily prices:

$$\text{Volatility} = \sqrt{\frac{A}{n-1} \sum_{t=1}^n (x_t - \bar{x})^2}$$

A = number of trading days in a year

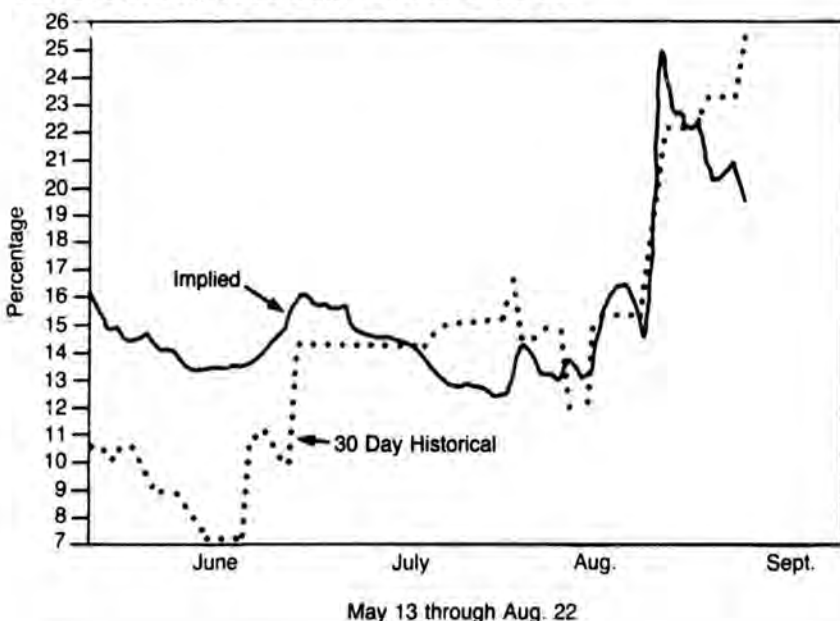
n = number of observations

$x_t = \ln \left(\frac{p_t}{p_{t-1}} \right)$ where p_t = price at time t

$\bar{x}$ = arithmetic mean of x_t 's

Volatility is defined on an annualized basis but it can be easily interpreted for a shorter period. This is more appropriate in the development of a specific crude option trading strategy. The first step in determining a standard deviation is to choose a time period and determine what yearly multiple

**Comparison of Historical and Implied Volatilities
The December, 1986 Gold Futures Contract**





that period represents. For a weekly standard deviation, the multiple is 52 because there are 52 weeks in a year. The next step is to take the square root of the yearly multiple ($\sqrt{52} = 7.2$). Next, divide the square root of the yearly multiple into the annual volatility. Thus if the volatility is 50%, the weekly standard deviation in percentage terms would be ($50/7.2 = 7.08\%$). This is the expected range within which prices are expected to trade two-thirds of the time. For \$20.00, this would translate to a range of \$1.41 above or below \$20.00.

The same can be done with monthly, daily, or other time increments. (Note: with daily data use 256 trading days in a year. In our example, one daily standard deviation would be $50/\sqrt{256} = 3.125\%$.)

There are two types of volatility that concern the options trader. The most easily understood volatility is historical. Historical volatility is an annualized measure of how active a market has been over a past period. It is calculated from the movement of the underlying futures prices over a specified period. The shorter the time period, the more emphasis or bias that is placed on recent price action. Common periods are 10, 30, and 60 days, but there can be many others. Many traders prefer monthly volatility

because it represents a time period that is neither too long nor too short.

The second type of volatility that the options trader should be aware of is implied volatility. This is the expected future volatility that is reflected or implied in an option premium. It can be calculated indirectly by solving for volatility as the unknown and using current premium, distance from the strike, risk-free interest rate, and time to maturity as knowns. There are numerous software packages that allow traders to calculate implied and historical volatility. Some brokerage houses also provide daily volatility information.

The relationship between implied and historical volatilities can vary significantly under certain market situations. The gold volatility chart (on page 14) shows how a monthly historical and implied volatility relate to each other. With crude oil it will also be possible to have considerable divergence between implied and historical volatilities. Such a situation could appear prior to an API report or an OPEC meeting. The futures market could be very quiet, but implied volatility would start to rise because premiums are being bid up in nervous anticipation of a potential sharp reaction.

Forecasting implied volatility encom-

passes many of the same factors and complexities as price forecasting. Numerous techniques are used to forecast implied volatility. Many traders watch volatility patterns over time and look for extreme levels relative to the current market situation. Others feel that implied should not diverge from historical by more than a certain percentage. Still other mathematical forecasting systems use various weightings of historical and expected volatilities.

How much effort should a trader put forth to monitor and forecast volatility? The floor trader and scalper needs to be constantly aware of volatility because small changes in volatility often determine if a short-term trade will be successful. The hedger or position trader who relies more on major market moves and trades less frequently should be aware of volatility and how it affects premiums, but normally does not try to forecast or monitor volatility. It is important that the hedger or position trader justify the premium expenditure for the amount of protection or profit objective. If the premium is too "expensive" for a particular hedge objective, then the trader can conclude that the current level of implied volatility is too high. Options are insurance instruments that constantly fluctuate in value. ■

NYMEX Public Customer Margins

Below is a fact sheet on public customer original margin requirements for basic option strategies.

Long Call or Long Put

The purchaser of an option pays the full premium. No margin is required.

Naked Short Call or Put

The seller of an option posts the premium for the option plus the original margin on the underlying futures contract less one-half the amount by which the option is out-of-the-money. The total margin must not be less than the sum of the option premium and one-half the original futures margin. If either the short put of the short call is a spot-month option, then the original futures margin is equal to the spot-month futures margin.

Short Call, Long Futures

A call option seller who also holds a long futures contract posts margin as follows:

- For an in-the-money call option: the premium for the option plus the original margin on the futures contract less one-half the in-the-money value of the option. This amount must not be less than the sum of the premium plus the spread margin for the futures contracts.
- For an at-the-money or out-of-the-money call option: the premium plus the original margin on the futures contract. These margin calculations also apply to short put, short futures combinations.

Long Call, Short Futures

The purchaser of an in-the-money or at-the-money call option who also holds a short futures contract posts the premium plus:

- The spread margin on the underlying futures contract, if the delivery months of the futures and option contract are different.
- The greater of the spread margin on the underlying futures contract less the in-the-money value of the option, or zero, if the delivery months of the futures and option contract are the same.

These margin calculations also apply to combined long put, long futures positions.

Short Call, Short Put

The seller of both a put option and a call option posts the premiums for both options plus:

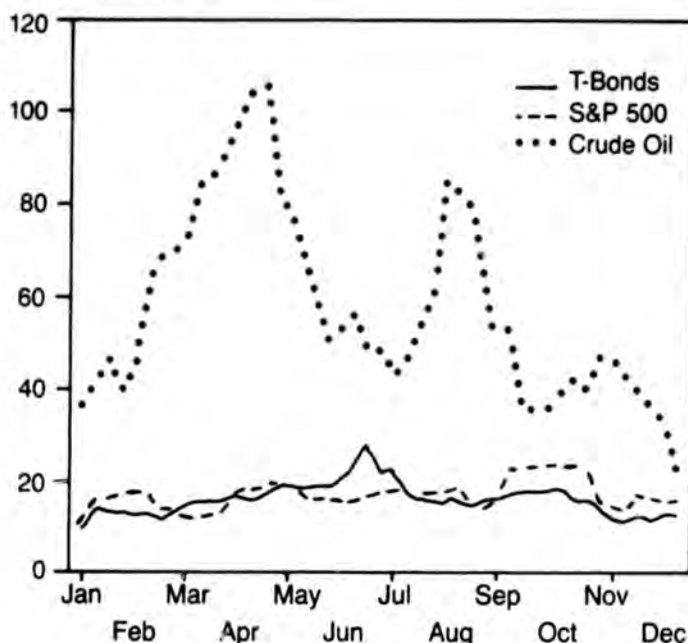
- If the original margin of both the underlying futures are the same, an amount equal to one original margin.
- If the original margin of both the underlying futures are different, an amount equal

to the greater original margin.

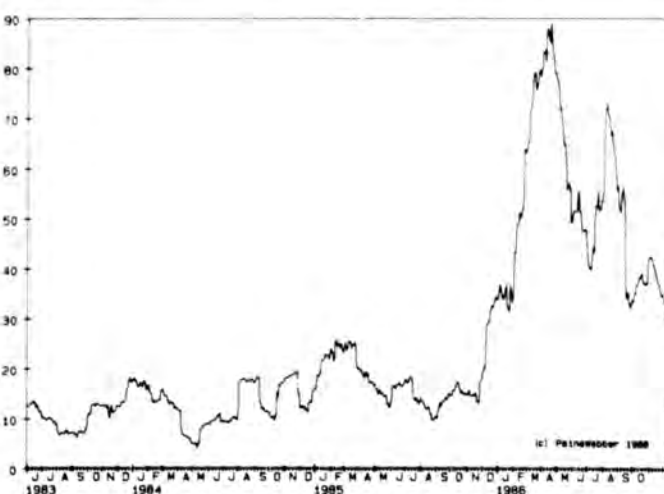
Vertical Spreads

Buying a call (put) and selling a call (put) with different strike prices but with the

Volatility Comparison (1986)
30-Day Volatility (%)



NYMEX Crude Oil 30-Day Volatility
Percentages



same expiration date is called a vertical spread.

- The margin of a net credit spread (that is, the long call strike is greater than the short call strike or the long put strike is less than the short put strike) is the difference between strike prices.
- The margin of a net debit spread (that is, the long call strike is less than the short call strike or the long put strike is greater than the short put strike) is zero.

Calendar Spreads

Buying a call (put) and selling a call (put) with different expiration dates is called a calendar spread.

- If the calendar spread is a net credit spread the margin is equal to the amount by which short option premium exceeds long option premium, plus the difference between the two strike prices. The margin cannot be less than the underlying futures spread margin nor greater than the underlying futures original margin.
- If the calendar spread is a net debit spread the margin required is equal to the underlying futures spread margin.

Conversion

A conversion consists of a long futures, long put and short call. All positions are in the same contract month and both option positions have the same strike price.

- The margin required for a conversion is equal to the amount by which the short option premium exceeds the long option premium.

Reverse Conversion

A reverse conversion consists of a short futures, short put and long call. All positions are in the same contract month and both option positions have the same strike price.

- The margin required for a reverse conversion is equal to the amount by which the short option premium exceeds the long option premium.

Butterfly Spreads

- A long butterfly (that is, long the options at the low and high strike prices and short two options at the middle strike) requires zero margin.
- Margin for a short butterfly (that is, short the options at the low and high strike prices and long two options at the middle strike) is equal to the greatest difference between two adjacent strike prices, not to exceed the original futures margin plus the amount by which the short option premiums exceed the long option premiums.

The NYMEX option contract specifications are detailed in the document, NYMEX Op-

tions Contracts, General Provisions, available from the NYMEX Marketing Department, tel. 212/938-2879.

Floor Member Margins

An Exchange Floor Member shall pay original margin on NYMEX options positions carried in his/her account as follows:

Step 1

Apply the appropriate futures spread margin rate to all futures contract spread positions.

Step 2

Determine the number of all long options and the number of all short options. For all short options in excess of long options, apply a margin surcharge of \$250 per contract.

Step 3

For all other positions in NYMEX futures contracts and options on such contracts:

- Assign a risk factor of -1.0 (negative one) to each remaining long futures contract and a risk factor of +1.0 (positive one) to each remaining short futures contract in the account.
- Assign a negative NYMEX Risk Factor to each long call option and each short put option in the account, and a positive NYMEX Risk Factor to each short call option and each long put option in the account.
- Determine the sum of the risk factors and the NYMEX Risk Factors described in (a) and (b).
- Multiply the resultant sum by the margin required for the NYMEX futures contract, disregarding any negative sign in the product.
- Determine the sum of spot-month futures' risk factors and spot-month options' NYMEX Risk Factors and multiply the resultant sum by the additional spot-month margin required for the underlying NYMEX futures contract as published by the Exchange, disregarding any negative sign in the product.

Step 4

Calculate the margin requirements for all other NYMEX contracts in the account.

Step 5

Determine the sum of the amounts computed pursuant to steps 1, 2, 3 and 4.

Step 6

Subtract the option equity in the account from the value determined in step 5.

Step 7

A positive number determined in step 6 represents the minimum margin required. A negative number determined in step 6 indicates no margin payment required. ■

How to Interpret Option Deltas

JAMES COLBURN

Options Product Manager
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An important concept in option theory is the sensitivity of option premiums to changes in futures prices, better known as the *delta*. How much can a call option premium be expected to increase if futures prices move \$.50/barrel higher? How much may a put decline if futures prices rally \$.30/bbl? Knowledge of deltas will help hedgers fine-tune desired crude oil price exposure. Hedgers must determine how many options to trade, and at what strike price, to establish the desired protection. Option deltas will be an important factor in determining an optimal option hedge.

Option premiums can be separated into two components: *intrinsic* (or *exercise*) value and *time* (or *extrinsic*) value. On November 25, February futures prices settled at \$15.04/bbl. The \$14 February call must be worth at least \$1.04 (\$15.04-\$14). Otherwise, a strategy of buy calls, sell futures and exercise calls would yield a risk free profit.¹ This \$1.04 is the option's intrinsic value. However, on November 25, the February \$14 call settled at \$1.37, \$.33 more than the intrinsic value. This additional value of \$.33/bbl. is the time value:

$$\text{Premium} = \text{Intrinsic Value} + \text{Time Value} \\ \$1.37 = \$1.04 + \$0.33$$

In Table I, February premiums are separated into intrinsic and time value (note that intrinsic value is either positive or zero, but never negative).

Using the example in Table I, when the futures price is trading at \$15.04/bbl, options with intrinsic value (the \$14 and \$15 calls and the \$16, \$17 and \$18 puts) are said to be *in-the-money*. Options with zero intrinsic value (the \$16, \$17, \$18, and \$19 calls and the \$13, \$14 and \$15 puts) are termed *out-of-the-money*. An option with a strike price close to the futures price is *at-the-money*. These classifications will help in our discussion of how option premiums react to changes in futures prices.

Time value is greatest for at-the-money options. On November 25, when February futures were at \$15.04, the maximum time value was for the \$15 put and call. Time value approaches zero as options become further in-the-money or out-of-the-money.

OPTIONS

A graph of time value (Figure I for calls, Figure II for puts) looks like a probability distribution. Figure I shows that the market has attached a relatively low probability that futures prices will move above \$19/bbl level by January 2, 1987 (the February option's expiration date). If trading had occurred in the \$13 or \$12 calls, time value would also approach zero, as the market attaches diminishing probabilities that futures will trade below those strike prices. There is usually a slight upward price bias expectation because crude prices at \$15.04 are more likely to increase by that amount than to decline by that amount. Figure II reveals a similar probability distribution for puts.

Option Deltas Defined

Option deltas are defined as the change in the option value divided by the change in the underlying futures price. They measure how sensitive option premiums are to moves in futures prices.² For example, a call option with a delta of 0.5 would be expected to increase in value by \$0.25/bbl, if futures rallied by \$0.50/bbl.

Deep in-the-money options trade almost tick for tick with futures contracts. Consider the \$18 put in Table I. With zero time value, the market is pricing the put with a high probability that it will expire in-the-money. This option trades primarily on intrinsic value and has a delta of approximately 1. If

futures decrease by \$0.25/bbl the option will increase by \$0.25.

Deep out-of-the-money options are less sensitive to moves in futures prices. Deltas of these options approach zero, as the market attaches very low probabilities that deep out-of-the-money options will expire in the money. The \$19 call, trading at \$.04, may not change at all if futures prices move slightly in either direction.

At-the-money options will exhibit deltas of approximately 0.5. A futures move of \$.25/bbl would indicate a \$.12 to \$.13 move in the option premium. At-the-money calls actually have deltas around 0.53 and puts around 0.47 because of a slightly upward

Table I

February Calls (November 25, 1986)

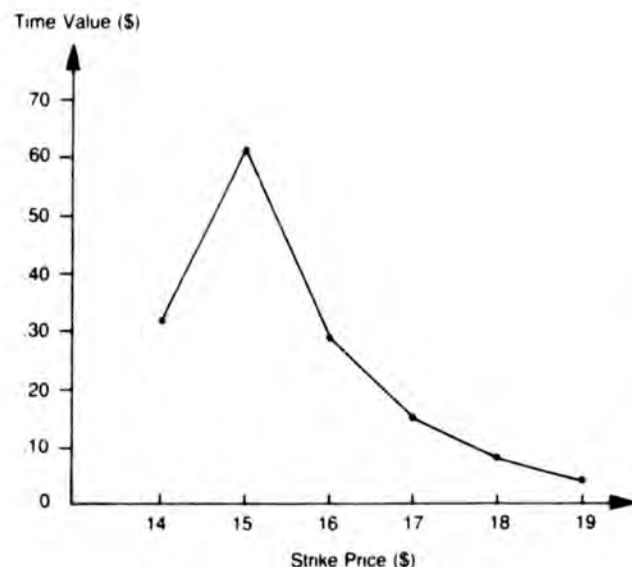
Strike	Premium	Intrinsic	Time	Classification
February Futures = \$15.04				
\$14	\$1.37	\$1.04	.33	In
15	.65	.04	.61	At
16	.29	.00	.29	Out
17	.15	.00	.15	Out
18	.07	.00	.07	Out
19	.04	.00	.04	Out

February Puts (November 25, 1986)

Strike	Premium	Intrinsic	Time	Classification
February Futures = \$15.04				
\$13	\$.12	\$.00	.12	Out
14	.32	.00	.32	Out
15	.63	.00	.63	At
16	1.25	.96	.29	In
17	2.10	1.96	.14	In
18	2.96	2.96	.0	In

Figure I

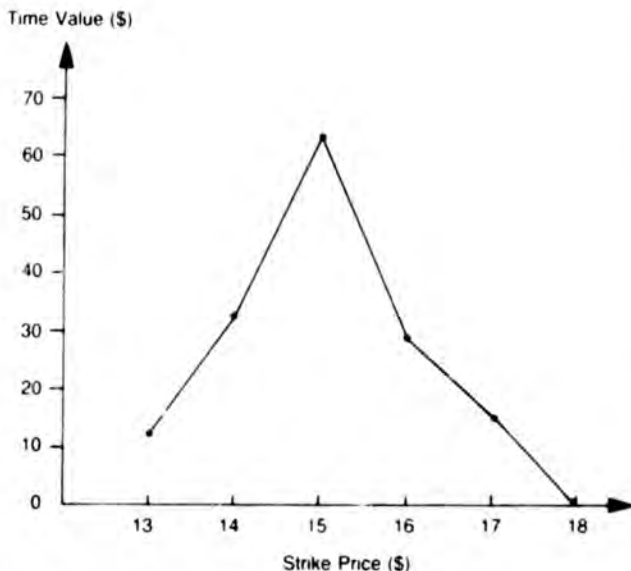
February Calls (November 25, 1986)



Option Classification: IN AT OUT OUT OUT OUT
Deltas 1 ← .53 → 0

Figure II

February Puts (November 25, 1986)



Option Classification: OUT OUT AT IN IN IN
Deltas 0 ← .47 → 1

bias in the expected price structure.

Applications to Hedging

Knowledge of option deltas is important in implementing and managing an option hedge. For example, if a trader is long 500,000 barrels of crude in the cash market and long 500 \$15 February puts, what is the total market exposure? Using plus signs for bullish positions and minus signs for bearish positions, and assuming that cash prices are perfectly correlated with futures, an overall position delta can be calculated. To do so, all positions are converted into futures equivalents. The long cash position is equivalent to +500 deltas, or 500 long futures equivalent positions. The long put position is equivalent to -235 deltas: a 0.47 delta (Figure 1) multiplied by 500 contracts with a minus sign (because buy put strategies are bearish). Summing the deltas reveals an overall position delta of +265 deltas, a 265 long futures equivalent position. While this position is still exposed to a downward price move, the exposure is not as great as the cash position without the long puts.

Traders could establish a *delta neutral* position by buying a total of 1,064 puts:

$$\begin{aligned} &1,064 \text{ contracts} \\ &\times -0.47 \text{ delta} \\ &= -500 \text{ futures equivalent positions} \end{aligned}$$

The long cash position, +500 futures equivalents, is now totally covered by 1,064 long \$15 puts. To determine how many options per 1,000 barrels are required to totally cover a cash or futures position, calculate the reciprocal of the delta, or in this example, 2.128. ($1 \div 0.47$). Multiply this number by 500 (the futures equivalent position being hedged) to obtain the 1,064 options contracts required to establish a delta neutral position.

Option deltas are dynamic because they vary as futures prices, time to expiration and volatility change. What is a delta neutral position when futures are trading at \$15.04/bbl is no longer delta neutral at, say \$14.80. If February futures fell to \$14.80/bbl, the option delta for the \$15 put would increase to 0.53. If the hedger is long 1,064 puts, the futures equivalent position is now -564 ($1,064 \times 0.53$). The overall position becomes -64 [$500(\text{cash}) - 564(\text{puts})$] or equivalent to being short 64 futures. To maintain a delta neutral position at the new price, a hedger needs to be long only 943 \$15 put options ($500 \times (1 \div 0.53)$). He would sell 121 puts to maintain delta neutrality. Long put options deltas become more negative as prices decline and less negative as prices rally. This means that price protection increases as futures prices

decline (as a put goes deeper in-the-money, its delta approaches minus one).

Why can't a trader use futures contracts to fine tune? If a delta of an option is 0.53 and a trader is long the equivalent of 500 deltas in the cash market, why not just sell 265 (500×0.53) futures to simulate a purchase of 500 puts? Or, if the trader desires a delta neutral position, why not just sell 500 futures? There may be several reasons why the optimal hedge would include options. Option deltas adjust automatically. If a trader is long puts with a delta of 0.47 and prices decline, the position gets shorter and shorter the market. If prices rally, the position gets longer and longer the market. The hedger receives more protection as prices decline, and less protection as prices rally. This occurs without adjusting the option position. A futures position would require constant adjustment to simulate an option hedge. This would be difficult in periods when prices are volatile or if markets open significantly higher or lower than the previous day's close. Also, futures prices aren't affected by changes in volatility and time.

As a measure of market risk, option deltas can help hedgers closely manage price exposure. But it is important to recognize that deltas are always changing. Caution when using delta measures is especially advised when the option is close to expiration. If time left to expiration is near zero, in-the-money options will exhibit deltas of close to one while deltas of out-of-the-money op-

tions will approach zero. The sensitivity of option deltas at expiration can be appreciated if one considers a futures price trading near a call options strike price. If prices rally slightly above the strike price, the option is in-the-money; the delta quickly approaches one. If prices trade below the strike price, the call option's delta quickly approaches zero. Rapidly changing deltas can confound a hedger's attempt to manage price risk. The need to monitor deltas at option expiration time is crucial.

1. See "The Role of the Market Maker."

2. Deltas can be calculated from exact option pricing models. For example, the Black model gives the value of a call option as:

$$C = e^{-rt} [f N(q_1) - s N(q_2)]$$

and the call option's delta is:

$$\frac{\partial C}{\partial f} = e^{-rt} N(q_1)$$

$$\text{where } q_1 = \frac{\ln(f/s) + (r + \frac{1}{2}\sigma^2)t}{\sigma\sqrt{t}}$$

$$q_2 = q_1 - \sigma\sqrt{t}$$

C = value of the call

r = short-term interest rate

t = time to expiration

f = futures price

s = option strike price

σ = volatility measure

e = base of natural logarithm

N() = cumulative normal density function

ln = natural logarithm



Crude Oil Options: The Energy Speculator's New Tool

BERT BECKMAN
Paine Webber, Chicago

Crude oil options bring the highly volatile crude oil market within reach of the smaller speculator, and open new trading strategies for the experienced professional. Options on futures are relatively new to the market. Banned by Congress in 1936, the first pilot programs initiated options on futures trading in 1982 and have enjoyed tremendous success. Futures options are most successful when their limited-risk nature is applied to volatile, uncertain markets. The crude oil futures market is an example of a market ripe for the flexibility of options while providing the liquidity necessary for success.

Crude Oil Options

Crude oil options are limited-risk trading instruments that convey the holder of the option the right to buy (if a call) or sell (if a put) crude oil futures at a specified strike price up until the expiration date of the option contract. Buy call strategies, similar to long futures, are bullish positions while buy put strategies and short futures are bearish positions. The purchaser of the option pays a premium to the writer of the option con-

tract for this right. The option buyer's risk is limited to the premium paid, and the buyer is not subject to margin calls. The option seller risks market losses and can earn, at most, the premium received. At expiration, the call option is worthless if the crude oil futures trade for less than the strike price of the call and a put option is worthless if the futures trade for more than the strike price of the put.

The option premium generally fluctuates less than the underlying futures price. In options terminology, the absolute value of an option's *delta* is usually less than one. The *delta* measures the amount by which a premium changes with respect to a change in the futures price. The deeper in-the-money an option is, the higher its *delta*, and the more the option position will resemble an outright futures position. A call option is termed *in-the-money* if the futures price is above the strike price and in the case of a put, if the futures price is below the put's strike price.

A crude oil option contract gives the holder the right to buy/sell a crude oil futures contract, representing 1,000 barrels. If a crude oil option increases in value by \$1/barrel the option will increase in equity by \$1,000. A crude oil option priced at \$3.50/barrel carries a premium of \$3,500. Options premiums can be estimated by mathematical models such as the Black model. In the examples that follow, option premiums were simulated for historical trading opportunities to examine how crude oil options might have performed.

Market Outlook: Bullish

Following several unsuccessful and uneventful OPEC meetings during the first half of 1986, the late July conference was widely expected to end without any substantive agreement. In anticipation of the meetings, the crude oil market generally traded sideways to lower in a volatile fashion. However, to the surprise of most observers, an agreement to curtail output was reached. This development quickly translated into a dramatic crude oil price advance from around \$11.50/bbl to the \$15-\$16 range within a matter of a few days — a move of \$4,500-5,500 per futures contract.

Before crude oil options were launched

on November 14, the only strategy available was a long position in crude oil futures (or possibly a spread position). For public customers, \$2,000 in original margin deposit must be put up on a futures contract and variation margin must be posted if losses are incurred. The risk is "unlimited" because the investor can lose more than the initial equity required for the trade. The trader profits by \$1,000 for each \$1/barrel rise in the price of crude and loses \$1,000 for each \$1/barrel drop.

As discussed above, buy call options yield profits on bullish moves while limiting the trader's risk to the initial premium paid. Many call options are available at various strike prices above and below "the at-the-money". As shown in Table 1, the lower the strike price, the higher the premium of the option, because lower strike prices give the trader the option to buy crude oil futures at a lower price. Conversely, the higher the strike price, the cheaper the option.

Which strike price is best? This depends on the particular investment objective. Table 1 includes three different call options, with various strikes, along with the performance of each over the investment period. The more expensive, in-the-money calls, earn more in terms of dollars than the cheaper, less-in-the-money calls. In the case of the \$12/bbl call, the dollar profit is almost identical to the futures position but the risk is limited. In comparing the performance of the options, note that the rate of return is greatest on the out-of-the-money call. Of course, the risk of the option expiring worthless is also greatest for an out-of-the-money call.

Market Outlook: Bearish

The first three quarters of 1985 proved to be a frustrating period for bearishly inclined traders of crude oil. Worldwide consumption was declining after a brief improvement in 1984 and output was being maintained at a relatively high level. The price picture changed dramatically during the fourth quarter as Saudi Arabia shifted its pricing and production strategies. Market share was suddenly given priority over official prices. The price impact was substantial as crude oil futures collapsed from over \$31/bbl at the end of November to as low as \$10/bbl by early April 1986.

To take advantage of a potential break in crude prices, the bearish trader could have shorted the futures market or bought put options (had they been available). The trader would have had to make a similar choice as in the preceding bullish example: determining which strike to choose.

Once again, there is a risk-return tradeoff.



The in-the-money option has the greatest dollar cost but returns the highest dollar profit. The deep-out-of-the-money put has the greatest risk of expiring worthless and is the least expensive. But it shows the best rate of return.

Market Outlook: Bullish and Bearish

A unique aspect of crude oil options is the straddle position, consisting of the purchase of both a put and a call. If a put and call with the same strike price are purchased, the position is called a *straddle* while a position with different strikes is known as a *strangle* or *combo* position. Both allow the buyer to profit on swings in the price of crude oil without having to predict market direction. In order for the straddle position to make a profit, the futures price must move up or down by a 'breakeven' amount. A straddle is considered a 'volatility' trade which profits from price movement in any direction, and incurs losses in stable markets. The maximum loss is limited to the total of the call and put premiums paid for the position. However, the profit potential of the put and call is unlimited. As the price of crude increases, the call increases in value. As crude oil prices decline, the put increases in value. Important industry news regarding, for example, OPEC meetings or weekly API statistics, may present opportunities for profitable straddles by allowing the trader to profit on market volatility without calling market direction.

In the simulations, volatility was assumed to be constant throughout the period for illustrative purposes only. In fact, volatility levels increased during both sample periods. By February 5, 1986 the 30 day historical volatility had risen to 43% from 30% in mid-December 1985 and by August 5, 1986 it had risen to 70%. It is reasonable to assume that in both examples, returns to the investor would have been even greater than was simulated since option premium levels increase as volatility increases. This added benefit was deleted from calculations to simplify the examples and to focus on price objectives.

In conclusion, options are most effective when sharp moves are expected, or unlimited margin risk cannot be tolerated by the trader. As time passes, options lose time premium and their effectiveness. The staying power that they provide can, however, keep the trader in the market when adverse losses might close out a futures trade. The key to successful options trading is understanding the factors that determine their profitability and affect their performance. ■

TABLE 1

Simulation of October Futures and Call Options

	Futures	\$12-call	\$13-call	\$14-call
6/27/86	\$12.28	\$.86	\$.44	\$.20
7/14/86	10.58	.14	.04	.01
8/5/86	15.91	3.90	2.90	1.94
Max Cost	\$3,700.00*	\$860.00	\$440.00	\$200.00
Profit	\$3,630.00	\$3,040.00	\$2,460.00	\$1,740.00
% Return	N.C.	353%	559%	870%
Max % Loss	N.C.	83%	91%	95%

TABLE 2

Simulation of April Futures and Put Options

	Futures	\$26-put	\$22-put	\$20-put
12/17/85	\$23.87	\$2.88	\$.74	\$.26
12/30/85	25.17	1.97	.36	.09
02/05/86	16.50	9.45	5.47	3.50
Max Cost	\$3,300.00*	\$2,880.00	\$740.00	\$260.00
Profit	\$7,370.00	\$6,570.00	\$4,730.00	\$3,240.00
% Return	N.C.	228%	639%	1246%
Max % Loss	N.C.	31%	51%	65%

TABLE 3

Simulation of October Futures and Options

	Futures	Straddle 12C, 12P	Strangle 13C, 11P	Strangle 14C, 10P
7/1/86	\$12.28	\$1.57	\$.78	\$.34
7/14/86	10.58	1.76	.91	.37
8/5/86	15.91	3.90	2.91	1.95
Max Cost	\$3,700.00*	\$1,570.00	\$780.00	\$340.00
Profit	\$3,630.00	\$2,330.00	\$2,130.00	\$1,610.00
% Return	N.C.	148%	273%	473%

TABLE 4

Simulation of April Futures and Options

	Futures	Straddle 24C, 24P	Strangle 22P, 26C	Strangle 20P, 28C
12/17/85	\$23.70	\$3.10	\$1.51	\$.62
12/30/85	25.15	3.12	1.55	.68
02/05/86	16.33	7.63	5.64	3.67
Max Cost	\$3,450.00*	\$3,100.00	\$1,510.00	\$620.00
Profit	\$7,370.00	\$4,530.00	\$4,130.00	\$3,050.00
% Return	N.C.	146%	273%	491%

* Maximum cash for initial and variation margins. (Margins would be higher for spot-month contracts.)

N.C. — not comparable to option profit/loss.



Time and Volatility

Option premiums are determined by several factors. Market, prices, strike prices, expected volatility, time left to expiration and interest rates combine, as in a kaleidoscope, to determine option premiums. Not only do these many factors determine premium levels, but these factors are also always changing. Isolating the effects of each variable requires the use of an exact option pricing model. In this article the Black model¹ is used to focus on two option pricing factors: volatility and time.

The effect of changing futures prices on option premiums is straightforward. Call premiums increase as prices rally and decrease as prices decline. Conversely, put premiums increase with declining prices and decrease with increasing prices.² Changes in expected volatility or changes in time until expiration, however, will sometimes influence option premiums more than a move in the underlying futures price.

Time

The less time remaining in an option's life

(that is, the less time an option buyer has the right to exercise), the less value an option will have. More time remaining implies that an option has a higher probability of becoming in-the-money. The market charges a higher premium for this extra time.

The rate of premium decay changes in relation to diminishing time remaining until option contract expiration. Premium decay per day is much more rapid on an option with two weeks left to expiration than the daily decay of an option with two months left. Figure 1 illustrates this phenomenon.

Let's examine the time effects on the \$17 (in-the-money), \$18 (at-the-money) and \$19 (out-of-the-money) call options assuming that futures prices are \$18, volatility is 35%, and interest rates are 6%. By plugging these assumptions into the option model and then changing the time to expiration, a premium decay curve is outlined.

The \$17 and \$19 call options illustrate flatter decay curves than the \$18 call because the out-of-the-money and the in-the-money options have less time value. Note that the \$17 call has \$1 of intrinsic value at expiration, while the \$18 and \$19 calls expire worthless. The \$18 call shows how much more rapidly premium decays with,

for example, one month left than with two or three months left. Premiums decline most rapidly within the last two weeks of an option's life.

An option trade which takes advantage of the rapid time decay in the nearby option is called a calendar or time spread. Selling nearby options and buying further-out options of the same type is an attempt to remove any effect of a price change while isolating and taking advantage of the rapid decay of the nearby premium. In early February, for example, a trader could sell \$18 April calls and buy May or June \$18 calls. This strategy, however, is confounded in crude oil markets because the underlying futures spreads are volatile. Adverse movement in the futures spreads could cause both option legs to show losses.

Time works against long option positions and works in favor of short option positions. Traders who are excessively long premium need to monitor time decay in order to effectively lift or roll positions into deferred months.

Volatility

An important piece of information extracted from options markets is the mar-

ket's expectation of future volatility. If futures prices are a "best" guess of future spot prices, option premiums are a "best" guess of the standard deviation of the expected price changes. If the market expects high price volatility, option premiums will be high. If the market expects low price movement, option premiums will be low.

Using our option pricing model, let's now isolate the volatility effects on option premiums. Assuming futures prices are at \$18, interest rates 6% and time to expiration is 90 days, an \$18 call with three expected volatility scenarios are examined: 30%, 35% and 40%.³ Figure 1 clearly shows the effect of changes in expected volatility on option premiums (intrinsic value was removed from option premiums, leaving only time value for illustrative purposes).

Volatility expectations are always changing. Before OPEC meetings, option premiums will tend to inflate as the market builds into premiums higher volatility expectations. If the market moves sideways for a period of time, declining expected volatility might deflate option premiums. However, option premiums will be determined by market expectations of future volatility, not necessarily by historic patterns or measures of volatility. Thus changes in volatility expectations may affect option premiums even without a move in the underlying futures price.

Increasing volatility works in favor of long option positions while decreasing volatility favors short option positions. A trader who is excessively short options must be wary of "pops" in volatility. And a trader might not wish to buy options when the market has high volatility expectations built into the premiums.

Summary

The constant tug-of-war between volatility and time can have dramatic effects on option premiums. Time always wins out: an option's time value is zero at expiration. But changes in the market's expectation of future volatility will change option premiums over the life of an option. The trader who understands the relationships among option variables will be better equipped to identify optimal hedging strategies. ■

¹ See Fischer Black, "The Pricing of Commodity Contracts," *Journal of Financial Economics*, 3 (January-March 1976), 167-179.

² A more precise measure of how a particular option will react to a move in futures price is called an option's delta. See "How to Interpret Option Deltas," pages 21-23.

³ See "Volatility and Option Valuation," pages 18-19, for a more detailed discussion on interpreting volatility measures.

Figure 1
Time Decay

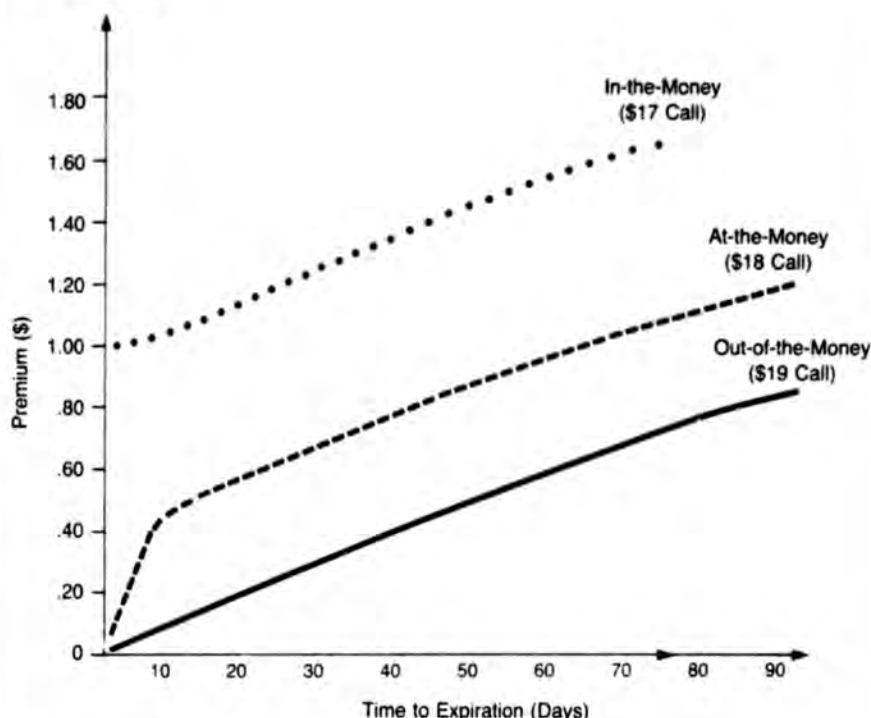
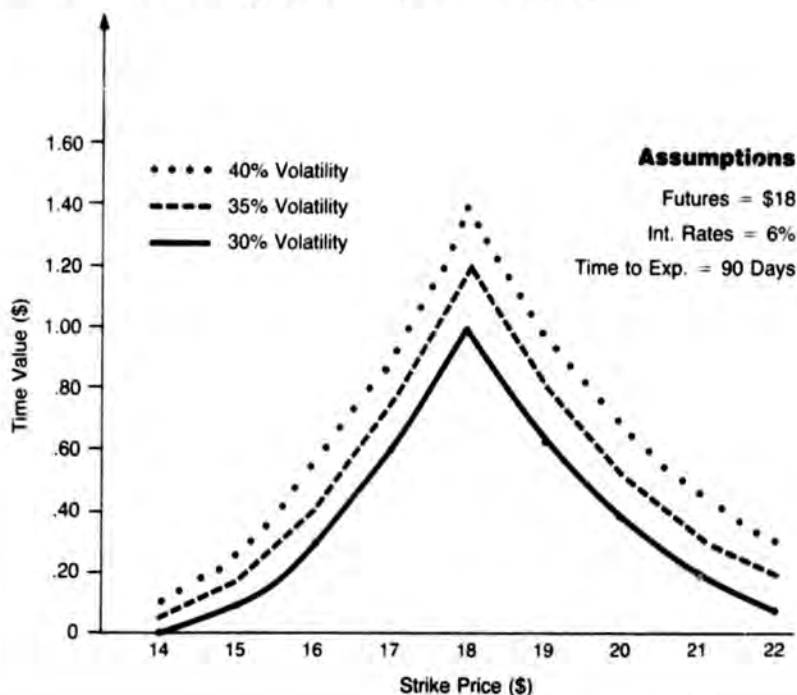


Figure 2
The Effect of Changing Volatility on Time Value



Six Basic Options Strategies

Options on crude oil futures have experienced rapid growth in terms of volume and open interest since their introduction on the NYMEX trading floor on November 14. This popularity reflects the great versatility of these instruments. Options permit traders to construct positions to suit virtually any view about market direction, timing and volatility, while tailoring the level of risk.

Presented here are six basic strategies along with their profit and loss profiles. Time is a critical factor in option valuation. This is illustrated in the accompanying charts which show the profit/loss profiles both at expiration and with 90 days remaining to expiration. These assumptions were entered into the "Black" model to calculate theoretical option premiums:

- Futures price of \$16 per barrel (when position established)
- Volatility of 35 percent
- Interest rate of 6 percent

In each example, *debits* are monies paid out by the buyer of the position and *credits* are cash funds received by the seller (or writer) of the option position. The *delta* is the amount by which an option premium will change relative to a change in the underlying futures price.

Long Call:

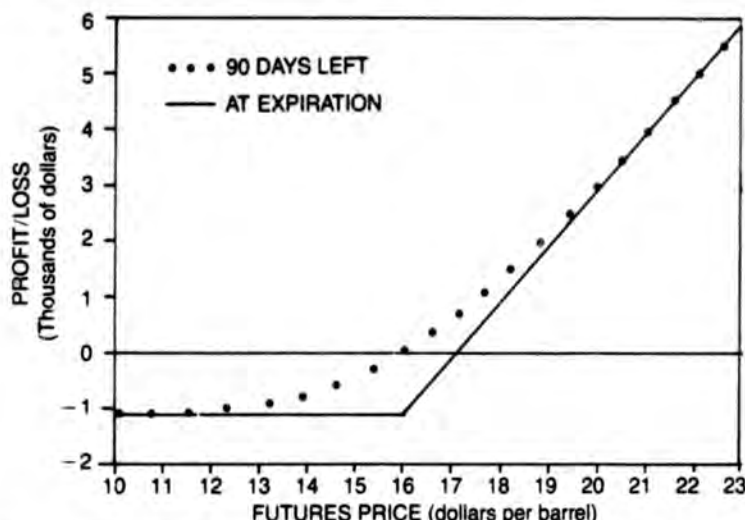
A long call strategy gives the holder the right, but not the obligation, to buy futures at \$16 per barrel for a specific period of time. This position profits if prices rally. Profits are unlimited on the upside; total risk is limited to the premium paid regardless of where futures trade. This trade is helped by increasing volatility, while the passage of time works against it. Hedgers can use buy call strategies to lock in purchase prices and still benefit from market declines.

Short Call:

In exchange for the premium received, the writer of a call option is obligated to sell the underlying futures at \$17 per barrel, any time prior to expiration, if assigned. This position maximizes profits if prices are at \$17 or lower at expiration. Profits are limited to the premium received, while risk is unlimited on the upside. Declining volatility is favorable to the trade, as is the passage of time.

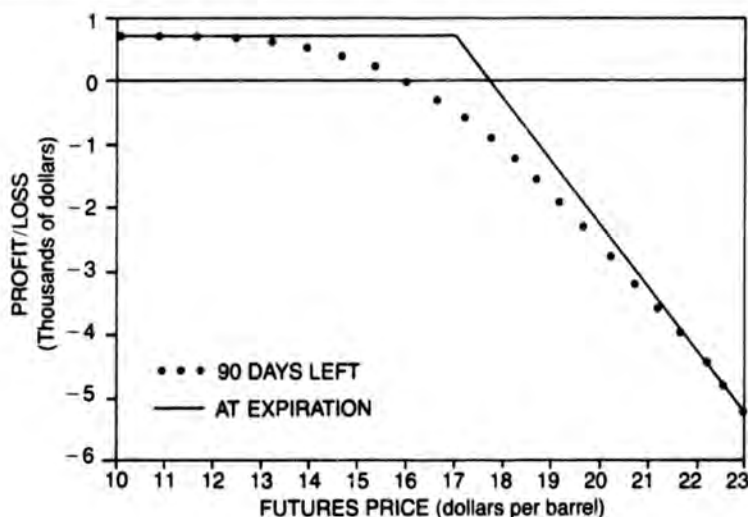
Long Call

Position	Premium	Dollar Premium	Delta
Buy 1 \$16 Call	\$1.09	\$1,090	+.53
Maximum Risk:	\$1.09 per barrel or \$1,090 per contract		
Maximum Profit:	Unlimited on the upside		
Breakeven Futures Price:	\$17.09		



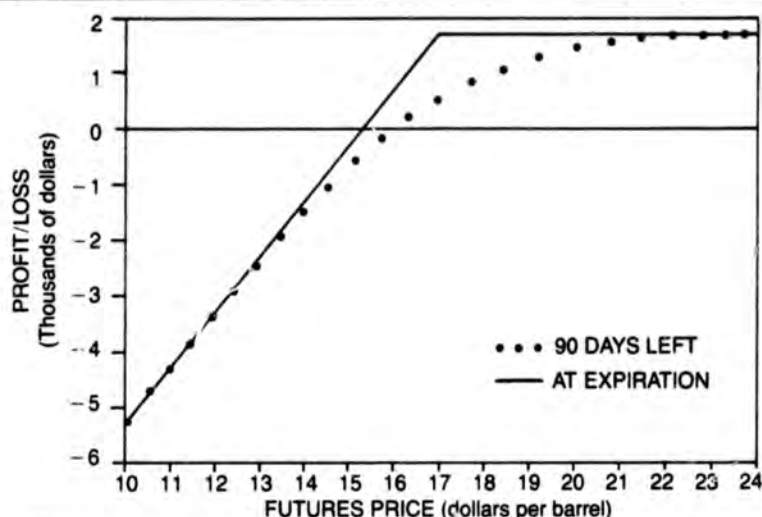
Short Call

Position	Premium	Dollar Premium	Delta
Sell 1 \$17 Call	\$0.70	\$700	-.53
Maximum Risk:	Unlimited on the upside		
Maximum Profit:	\$0.70 per barrel or \$700 per contract		
Breakeven Futures Price:	\$17.70		



Covered Call

Position	Premium	Dollar Premium	Delta
Buy 1 \$16 Futures			+1.00
Sell 1 \$17 Call	\$0.70	\$700	-.40
Net Credit	\$0.70	\$700	
Net Delta			+.60
Maximum Risk:	Unlimited on downside		
Maximum Profit:	\$1.70 per barrel or \$1700 per covered call		
Breakeven Futures Price:	\$15.30		



Covered Call:

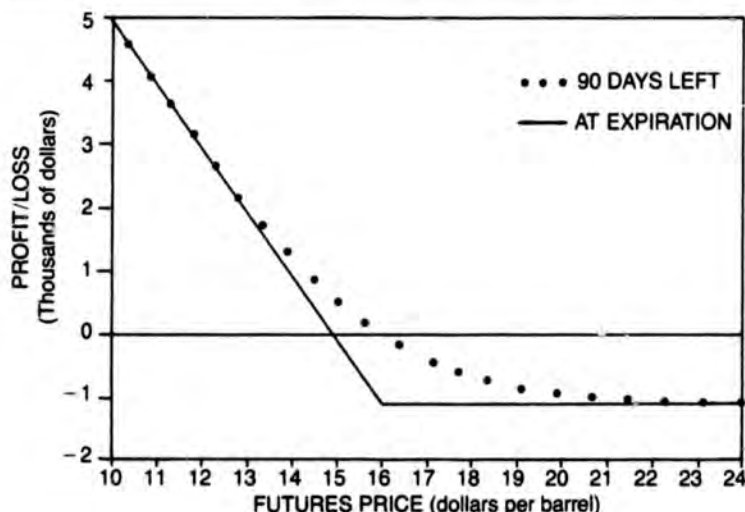
Calls are sold against a long futures position. Premium income is earned if futures move sideways to slightly higher or lower. This position is bullish (note the +.60 delta) and is helped by lower volatility and the passage of time. Profits are limited on the upside; losses are unlimited as prices decline. The premium received from the sale of the put acts as a hedge for the futures position as prices decline.

Long Put:

This position gives the holder the right but not the obligation to sell futures at \$16 per barrel for a specific period of time. This position profits if prices decline. Profits are unlimited on the downside; total risk is limited to the premium paid. Increasing volatility favors this position while the passage of time works against this trade. Hedgers can use buy-put strategies for unlimited downside protection, yet still participate in market rallies.

Long Put

Position	Premium	Dollar Premium	Delta
Buy 1 \$16 Put	\$1.09	\$1,090	-.47
Maximum Risk:	\$1.09 per barrel or \$1,090 per contract		
Maximum Profit:	Unlimited on the downside		
Breakeven Futures Price:	\$14.91		



OPTIONS

Short Put:

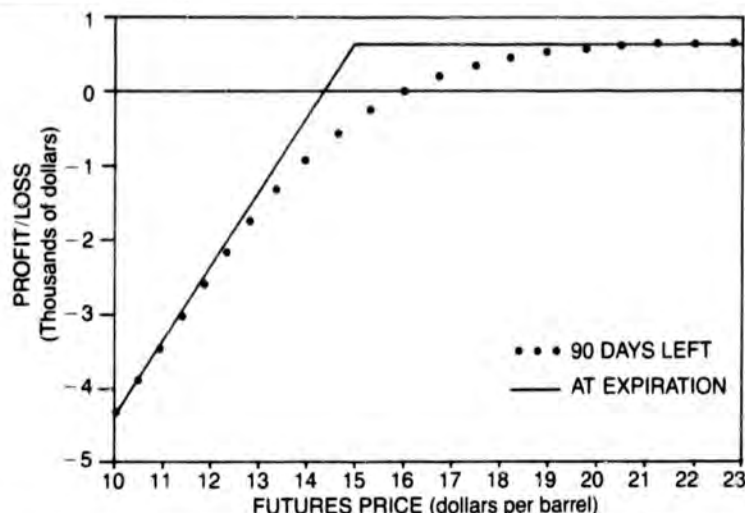
In exchange for the premium received, the writer of a put option is obligated to buy the underlying futures at \$15 per barrel, any time prior to expiration, if assigned. This position realizes maximum profits if futures are trading at \$15 or above at expiration. Profits are limited to the premium received, while risk is unlimited on the downside. Declining volatility is favorable to this trade, as is the passage of time.

Long Straddle:

A long straddle is a combination of long puts and long calls with the same strike price and same expiration date. Long straddles are also called long volatility trades because the position profits when the market moves sharply in either direction. Profits are unlimited in either direction. Losses are limited to the total premium paid. Maximum risk is \$2,180 and occurs if futures are at \$16 per barrel at expiration. This trade might be established ahead of a scheduled release of economic information or before an OPEC meeting, in anticipation of increased market volatility.

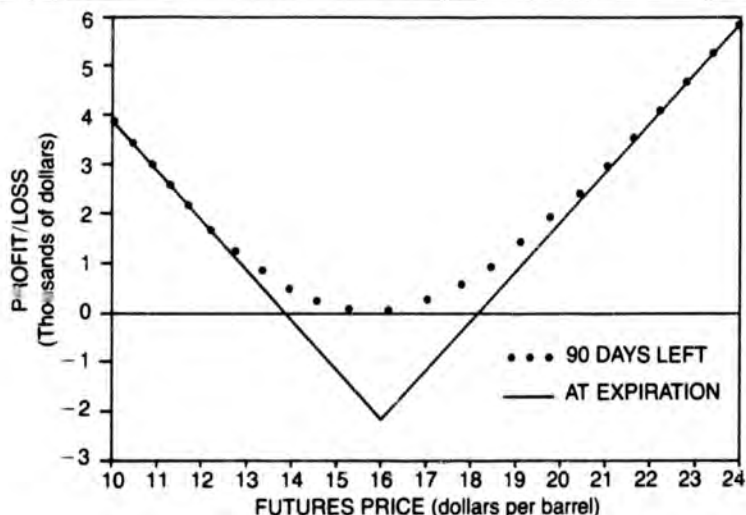
Short Put

Position	Premium	Dollar Premium	Delta
Sell 1 \$15 Put	\$0.64	\$640	+ .32
Maximum Risk:	Unlimited on the downside		
Maximum Profit:	0.64 per barrel or \$640 per contract		
Breakeven Futures Price:	\$14.36		



Long Straddle

Position	Premium	Dollar Premium	Delta
Buy 1 \$16 Call	\$1.09	\$1,090	+ .53
Buy 1 \$16 Put	\$1.09	\$1,090	-.47
Net Debit	\$2.18	\$2,180	
Net Delta			+ .06
Maximum Risk:	\$2.18 per barrel or \$2,180 per straddle		
Maximum Profit:	Unlimited in either direction		
Breakeven Futures Prices:	\$18.18 and \$13.82		



THE HOT NEW LOW-STAKES PLAY IN OIL

CRUDE OPTIONS, WHICH JUST ARRIVED ON NYMEX, ARE CHEAPER, LESS RISKY, AND MORE FLEXIBLE THAN FUTURES

The conventional wisdom has it that OPEC is back in the driver's seat and oil prices are firming for the long, cold winter. But if you don't buy that line and you've got some spare cash for a roll of the dice, you can play the hottest game in town. It's options on crude-oil futures, and for the stout-hearted it could produce some nifty returns for little money and not much risk.

Here's how it works. If you think oil prices will tumble from the current \$19 a bbl. in the next few months, buy a put

crude options began trading on the New York Mercantile Exchange, volume has averaged about 5,000 contracts a day. That's peanuts compared with the 33,000 oil futures contracts that trade on NYMEX in the average day, but one day crude options may be just as popular as the underlying futures. "I've been astounded at the acceptance so far," says Randall K. Rothenberg, vice-president for options at Preston Head Ltd. "Crude options could trade as heavily as futures within three to five years."

Oil traders are quickly discovering that trading options can be not only cheaper and less risky than trading futures but also more flexible. With options, for instance, traders can buy price insurance at a fixed cost to protect against adverse price moves without giving up the potential profits of favorable price moves. A trader with inventory buys put options to protect against a slide in oil prices. Or he sells call options—the right to buy futures—against inventories to earn premium income.

STILL STUNNED. Trading in crude options will be fueled even more as the oil industry begins to use these instruments. It was the industry's participation in oil futures that finally put those futures on the map. Indeed, when NYMEX listed its crude-oil futures barely four years ago, most experts said the contracts were doomed. After all, they had been tried earlier in London and Chicago and failed miserably. By 1985 professional traders had pushed volume up to nearly 16,000 contracts a day, but it doubled in 1986 when energy companies became the dominant players in crude futures.

Still stunned by last year's plummeting crude prices, oil producers are desperate for new ways to protect themselves. As a result, BP and a number of oil-producing companies are looking at crude options, says Robert G. Gunnin, manager of hedging for BP North America Petroleum Inc. in Houston. Now that oil prices appear to be rising, the company is using a strategy of writing covered calls: The company sells call options, which are backed by physical inventory. The value of the crude is protected somewhat by the premium the company takes in. "That strategy," says Gunnin, "has been very profitable for us."

Refiners and oil-consuming companies, and even oil-producing states, could be major users of options. In the simplest hedging programs, producers can protect their inventories against drops in crude-oil prices by buying puts. Refiners, on the other hand, can buy calls to protect against higher oil prices that would erode profits. Oil-dependent states such as Texas, Louisiana, or Oklahoma may choose to use crude options to hedge against unanticipated declines in oil production tax revenues.

Energy banks and other financial institutions in the Southwest are showing their customers how to use options to lock in prices that will guarantee a certain level of revenues or help protect the value of oil reserves. Of course, it will take a couple of years before all these trends take hold. But when they do, crude-oil options may become the star of the options exchanges.

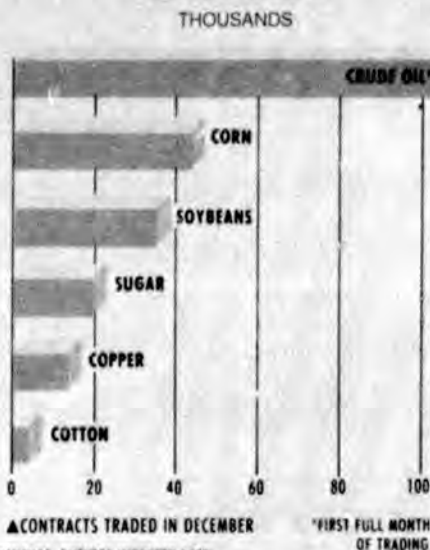
By Terri Thompson in New York

BIG SWINGS IN OIL PRICES...



DATA: NEW YORK MERCANTILE EXCHANGE, FUTURES INDUSTRY ASSN

...GIVE OIL OPTIONS A FAST START



▲CONTRACTS TRADED IN DECEMBER

*FIRST FULL MONTH OF TRADING

option. For just \$800, for example, the owner of the put gets the right—but not the obligation—to sell an oil futures contract by Apr. 3 at \$18 a bbl. If the price of oil drops to, say, \$15 a bbl. by that date, the option would be worth a cool \$3,000, for a profit of \$2,200.

NO MARGINS. Of course, if oil prices stay the same or rally, you lose—but only \$800. You won't have to worry about paying margin charges as the market moves against you. Unlike futures, options aren't margined. Suppose the price of the oil were to go to \$22 a bbl. Selling the actual futures would result in a loss of about \$4,000. The potential loss could be greater if oil prices rocketed higher.

The new oil game has caught the speculators' fancy. In the two months since

Crude options got off to a fast start because of gyrating oil prices (chart). When the late-December OPEC meeting sent prices soaring, the volume in these newborn crude options jumped to nearly 10,000 on one day—more action than some futures options see in a month. In December, the first full month of crude-options trading, more than 106,000 of the contracts changed hands.

Options on other futures have been trading only since 1982. The first were Treasury bonds, sugar, and gold, and there are now 34 listed contracts for options on futures. A few have generated little interest. But generally they're popular. By 1985 more than 20 million contracts were traded; last year total volume jumped 58.5%, to nearly 32 million.

Financial Instruments For Today's Oil Industry



Price volatility is changing today's oil industry. Financial planning is now more art than science. Competition is intense. And all segments of the business—producers, refiners, marketers, end-users—are responding to market forces as never before.

In this dynamic environment, managing price risk is a top priority. That's why companies throughout the oil industry are using financial instruments like NYMEX futures and options contracts to reduce the effect of price changes on operating results.

NYMEX futures contracts allow these companies to fix oil prices in advance of actual purchase

or sale. NYMEX options contracts permit them to insure against adverse price fluctuations and still capture some benefit from favorable moves.

Both help companies manage risk by minimizing the uncertainty of future oil prices.

Energy futures and options. Two ways to cushion the impact of oil price volatility. From NYMEX—a leader in financial instruments for today's oil industry.



NYMEX—The Energy Exchange

FOUR WORLD TRADE CENTER, NEW YORK, NY 10048
212/938-2879

212-908-2622
Telex 12491

James T. Colburn
Product Manager — Options



NEW YORK MERCANTILE EXCHANGE
Four World Trade Center, New York, N.Y. 10048



Crude Oil Options

Option Terms

- Put / Call
 - Buy / Write
 - Exercise (Striking) Price
 - Expiration
 - Premium
 - Intrinsic Value
 - Time Value
-

 NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

Long/Short Options

Long (Buy)

Pay Premium

Have Rights

Risk Limited to Premium

Profit Unlimited

Short (Sell)

Receive Premium

Have Obligations

Risk Unlimited

Profit Limited to Premium

Require Margin

 NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

Long/Short The Market

Long (Buy)

Short (Sell)

Buy Futures

Sell Futures

Sell Puts

Buy Puts

Buy Calls

Sell Calls

 NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

Option Description

Option

Future

Buy/Sell

Buy/Sell

Quantity

Quantity

Premium

Price

Month (Expiration)

Month

Strike Price

Put/Call

Disposition of Option

1. Close Out
 2. Exercise
 3. Lapse
-

Option Pricing Factors

- 1. Volatility**
 - 2. Time**
 - 3. Interest Rates**
 - 4. Market Price Relative to Exercise Price**
-

✕ NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

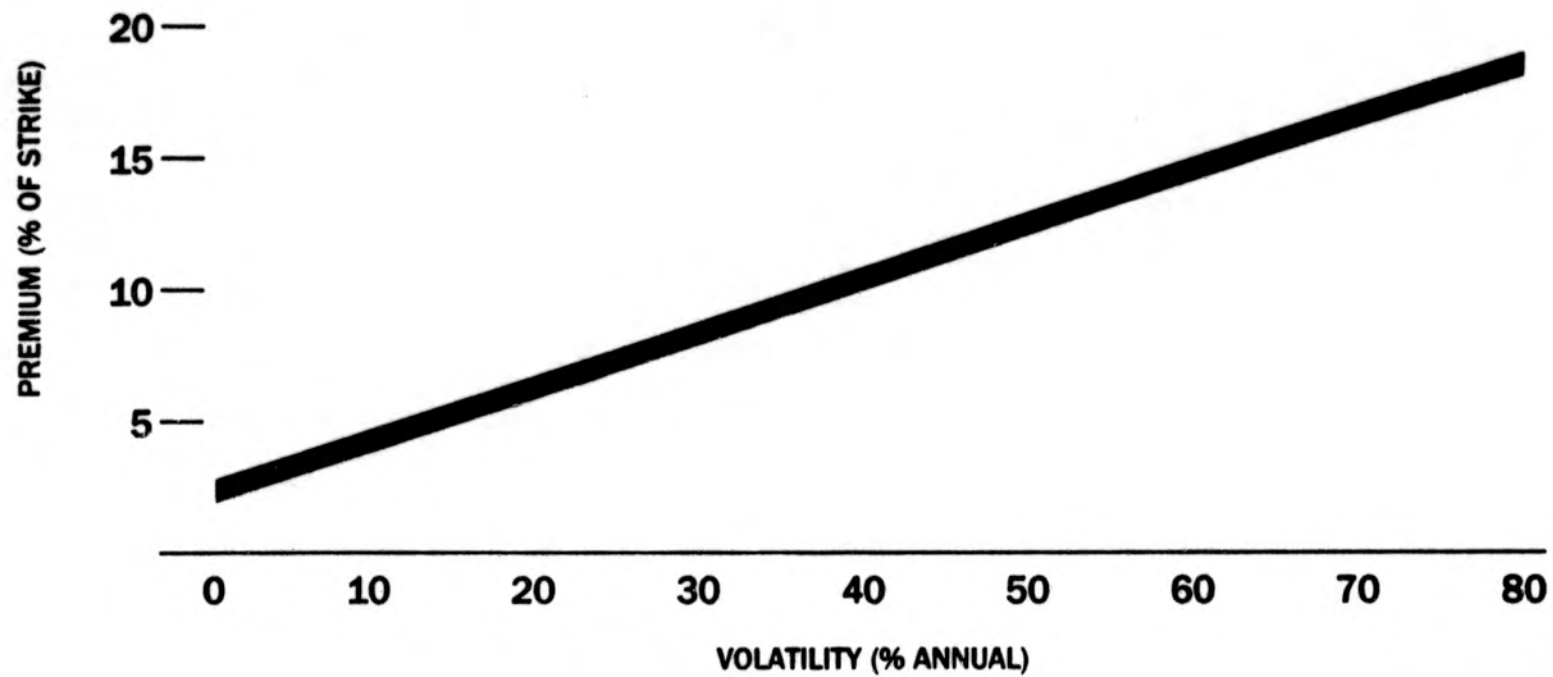
**Premiums for Three-Month Options —
Futures at \$15**

<i>Exercise Price</i>	<i>Call Premium</i>	<i>Put Premium</i>
\$14	\$2.05	\$1.05
15	1.50	1.50 <i>per barrel</i>
16	1.10	2.10

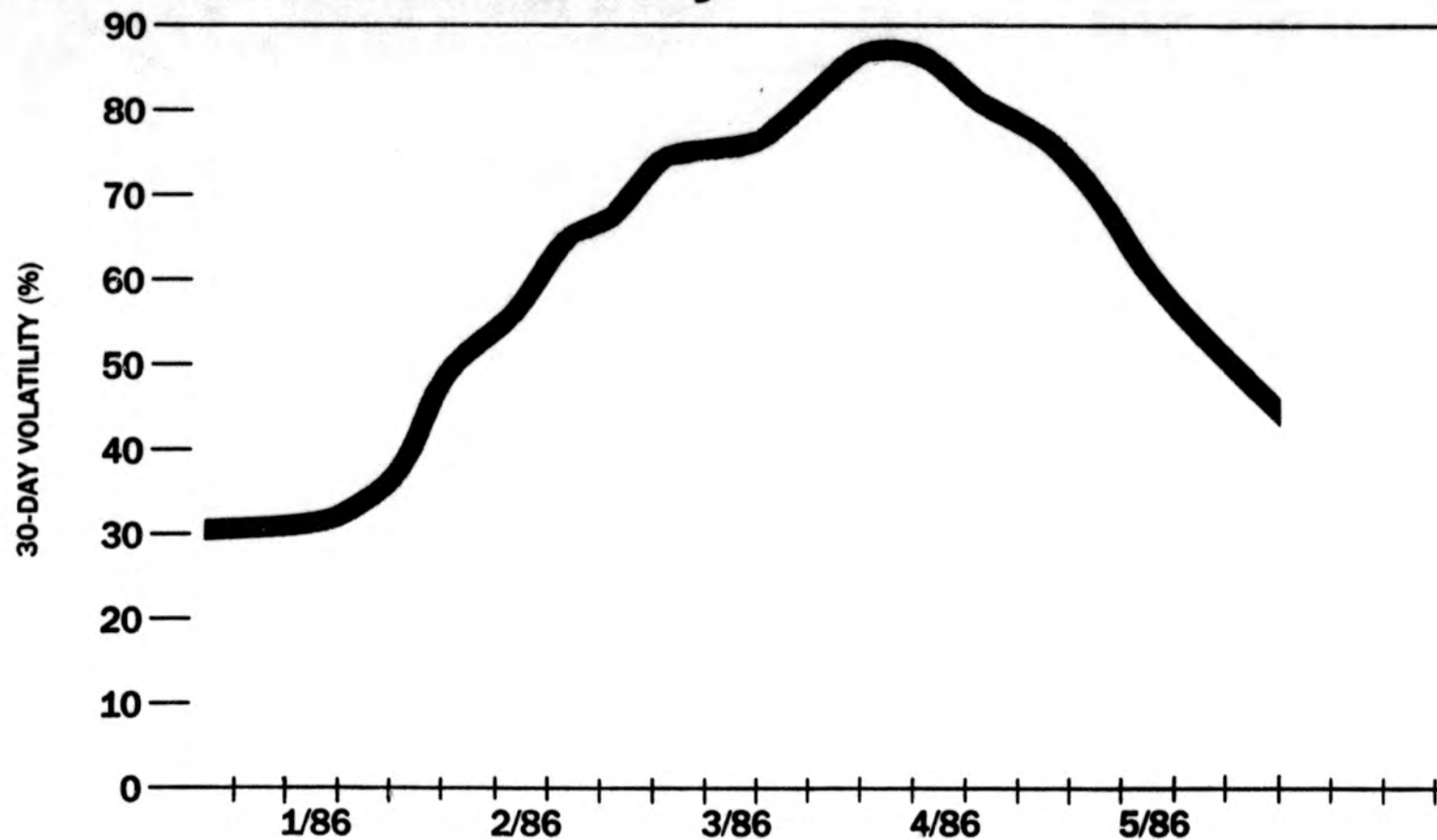
*Estimated
liquidity
options*

 NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

Volatility



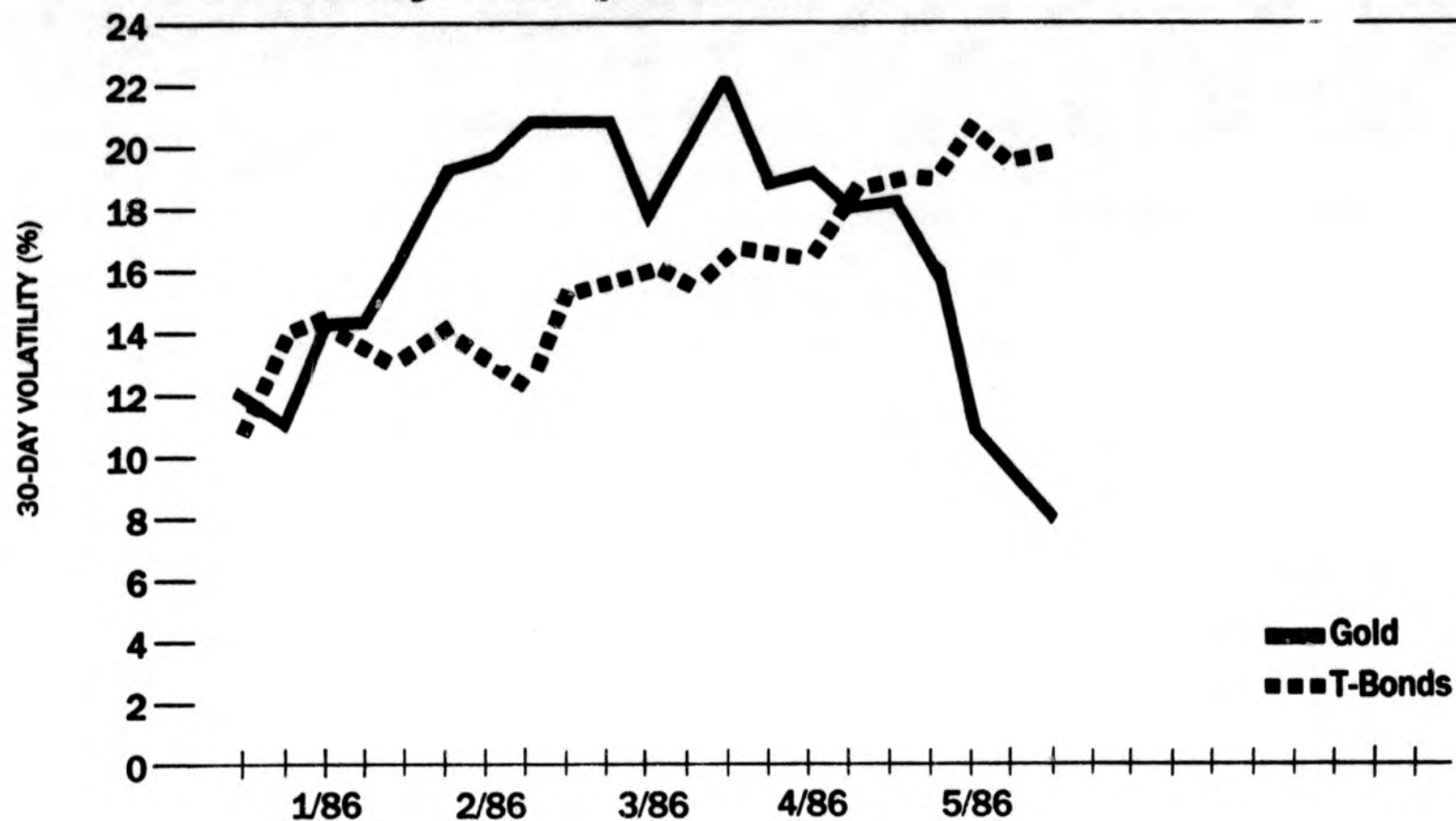
Crude Oil Volatility





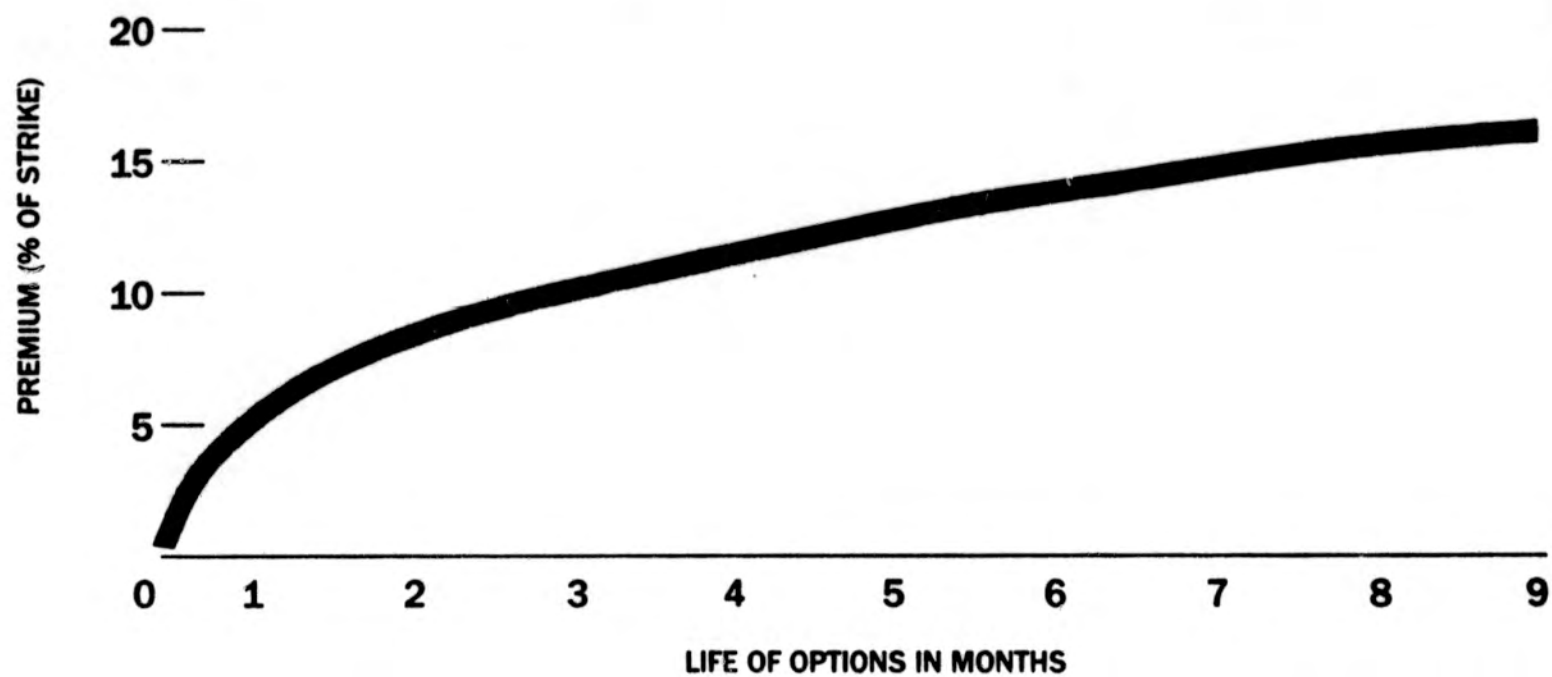
NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

Volatility Comparison



NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

Time



 NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

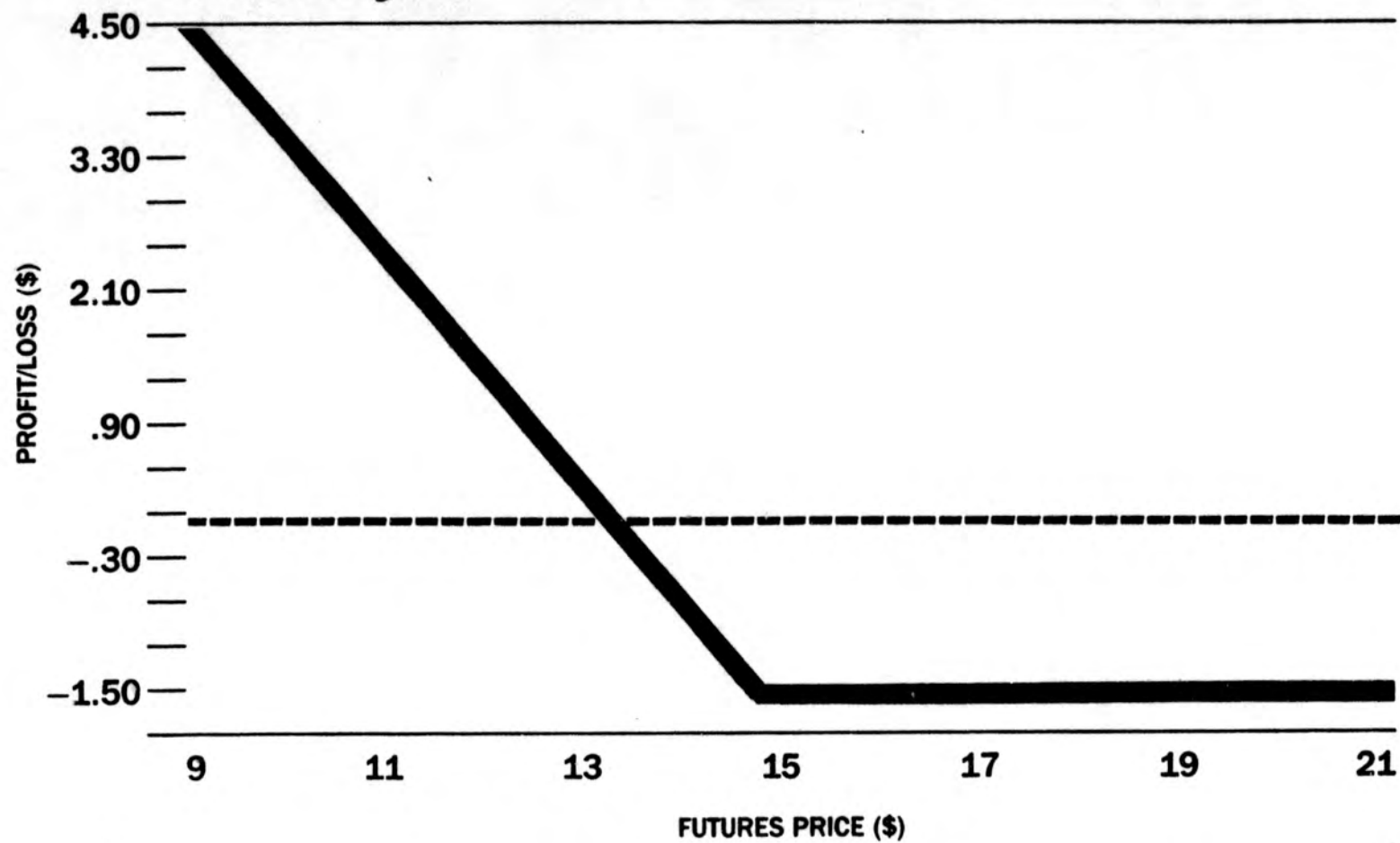
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NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

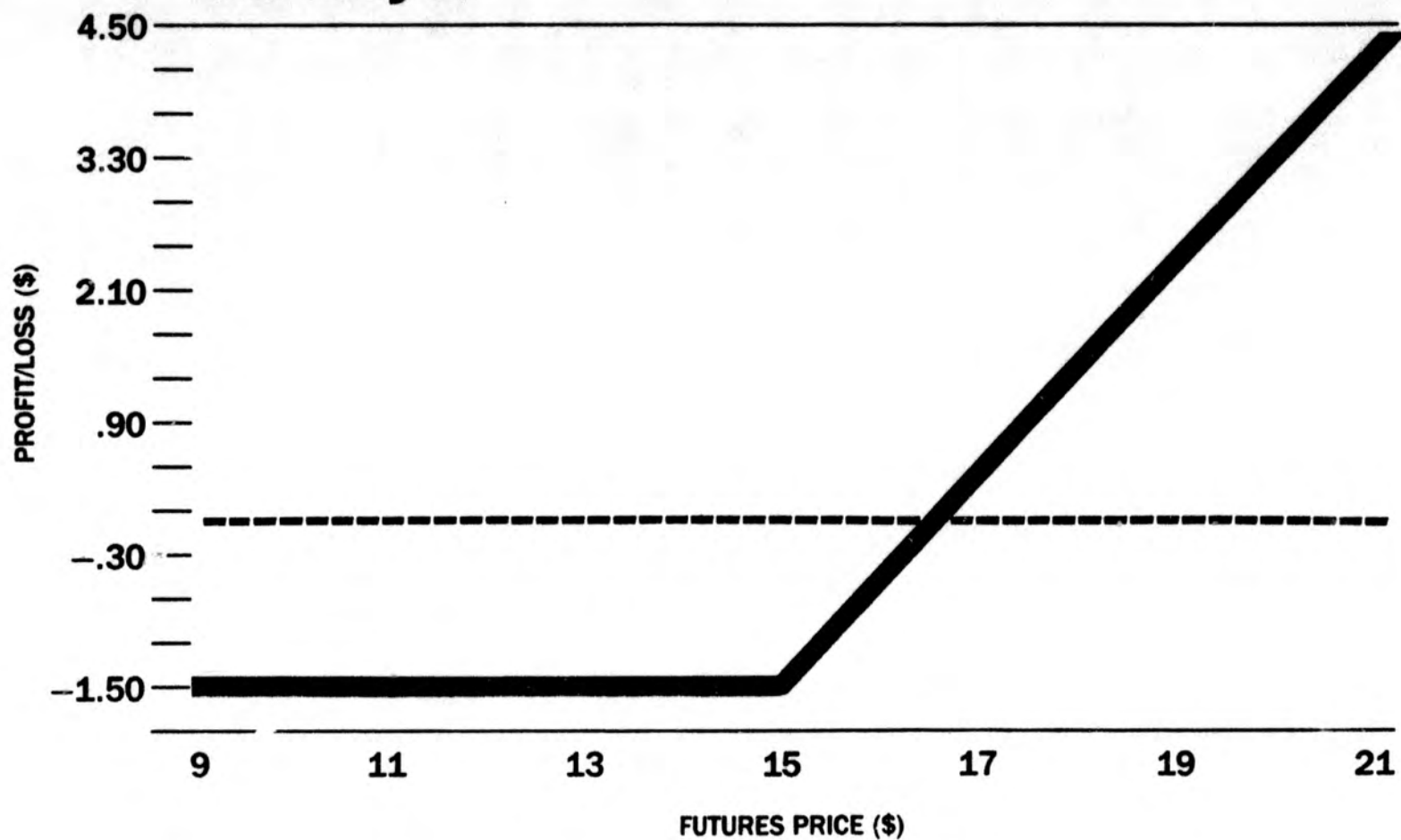
Put Buyer





NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

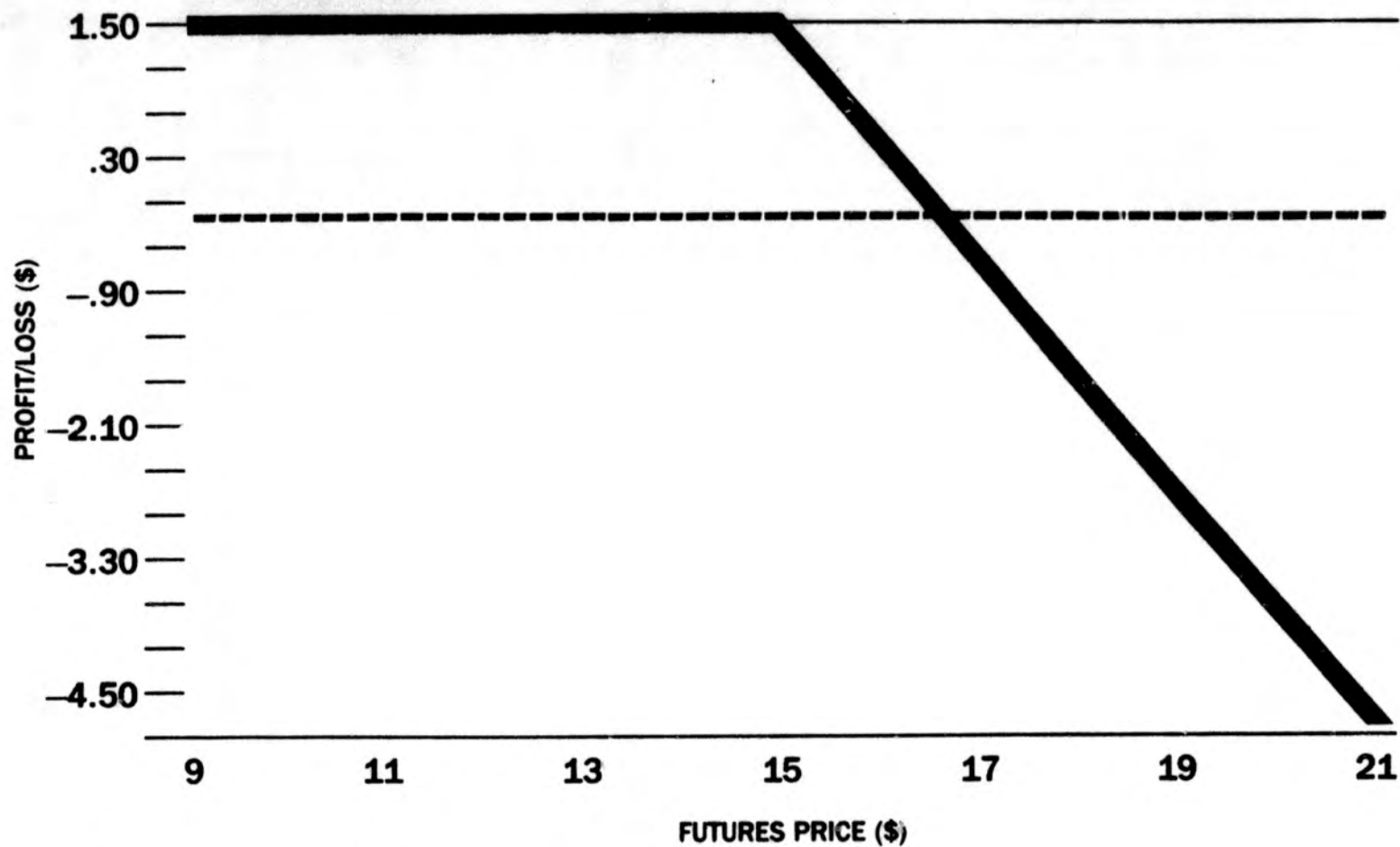
Call Buyer





NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

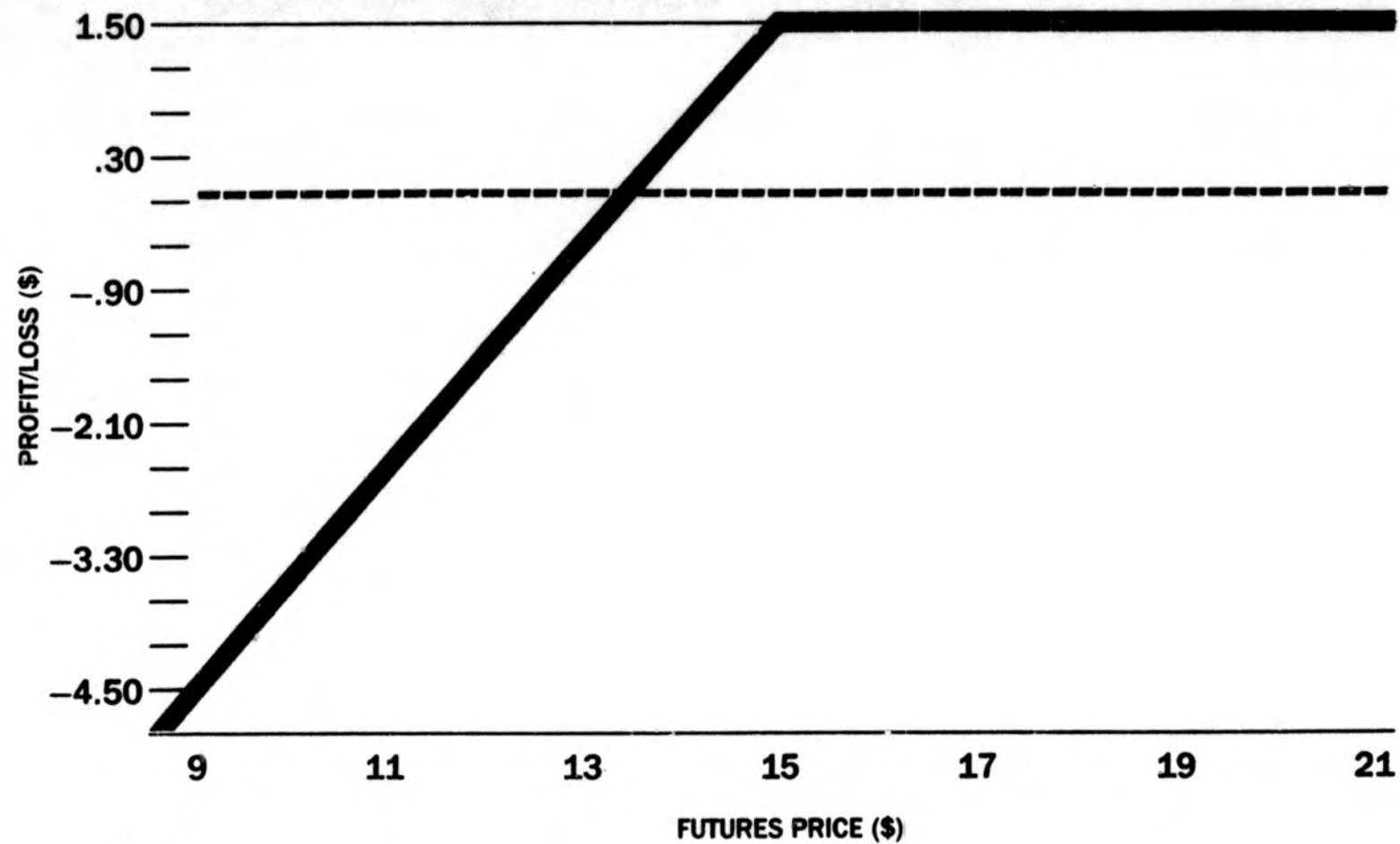
Call Writer





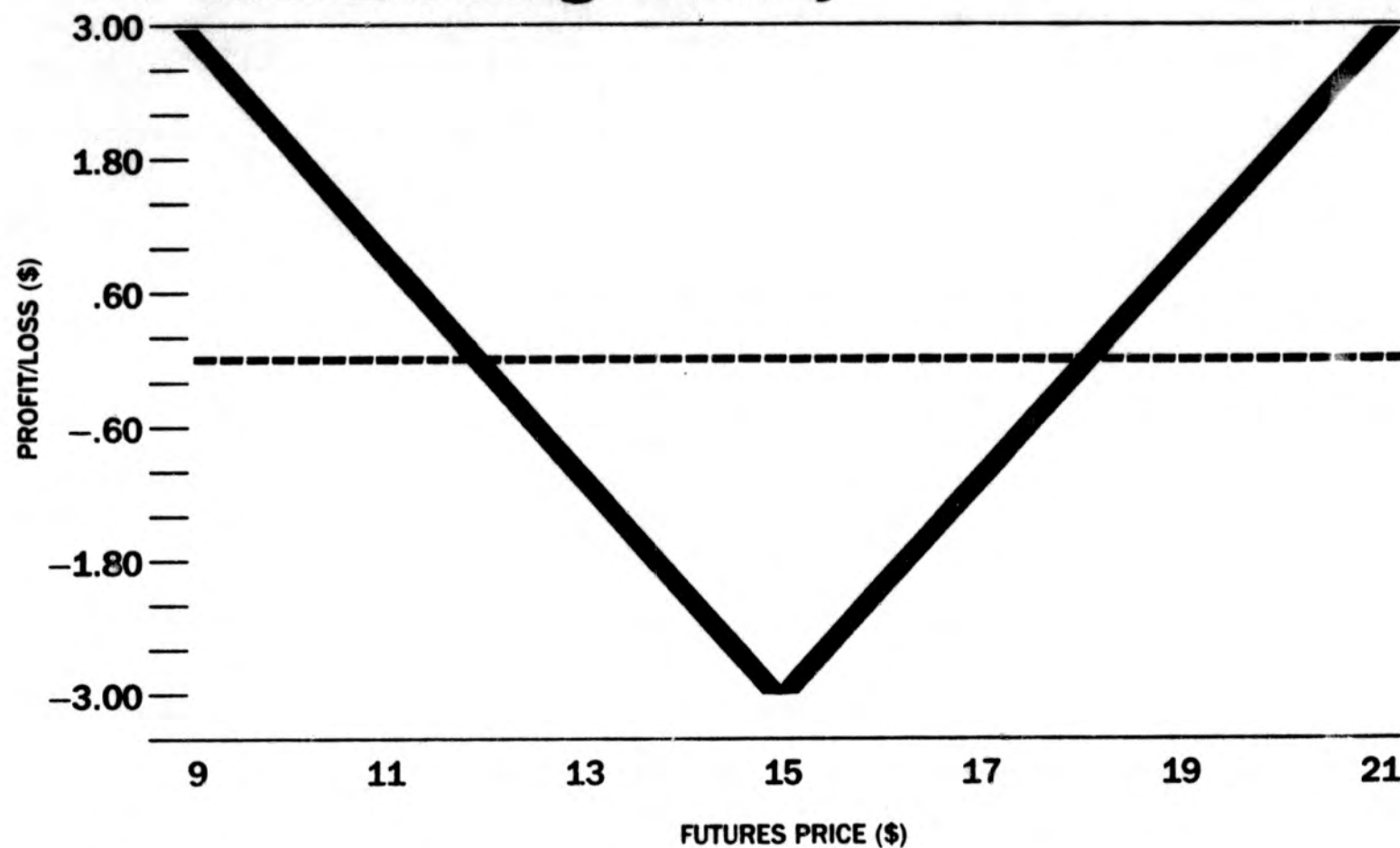
NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS

Covered Call Writer



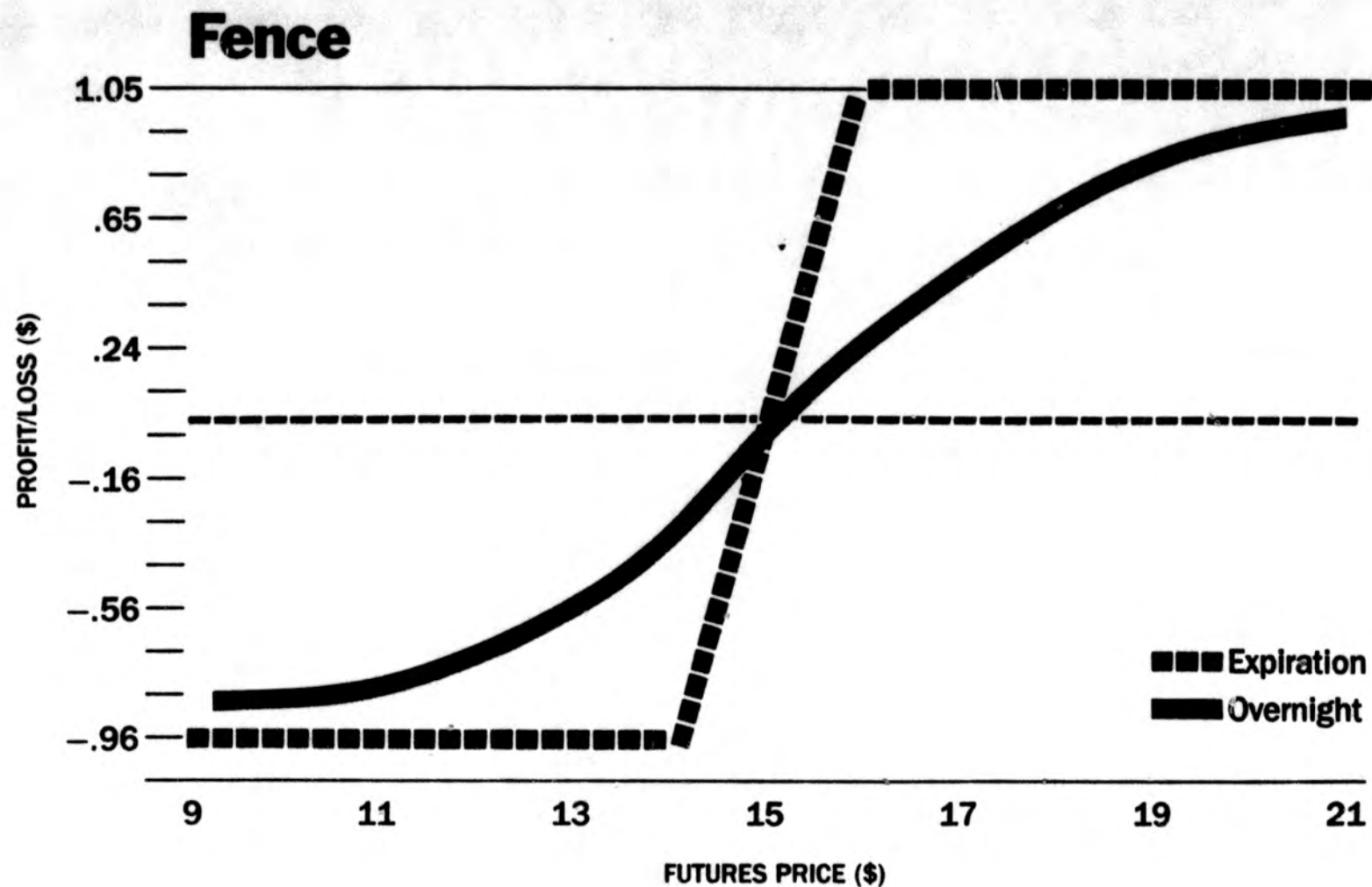


Straddle: Long Volatility

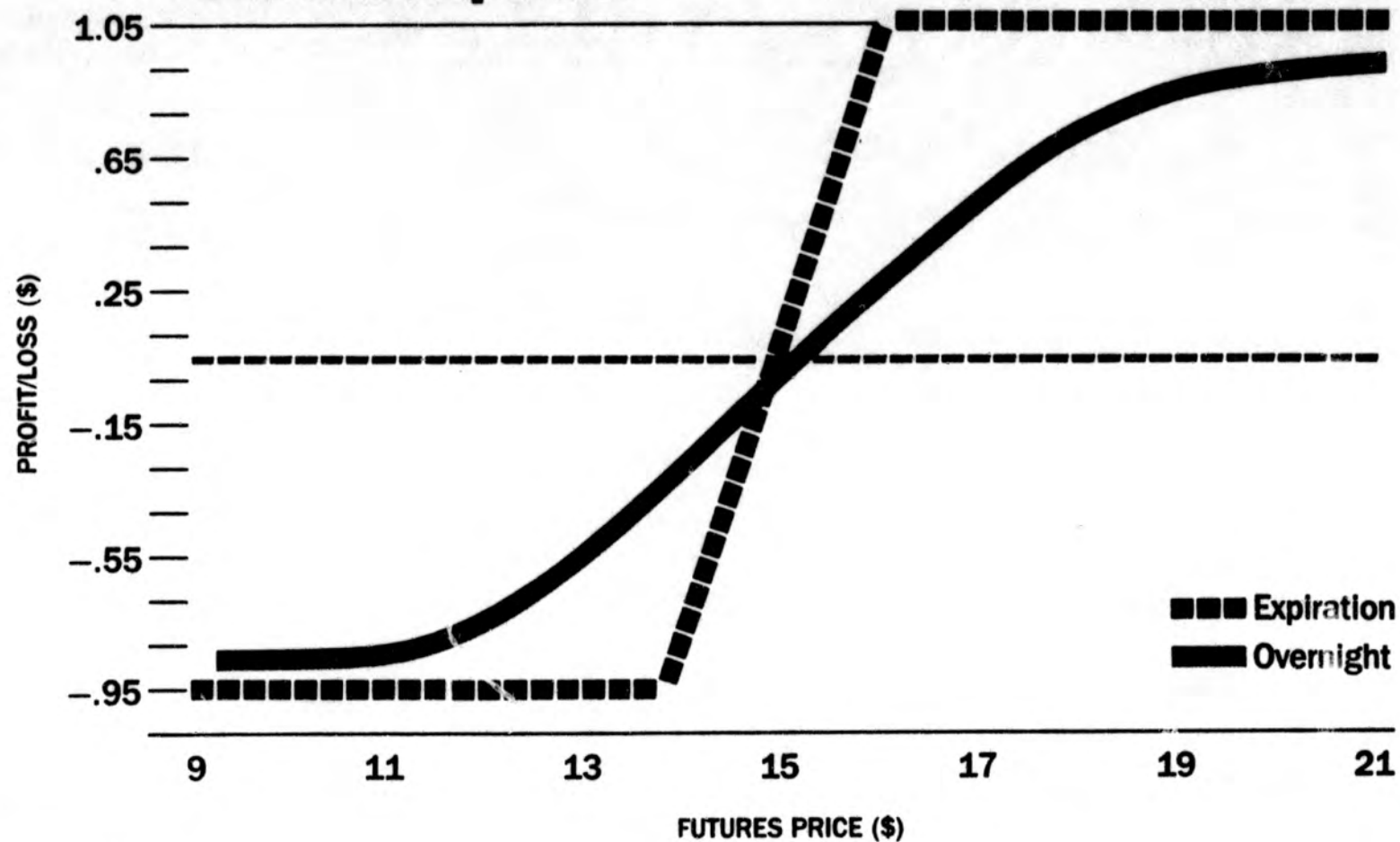




NEW YORK MERCANTILE EXCHANGE: CRUDE OIL OPTIONS



Call Bull Spread



(NW¼) of Section Twenty-
3), Township One North,
one West, Fairbanks Meridian,
AKS Recording District,
Judicial District, State of
more particularly described

encing at the Northwest
of the Northwest Quarter
of said Section:

the South 00 degrees 02' East
the West line of said Section,
set:

the North 89 degrees 58' East,
to the true point of begin-

the South 00 degrees 02' East,

the North 89 degrees 55'
34 feet to a point;

the North 00 degrees 02' West,
set to a point that is North
85 58' East from the true
beginning;

the South 89 degrees 58' West,
set to the true point of

the rising 2.998 acres, more or

whereas, a breach of the
secured by said deed of
occurred in that payment
been made in accordance
terms thereof and there is
and owing the principal
\$5,328.18, plus interest
at the rate of 12% per annum
on \$120,000, together with
administration not yet
beneficiary.

therefore, Safeco Title
Inc., an Alaska corporation,
Fairbanks Title Agency, acting
the undersigned attorney,
the real property described
public auction to the
the best bidder to satisfy the
then secured by the deed
The sale will be conducted
in front door of the State Court
604 Barnette Street, Fair-
banks, Alaska, at 1:00 o'clock, P.M.,
April 24, 1987. Beneficiary
the right to make an offset
amount equal to the obliga-
tion by the deed of trust at
the

this 20th day of March,

Title Agency, Inc.,
Alaska corporation, d/b/a
Safeco Title Agency

Mark Tomlinson, Its Manager

Donnellan
attorney for beneficiary

27, April 3, 10, 17, 1987

AIM ON VIOLATIONS

WALK OPERATOR FOR

ENITH 3377



A FISH & WILDLIFE
REFUGE

HB200 which requires per-
sons appointed to the Boards of

budget address.

The original suggestions for
cuts were sensible in his address

V. Juneau, AK 99811, or call
465-4940.

Bits From Bettie

Option Contracts Could Help Cushion Oil Price Swings

By Sen. Bettye Fahrenkamp

What will the price of oil be
next year? Who can predict
next month's or even next
week's oil price?

The oil market is now being
described as "volatile" and "un-
stable." How can Alaska, with
our overwhelming dependence
on this price, deal with this un-
certainty?

At a recent hearing before
the Senate Special Committee
on Oil and Gas, a proposal for
reducing that risk was discussed.

In an effort to plan our
future revenues, the state now
gazes into its computer crystal
ball and predicts what the price
of oil will be during upcoming
years.

Four times a year the De-
partment of Revenue updates
the "Petroleum Production
Revenue Forecast." They use a
sophisticated computer model
and consider all the current
trends in the world oil market.

But in today's volatile oil
market, planning next year's
budget is like shooting at a mov-
ing target.

Many companies in the oil in-
dustry are using the oil futures
and options market to reduce
the effect of price changes.

Futures contracts allow com-
panies to fix oil prices in
advance of actual sales. Using
option contracts, companies can
in effect buy an insurance policy
against oil price declines.

It may be possible for the
state to use these financial
instruments to manage risk by
minimizing the uncertainty of
future oil prices. But isn't play-
ing the commodities market a
dangerous and risky game?

It is if you're using it to
speculate. It's not so much if
it's used as a hedge.



In a sense, the state's current
budgeting process can be viewed
as speculation on the price of
oil. The state benefits from un-
anticipated increases in the price
of oil and suffers when the price
falls below the forecast price.

A hedging strategy may help
cushion oil price swings. We
may not make as much if prices
rise, but we may protect our oil
revenues when prices fall.

By using oil futures and op-
tions, or through negotiated long
term agreements with oil users,
it may now be possible to lock
in a guaranteed future price for
our oil.

On April 7, the Senate Spe-
cial Committee on Oil and Gas
heard from two New York
energy market experts on how
the state may use oil futures
and options to hedge against oil
price risks. Legislators have ex-
pressed interest in learning more

about this and our committee is
continuing to investigate differ-
ent techniques for managing
future oil revenues.

This is not a new idea, but
may be the time for policy
makers to re-evaluate our overall
goals for royalty oil disposal.

When oil prices were high
and the state budget was bloated
by petrodollars, we were most
concerned with determining the
best use of it.

Today, we should be more
concerned with ensuring that
our oil revenues are protected
and we are receiving the best
possible price for our royalty oil.

Managing our royalty oil
should be like managing personal
finances. What kind of bank
account is best? A checking
account with unlimited check-
writing but no earned interest?
A savings account with a guar-
anteed rate of return? A high
risk mutual fund with potential
for high returns? A combination
of all three?

This kind of planning does
not eliminate the problem of
coping with reduced revenues
due to oil price declines. If
prices don't rebound, state
spending must be cut and new
sources of revenue found. How-
ever, there may be other ways
to soften the effects of volatile
oil prices on our budget plan-
ning process.

Take
stock
in America.

