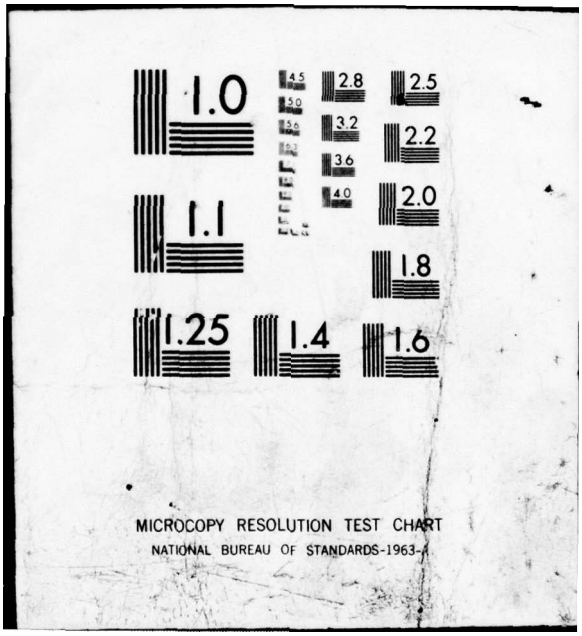
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The Defense Fuel Supply Center procures JP-4 fuel requirements for the Western Pacific market area using fixed price contracts with escalation. Currently, several reference prices are used in DFSC contracts, upon which contract price adjustments are based. The authors analyzed the petroleum market and attempted to determine if there is one "best" reference price or combination of reference prices that could be used in DFSC contracts. The authors concluded that the "best" reference price was a combination of crude oil posted prices.

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AN ANALYSIS OF REFERENCE PRICES FOR WESTPAC JP-4 PROCUREMENT

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

Edward P. Bradshaw, BS
Captain, USAF

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June 1977

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and has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

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CHAPTER I

INTRODUCTION

Statement of the Problem

Bulk petroleum products for United States military installations in the western Pacific area (WESTPAC) are procured by one governmental agency, the Defense Fuel Supply Center (DFSC) (34:1). All contracts negotiated by the DFSC for WESTPAC bulk petroleum requirements are fixed price contracts with escalation, economic price adjustment. All economic price adjustments in DFSC petroleum contracts are based upon changes in a negotiable reference price which is established in the escalation clause of the contract. In an attempt to be fair and reasonable to all petroleum suppliers, the DFSC uses several reference prices in their contract awards (11:20; 30:1-3). The problem is that the use of several reference prices increases overhead costs and may actually be defeating the objective of negotiating contracts at least cost to the government.

Definition of Terms

Barrel (Bbl) - a common unit of measurement of liquids in the petroleum industry; one barrel equals 42 U.S. standard gallons (1:10).

Bulk Petroleum Products - Refined petroleum products consisting of aviation fuels (JP-4, JP-5, JP-8), gasolines, distillates, and residuals delivered as ship cargoes (34:1).

Entitlement - A government subsidy to refiners in the United States, its territories, or possessions who do not own their own crude oil. The subsidy is made to equalize the cost of crude oil for all refiners and to give an equal market advantage to all parties concerned (19).

Feedstock - Crude oil or fraction thereof to be charged to any process equipment in a refinery (1:45).

Market Price - A price established in the usual and ordinary course of trade between the sellers who own the item and buyers who are free to bargain (33:E-8).

Participation - The gradual transfer of ownership of oil from oil companies to the governments of countries belonging to the Organization of Petroleum Exporting Countries (18:167-173).

WESTPAC - The DFSC WESTPAC area is comprised of U.S. Military installations in the following geographic locations (32:12-16)

(1) Japan
(2) Taiwan
(3) Okinawa
(4) Korea
(5) Guam
(6) Philippines
(7) Diego Garcia
(8) Kwajalein

Background

Multiple contract awards. The Defense Fuel Supply Center, Alexandria, Virginia, is a major field element of the Defense Supply Agency (2:60). As a supply center, the DFSC is responsible for the procurement of refined bulk petroleum for United States military installations overseas (34:1). The military installations are grouped by geographical areas,

among which is WESTPAC (35:Enclosure 1). The bulk petroleum requirements for WESTPAC include JP-4, JP-5, diesel fuel marine (DFM), automotive gasoline (MOGAS), kerosene, and Navy Special Fuel Oil (NSFO) (34:1). The petroleum requirements for WESTPAC are procured through one solicitation providing for requirement coverage on a calendar year basis (i.e. 1 January through 31 December) (33:1). However, the yearly petroleum requirements are so large[1] and the military destinations are so far apart that a single contractor cannot provide adequate requirement coverage at least cost to the government (19). Hence, multiple contract awards are necessitated.

Fixed price contracts with escalation. All contracts awarded by the DFSC for bulk petroleum procurement are fixed price contracts with escalation, economic price adjustment (14). The purpose of the escalation clause is to adjust for changes in the contractor's cost schedule that lie outside his control and/or which cannot be accurately predicted to allow assurance of contract fulfillment at a fair and reasonable return to the contracting parties (24:23).

Developments of the 1970's have driven the petroleum industry to require that an escalation clause be included in contract awards as a means of protecting itself from the adverse effects of inflation, government actions (i.e.,

taxes imposed by the producing country on crude oil production), recessions, embargoes, currency fluctuations, etc.(8).

The dynamic environment mentioned above was explained by Rear Admiral William M. Oller, Commander, Defense Fuel Supply Center, at a Congressional hearing before the Special Subcommittee on Department of Defense Energy Resources and Requirements on February 6, 1974:

> . . . This past year we have had to change our contracting clauses regarding escalation. Through the years, prices of crude [oil] remained fairly stable, and of course, very low. Within the last several years, though, they started to escalate, so as a result when the contracts were renewed they were modified to provide for escalation or de-escalation, which has yet had to happen in the cost of this fuel. So when we contract the fuel, we pay a price which we agreed upon, plus any escalation which has occurred between the time of our contract and the time of the delivery of the fuel.
>
> This was necessary, we found because of the world markets and the competition for fuel. None of the refineries would agree to contract with us with the prospect of losing money in their contract as a result of escalating prices during the period . . . [29:68].

The conditions for awarding fixed price contracts with escalation, economic price adjustment, are explicitly set forth in the Armed Services Procurement Regulation (ASPR).

> . . . The fixed price contract with economic price adjustment may be used under the applicable conditions set forth in this paragraph when the contracting officer determines that price adjustment provisions are necessary either to protect the contractor and the Government against significant economic fluctuations in . . . material costs or to provide for contract price adjustments in the event of changes in the contractor's established prices. The economic price adjustment provisions are designed to provide for the upward and downward revision of the stated contract

> price upon the occurrence of certain contingencies which are specifically defined in the contract . . .
>
> Use of this type of contract is appropriate when serious doubt exists as to the stability of market . . . conditions which will exist during an extended period of contract performance . . . [36:3:30].

Escalation clauses. In fixed price contracts with escalation, the reference price is established, through negotiation, in the escalation clause. Changes in the value of the reference price provide the basis for price adjustments in the contract prices (32:E8-E10,E11-E12.2). In WESTPAC petroleum contracts, prices payable to the contractor are usually increased or decreased by the same number of cents, or fractions thereof, that the applicable reference price increases or decreases (19).

There are two basic DFSC escalation clauses used in all WESTPAC contracts: the Clause E19 Economic Price Adjustment (DFSC August, 1973) and the Clause E19.03 Economic Price Adjustment (DFSC February, 1976) (14).[2]

Clause E19.03 is mandatory for those contractors receiving entitlements under the Federal Energy Administration (FEA) entitlements program. Since the reference price used in Clause E19.03 is restricted to the contractor's actual acquisition cost of crude oil or other bona fide feedstock and, as such, is priviledged information, this reference price cannot be included in this research (3; 20).

Clause E19 is applicable for those contractors not receiving FEA entitlements. In all instances, the reference

price established in the clause is a market price, specifically a posted price[3] (20) (See Figure 1). Clause E19, in its entirety, follows:

E19 ECONOMIC PRICE ADJUSTMENT (DFSC 1976 JUN)

The Contractor represents that the unit prices set forth in this contract do not include any contingency allowance to cover the possibility of increases in the reference price(s) in the Contractor's bid or proposal.

PART A

As used throughout this provision:

(a) The term "listed items" means the items of Section E of the Schedule that are listed in the Reference Price Tabulation of Part C of this provision and are the only items to which price adjustment shall apply, unless otherwise provided in the contract schedule.

(b) The term "base price" means the unit price set forth opposite the item in Section E of the Schedule.

(c) The term "reference price" means the independent index or established price set forth in this provision with which the base price is to fluctuate. The reference price should be a price for the same or similar product(s) as the item being purchased.

(d) The term "independent index" means an index measuring the general rate and direction of price movements for a commodity within a market which is beyond the control of the Contractor. Examples of such indices would include a wholesale price index such as published by The Bureau of Labor Statistics.

(e) The term "established price" means one which (i) is an established catalog or market price for a commercial item sold in substantial quantities to the general public, and (ii) meets the criteria of paragraph 3-807.1(b)(2) of the Armed Services Procurement Regulation. It is established in the usual and ordinary course of trade between the seller (which maintains it) and buyers who are free to bargain. It is a price included in a catalog, price list, schedule or other form that is regularly maintained by the manufacturer or vendor, is either published or otherwise available for inspection by customers, and states prices at which sales are currently, or were last, made to a significant number of buyers constituting the general public. A commercial item is one which is regularly used for other than Government purposes and is sold or traded in the course of conducting normal business operations. Commercial items are sold to the

general public when all of the following criteria are met:
(i) Sales to the general public are not negligible in themselves and total 55% or more of all sales made;
(ii) 75% or more of those sales made to the general public are made at the established price. An item is sold to the general public if it is sold to other than affiliates of the seller for end use by other than the Government. Items sold to affiliates of the seller and sales for end use by the Government are not sales to the general public.

(f) The term "date of delivery" means

(i) the date and time vessel begins to load where contract calls for delivery at origin into tanker or barge;

(ii) The date and time vessel begins to discharge where contract calls for delivery at destination by tanker or barge;

(iii) the date and time product commences to move past the specified f.o.b. point where contract calls for delivery into storage by pipeline;

(iv) the date product is received for all methods of delivery other than (i), (ii), and (iii) above.

PART B

(a) The Contractor shall notify the Contracting Officer, Defense Fuel Supply Center, Cameron Station, Alexandria, Va., 22314 of any change in the reference price by telegram dated (preferably confirmed promptly by letter), registered letter mailed, or unregistered letter received within fourteen (14) days from the date thereof.

(i) In the event the Contractor fails to notify the Contracting Officer of any increase in reference price, such increase shall apply only to deliveries made on and after the date of receipt by the Contracting Officer of a written notification from the Contractor of such increases.

(ii) In the event the Contractor fails to give notice of a decrease in the reference price, such decrease shall apply to all deliveries made on or subsequent to the date of such decrease.

(iii) An increase or decrease in any reference price published in a trade price service or in a commercial journal shall apply only to deliveries made on and after the publication date of such trade price service or commercial journal.

(iv) The Contracting Officer will issue a modification to this contract to reflect any change pursuant to this provision. However; no modification incorporating an increase in a contract unit price shall

be executed pursuant to this provision until the increase in the applicable established price has been verified by the Contracting Officer.

(b) Notwithstanding any provision of this clause to the contrary, the prices payable under this contract shall in no event exceed either.

(i) The lower of Contractor's posted or established selling price in effect on the date of delivery for the product supplied in the form of delivery made at the point of delivery, or

(ii) The maximum prices shown in Column VII of the Reference Price Tabulation.

(c) The Contractor warrants that the prices to be invoiced hereunder for listed items shall be computed in accordance with these escalation provisions.

(d) In the event the reference price is an average of published or posted prices, and any one price ceases to be posted or published, the remaining prices shall be used to determine the average. In the event the reference price is published in a trade price service or commercial journal and such publication shall cease to publish said reference price or changes its methods of quoting prices, this contract shall be amended effective on the date such publication ceases to publish or changes its method of quoting to (i) provide for a substitute reference price comparable to the one which the publication has ceased to publish or has changed its method of quoting, or (ii) conform to the new method of price quotations.

PART C

(a) The prices payable under this contract for listed items shall be the base price for the listed item increased or decreased by the amount, determined according to the formula in paragraph (b) below, that the reference price for the listed item shall have increased or decreased to and including the date of delivery.

(b) The amount of increase or decrease in the base price shall be

(Check appropriate box and complete applicable blanks)

[ ] the same number of cents, or fractions thereof, that the reference price increases or decreases per like unit of measure.

[ ] the number of cents, or fractions thereof, determined by the ratio of $..... per gallon for each $..... per barrel that the reference price increases or decreases.

[ ] the number of cents, or fractions thereof, at the rate of $..... per gallon for each

full $..... per barrel that the reference price increases or decreases.

(c) The reference price with which the base price for the listed item is to fluctuate (and which is more fully defined in the tabulation to follow) is:

[ ] (1) the low price published in

.....
(name of publication)

[ ] (2) the average of the prices

published in .....
name of publication)

[ ] (3) the established price posted by

..... and published in
(name of company)

.....
(name of publication)

Posted prices. A posted price is an established market price listed in a published price list, such as Platt's Oilgram (33:E-8). Posted prices fall into one of two categories: (1) posted prices for refined products or (2) posted prices for crude oil. Examples of posted prices are as follows:

(1) Platt's posted price for Bahrain turbine fuel

(2) Platt's posted price for Saudi Arabian Light crude oil

Posted prices for refined products are established by oil companies (sellers) and published by a pricing service (i.e. Platt's Oilgram Price Service) whose price reporters contact the sellers in applicable geographical areas, on a daily basis, and in effect ask the following questions:

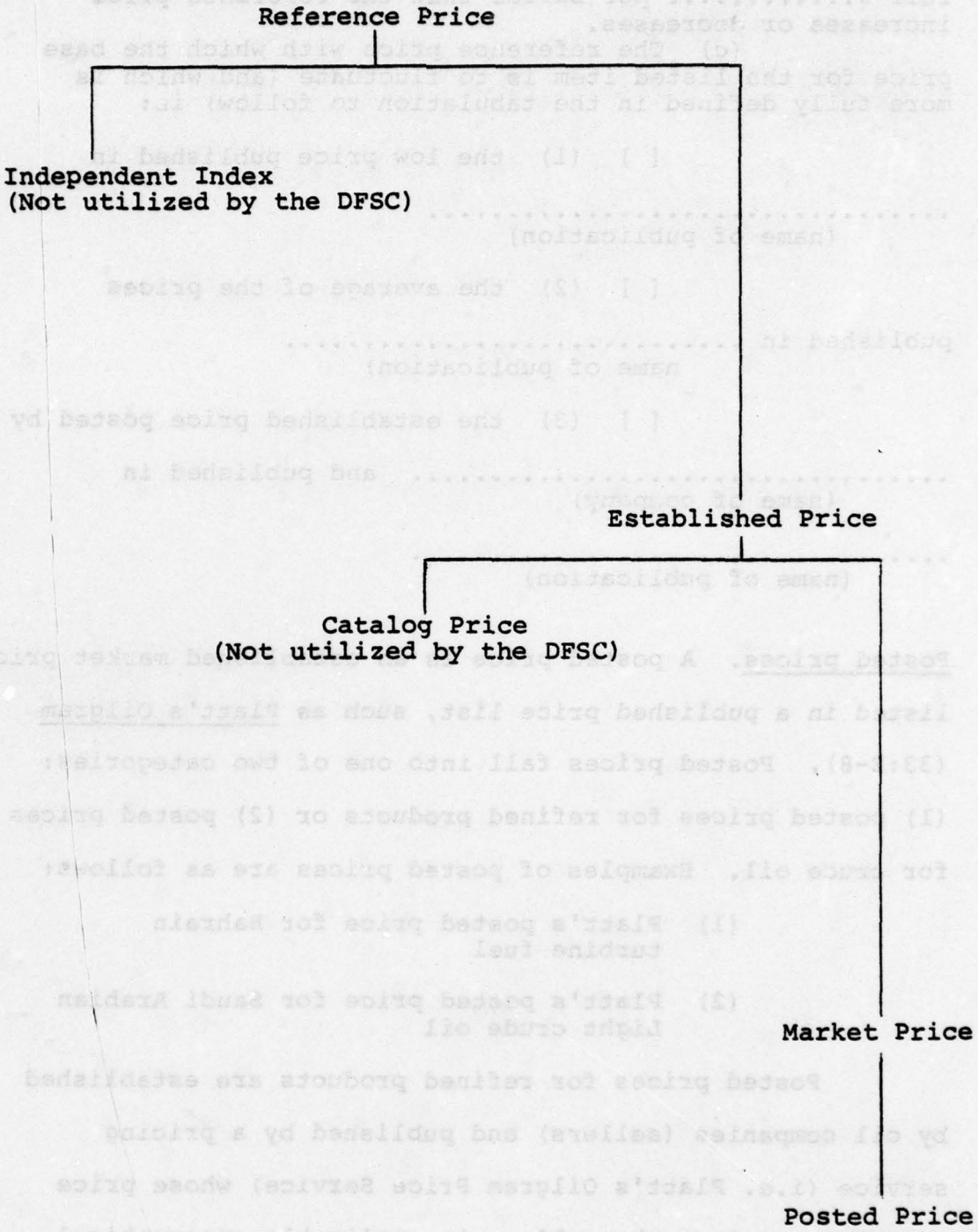


Figure 1. Relationship between Reference and Posted Prices

(1) What are your prices today?

(2) Have you made any sales or offerings?

(3) Do you know of any sales or offerings that have been made at any prices; and, if so, what are they?

Buyers are also contacted to verify the prices obtained from the sellers (6:142).

Posted prices for crude oil are also established by sellers. However, in the case of crude oil originating from countries belonging to the Organization of Petroleum Exporting Countries (OPEC), the posted prices are tax reference figures only and are set by the government of the applicable exporting country (20). For example, the posted price/tax reference figure for Saudi Arabian Light crude oil on 31 December 1976 was $12.376 per barrel. The actual cost of the crude oil to applicable companies was based on royalty payments and income taxes determined as follows (23:33):

(1)	Posted price	$12.376
(2)	Production cost (expense)	.30
(3)	Royalty payment (expense) [20% x (1)]	2.475
(4)	Income tax on profits [85% x (1-2-3)]	8.161
(5)	Cost of barrel of crude oil (3) + (4)	$10.636

A reference price for a JP-4 contract may be composed of (1) one refined product posted price or (2) an

average or weighted average of two or more refined product posted prices or (3) one crude oil posted price or (4) an average or weighted average of two or more crude oil posted prices.[4]

Scope

Only one petroleum product, JP-4, was studied in this research because of time constraints placed upon thesis completion. JP-4 was chosen because its procurement requirement of 341,600,000 gallons for calendar year 1977 represents approximately 30 per cent of the total WESTPAC bulk petroleum requirements (32:1).

Posted prices, applicable to JP-4 procurement, from 1 January 1974 through 31 December 1976 were analyzed. The preceding time period was chosen because the posted price of crude oil rose from approximately $3.00 per barrel in October 1973 to $11.65 per barrel in December 1973 (12:71). The impact of the $8.65 increase of crude oil on the posted prices of petroleum products and on the reference price environment can be summarized in the following statement:

> . . . The series of sharp increases in the price of oil that began in October 1973 subjected the world economy to a severe shock that proved difficult to manage not only because of its suddenness and size but also because it was imperfectly understood. Its repercussions continue to affect the world economy as adjustment policies--both domestic and international--continue to be debated . . . [13:vii].

Statement of Purpose

The purpose of this research was to determine if there is a single "best" reference price or combination of reference prices to use in the escalation clause of contracts for JP-4 bulk petroleum procurement in WESTPAC.

Justification

The problem of what reference price the DFSC should base their escalation upon was originally suggested by Mr. Dan Calhoun, Contracting Officer for the DFSC (5). More recently, the DFSC has initiated an investigation to determine if a "best" reference price can be established for their contracts with escalation on a worldwide basis (20).

Changes in WESTPAC reference prices cause invocation of the escalation clause approximately eighteen times in a calendar year. Total dollar figures resulting from past escalation of contract prices are not available. However, if the reference prices for the 1977 JP-4 contracts were to average only a half cent increase over the coming calendar year, a total cost increase of $1,708,000 could be expected.[5]

Contractor requests for escalation are only randomly investigated and 90% of the time approved without questioning because the DFSC does not have the staff to investigate each escalation request (20). Hence, the DFSC wants to ensure that escalation clauses are based upon a sound reference price.

Additionally, reduction in the number of reference prices should result in a substantial decrease in overhead costs due to a decrease in the number of contract modifications and a decrease in the number of manhours spent on contract administration.

Literature Review

A thorough literature review revealed that little research has been conducted in the area of reference pricing in the petroleum industry. However, material consisting of both books and periodical articles was found in the following related areas of research:

a. Crude oil pricing in the petroleum industry
b. Posted pricing in the petroleum industry
c. The Organization of Petroleum Exporting Countries (OPEC) and their pricing policies
d. The use of price index numbers in Department of Defense contracting
e. Economic discussion of the measurement of price changes
f. The relationship of oil companies and foreign governments who produce crude oil.

Formal searches were made through the Defense Documentation Center (DDC), Cameron Station, Alexandria, Virginia, and the Defense Logistics Studies Information Exchange (DLSIE), Fort Lee, Virginia. The searches did not

provide any applicable information on reference pricing or pricing, in general, in the petroleum industry. A search using the National Technological Information Service (NTIS) did not provide any information with a direct bearing on the research problem. NTIS Volumes 1-26 for 1975 and Volumes 1-21 for 1976 were searched in the subject fields of Behavioral and Social Sciences (Subgroup 5c-Economics) and Propulsion and Fuels (Subgroup 21D-Fuels).

Research Question

Is there a single "best" reference price or combination of reference prices for use in the escalation clause of DFSC contracts for JP-4 procurement in WESTPAC?

Research Subquestions

1. What are the properties of a reference price for JP-4 that are fair and reasonable to both the contractor and the DFSC?

2. What posted prices may be used as reference prices for JP-4 bulk procurement in WESTPAC?

3. Have individual posted prices which may be used as JP-4 reference prices differed in their trend behavior for the years 1974, 1975, and 1976?

4. Can posted prices which may be used as JP-4 reference prices be accurately forecasted?

CHAPTER II

METHODOLOGY

In this chapter each subquestion is analyzed individually. The subquestion is identified, and the relationship of the subquestion to the research question is explained. Kinds and sources of data pertaining to each subquestion are identified; and, finally, an explanation of how the data are treated to answer the subquestion follows.

Definition of Terms

1. Forecast Horizon: The number of time periods for which a forecast is to be projected.
2. Lead Time: The number of time periods for which the forecast is to be calculated and the forecast parameters optimized.
3. TCAST: A FORTRAN program designed for time series analysis and forecasting.
4. Time Series: The discrete sequence of quantitative data assigned to specific moments in time.
5. Trend: Long term underlying growth movement of a time series.

Subquestion I

What are the properties of a reference price for JP-4 that are fair and reasonable to both the contractor and the DFSC?

Relationship of the subquestion to the research question. The answer to the subquestion identified the prerequisites/ criteria of a "best" reference price.

Kinds of information. Descriptive, evaluative, and judgemental information related to characteristics that make one reference price better than another.

Sources of information.

1. Lt. Col. A. Moncivaiz, USAF, DFSC-PP
2. The Defense Fuel Procurement Clause Book
3. Campbell, H.G. Aerospace Price Indexes
4. Smith, Larry L., Lt. Col., USAF. The Use of Price Index Numbers in Defense Contract Pricing
5. The Armed Services Procurement Regulation
6. Mr. Stuart Clarkson, Superintendent for Marketing, Bahrain Petroleum Company

Treatment of the information. The information was subjectively examined for bias and contradiction. Statements from sources in the form of judgements, criticisms, and evaluations were subjectively analyzed. After the subjective analysis, a synthesis of the validated information was performed to establish a property profile of a "best" reference price.

Subquestion II

What posted prices may be used as reference prices for JP-4 bulk procurement in WESTPAC?

Relationship of the subquestion to the research question. The answer to the subquestion identified the population of posted prices from which a "best" reference price or combination of reference prices was selected.

Kinds of data. Posted prices published in Platt's Oilgram from January, 1974, through December, 1976.

Sources of data.

1. Lt. Col. A. Moncivaiz, USAF, DFSC-PP, Defense Fuel Supply Center, Cameron Station, Alexandria, Virginia
2. Platt's Oil Price Handbook and Oilmanac New York: McGraw-Hill
3. Platt's Oilgram

Treatment of the data. The posted prices were compared and analyzed by the properties established in Subquestion I.

Subquestion III

Have individual posted prices which may be used as JP-4 reference prices differed in their trend behavior for the years 1974, 1975, and 1976?

Relationship of the subquestion to the research question. The answer to the subquestion established which posted prices should have had the least amount of impact on contract cost increases had they been used as reference prices in the years 1974, 1975, and 1976. A posted price that made fewer

and smaller changes during a year was more stable and should have had less impact on contract cost adjustments.

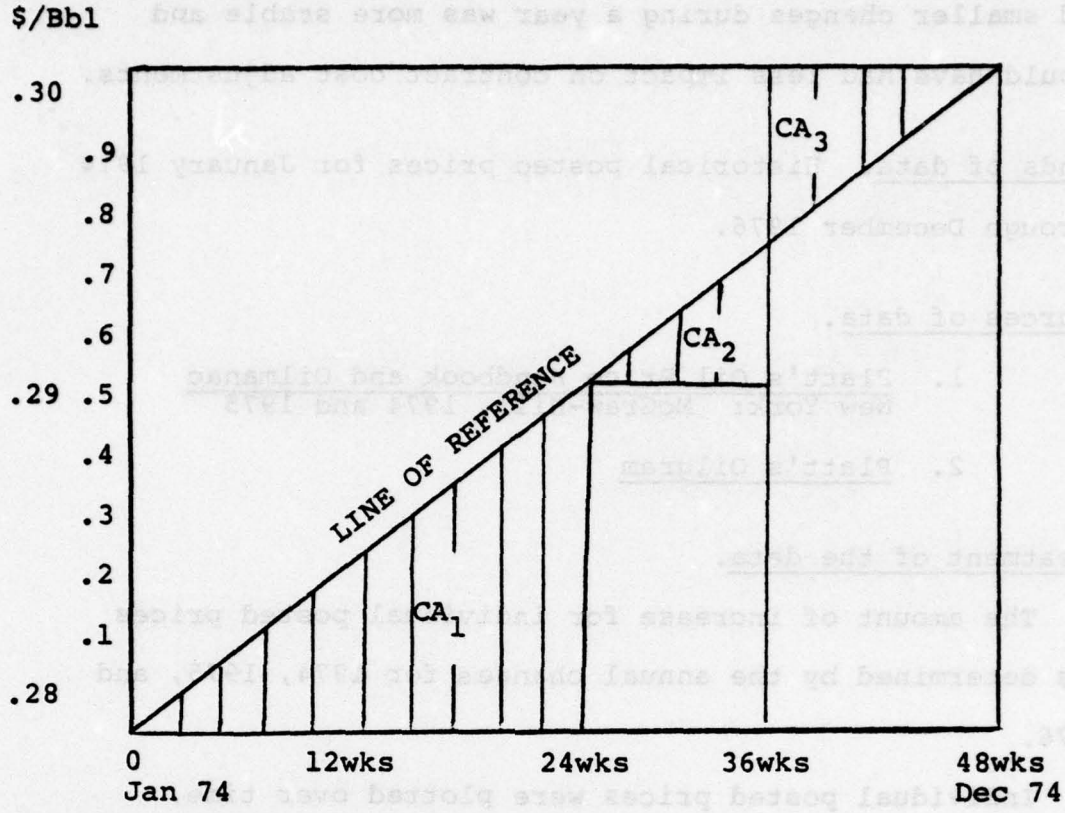
Kinds of data. Historical posted prices for January 1974 through December 1976.

Sources of data.

1. Platt's Oil Price Handbook and Oilmanac New York: McGraw-Hill, 1974 and 1975
2. Platt's Oilgram

Treatment of the data.

1. The amount of increase for individual posted prices was determined by the annual changes for 1974, 1975, and 1976.
2. Individual posted prices were plotted over time, January 1974 through December 1976, to visually observe trend behavior. A subjective judgement was made from the resultant graphs to determine which posted prices were more stable.
3. An adaptation of the Lorenz curve was used to determine the comparative degree of uniformity of posted price trends over time (3:43-50). In the analysis, three plots (box diagrams) were required for each posted price, one plot for 1974, one plot for 1975, and one plot for 1976 (see Figure 2). The horizontal axis, January through December, was partitioned into 48 weeks. The vertical axis, initial posted price through closing posted price in dollar value,



Sample plotted posted price changes:

(1) .28 increase to .29 at week 24
(2) .29 increase to .30 at week 36

Sample Calculations:

(1) $CA_1 = (.5)(24)(.5) = 6$

$CA_2 = (.25)(12)(.5) = 1.5$

$CA_3 = (.25)(12)(.5) = 1.5$

(2) $CA_1^2/w_1 = 36/24 = 1.5$

$CA_2^2/w_2 = 2.25/12 = .1875$

$CA_3^2/w_3 = 2.25/12 = .1875$

(3) Total Deviation $= \sum_{i=1}^{3} CA_i^2/w_i$

Total Deviation $= 1.5 + .1875 + .1875 = 1.875$

Figure 2. Trend Analysis of Posted Prices

was partitioned into tenths. A line of reference was drawn from the origin to the upper right hand corner of the graph. This line of reference indicated a uniform trend of posted prices. Changes during the applicable year in the posted price were plotted and connected to form a bar graph. A total deviation of posted price behavior from the line of reference was then computed as follows:

(1) Calculate the concentration areas ($CA_{i's}$) above and/or below the line of reference.

$$CA_i = \text{tenths} \times \text{width in weeks} \times .5$$

(2) Square the $CA_{i's}$ and divide by the applicable widths.

$$CA_i^2/w_i$$

(3) Sum the $CA_{i's}^2/w_{i's}$

$$\text{Total Deviation} = \sum_{i=1}^{n} CA_i^2/w_i$$

A bar graph with a large total deviation indicated a large variance from a uniform trend; in other words, posted prices showed erratic price changes during the year instead of a relatively smooth trend of increasing or decreasing prices.

4. Comparisons were made of total deviations of posted prices to determine which posted prices exhibited more normalized uniformity.

Subquestion IV

Can posted prices which may be used as JP-4 reference prices be accurately forecasted?

Relationship of the subquestion to the research question. The ability to accurately forecast reference price behavior over time provided insight into which reference price will have the least overall impact on future contract costs.

Kinds of data. Historical posted prices for January 1974 through December 1976.

Sources of data.

1. Platt's Oil Price Handbook and Oilmanac.
2. Platt's Oilgram

Treatment of the data.

1. Individual daily posted prices for January 1974 through December 1976 were averaged to a weekly price; four weeks to a month and forty-eight weeks to a year.
2. Individual posted prices were forecast for 1976, on a weekly basis, from historical data for January, 1974, through December, 1975. The forecasting was performed using the FORTRAN program TCAST.[6] In the TCAST analysis the weekly data were subjected to (1) single smoothing, (2) double smoothing, and (3) triple smoothing. Smoothing constants, alphas, were not allowed to exceed .8; otherwise the basis for the forecast became too heavily biased

by the most recent data (17). Lead times of 4, 6, 8, 12 and 24 weeks were utilized.

Since the DFSC is interested in the value of a reference price throughout the life of a contract, the 1976 forecasts were evaluated on a weekly basis from January, 1976 through December, 1976. The evaluation was performed by comparing the forecasts, obtained using the alpha constant and lead time resulting in the smallest respective mean absolute deviation (MAD), to actual posted price averages for weeks one through forty-eight for 1976.

In the comparison an 80% confidence interval (C.I.) was established around the forecasted posted prices as follows (16; 17; 4:286):

$$80\%\ \text{C.I.} = \text{Forecasted price} \pm (1.607)(\text{MAD})$$

An 80% confidence level was chosen in order to keep the interval small because of the significant impact even small changes in the reference price have on the total dollar costs of the contract.

Additionally, the above confidence interval was based on the following assumptions:

(a) The mean absolute deviation is proportional to the standard deviation of any distribution (4:275).

(b) Forecast errors follow an approximately normal distribution (4:275).

(c) The allowance for forecast error (y) may be expressed as a multiple of the mean absolute deviation (4:286):

$$y = K(MAD)$$

(d) The chance that the observation will differ from the forecast by an amount y is the same as the chance that the forecast error will be larger than K x MAD (4:286).

3. Hypothesis for Criterion Test for Forecasting:

H_0: Forecasted posted prices for 1976 ≠ actual posted prices for 1976.

H_1: Forecasted posted prices for 1976 = actual posted prices for 1976.

Decision Rule: Since an 80% confidence interval was established, a maximum of 9 (20%) of the 48 weekly forecasts for 1976 were allowed to fall outside the confidence interval in order to reject H_0: Forecasted posted prices ≠ actual posted prices for 1976 (17).

Determination of "Best" Reference Price

The "best" reference price or combination of reference prices was chosen from the population of posted prices identified in Subquestion II which also had the properties identified in Subquestion I. The above population was ranked according to stability and uniform trend behavior, determined from Subquestion III, and forecastability, determined from Subquestion IV. A subjective

determination was then made from the rankings of stability, uniform trend behavior, and forecastability to determine a "best" reference price or combination of reference prices to use in JP-4 bulk procurement.

Assumptions

1. The DFSC Determination and Findings that fixed price contracts with escalation are required for WESTPAC bulk petroleum procurement is valid.

2. If there is a "best" reference price(s), the reference price(s) exists in the population of posted prices and is published in Platt's Oilgram.

Limitations

1. TCAST can only handle up to 310 raw data point inputs (15:42).

CHAPTER III

ANALYSIS

Subquestion I

What are the properties of a reference price for JP-4 that are fair and reasonable to both the contractor and the DFSC?

The DFSC considers the following properties as essential when negotiating for reference prices for JP-4 contracts (20):

(1) The price is for a commercial item

(2) The price is not controlled by the potential supplier

(3) The price is an international market price (preferably a price leader)

(4) A relationship should exist between the contractor and the reference price

(5) Risk

Commercial Item

A commercial item, as previously defined in the Economic Price Adjustment Clause E19, is an item which is regularly used for non-government purposes and is sold to the general public (33:E-8). "Items sold to affiliates of the seller and sales for end use by the government are not sales to the general public . . . [33:E-8]." An example of a commercial item is kerosene. Therefore, commercial

items, representing sales to the general public, reflect established market prices for the petroleum industry.

Price Control

The following companies are bidders/suppliers in the WESTPAC market area (11:20):

(1) Caltex Oil Products Company

(2) Korea Oil Corporation

(3) Shell Curacao

(4) Chinese Petroleum Corporation

(5) Honam Oil Refining Company

(6) Kymus Sekiyu

(7) Hess Oil Refining

(8) Kyung In Energy

(9) Shell Eastern Petroleum

As suppliers, these companies are capable of controlling market prices for their refined petroleum products and, therefore, would be able to control reference prices. The DFSC should ensure that the potential supplier is unable to control the reference price which is utilized as a base for contract price adjustments.

International Market Price

An international market price reflects the current value of petroleum products and is a more accurate indicator of the pricing environment than a domestic market price. The DFSC not only wants to ensure that the reference

price it uses in contracts is an accurate indicator of the pricing environment but also a price leader in the petroleum industry. In the petroleum industry, price leadership refers only to posted prices; and it exists only at the crude oil level and in the sale of products through bulk plant and retailer to the ultimate consumer (6:99). According to Joel Dean, Managerial Economics, the requisites of a price leader are:

> (1) a substantial share of the market. Typically, although not necessarily, the largest firm becomes the leader, because this firm is presumed to have the greatest stake in the industry welfare; to be able to enforce followership; and to be the best informed about industry demand and supply conditions, and hence best equipped to determine price policy.
> (2) a reputation for sound pricing decisions, based on better information and more experienced judgement than other firms have.
> (3) initiative . . . [9:434].

Contractor and Reference Price Relationship

A relationship should exist between the contractor and the reference price. The purpose of the relationship is to ensure that any changes that occur in the reference price during the term of the contract have a direct financial impact upon the contractor and his ability to fulfill contract requirements.

Risk

The fifth property of a reference price for DFSC contracts is the amount of financial risk shared between

the DFSC and the contractor. Ideally, the DFSC, to be fair and reasonable, should share the same amount of risk with each contractor for WESTPAC JP-4 contracts. Current DFSC contracting procedures, however, allow the use of crude oil or refined product posted prices as reference prices. These procedures create an environment where the level of financial risk is not always shared the same by the DFSC and the various contractors (27).

Crude oil posted prices. The use of crude oil posted prices as reference prices protects the contractor against the "unusual" risk of absorbing cost increases in raw materials (i.e. crude oil), a contingency beyond the control of the contractor (2:128). The use of crude oil prices as reference prices is consistent with Rear Admiral Oller's statement, made before the Special Subcommittee on Department of Defense Energy Resources and Requirements, that the DFSC initially went to fixed price contracts with escalation because of escalating crude oil prices (29:68).

Refined product posted prices. Utilization of refined product posted prices protects the contractor not only against the unusual risk of crude oil price increases but also against the normal business risk of day-to-day price fluctuations of refined products.

The reason that contractors want to use refined product posted prices as reference prices is based upon

the "balanced barrel" concept. The "balanced barrel" concept, itself, is based upon the fact that a barrel of crude oil always yields various types of refined products, anyone of which can only be maximized to a finite degree. Hence, while production of a refined product in high demand can be maximized, a market must still be found for the rest of the refined products from the barrel of crude oil. Therefore, the supplier must sell low demand refined products at a loss to deplete inventories, while high demand products are sold at a profit sufficient to offset the losses (8). Historically, gasolines and refined petroleum products for aviation have been ideal targets for profit maximization because, unlike distillates and residual fuels, there are no alternatives/substitutes and demand is quite inelastic (28: 192). Using refined product posted prices, therefore, requires the DFSC to assume a larger share of the financial risk associated with the contractor's operations.

Subquestion II

What posted prices may be used as reference prices for JP-4 bulk procurement in WESTPAC?

Crude Oil Posted Prices

The companies bidding on/supplying JP-4 requirements for WESTPAC obtain their crude oil, which is a commercial item, from Saudi Arabia, Kuwait, and, to a lesser degree, Nigeria. Therefore, the posted prices (also international

market prices) for crude oil from these three OPEC countries may be used as reference prices for WESTPAC JP-4 contracts (20).

Crude oil control/leadership. The posted prices for crude oil from Saudi Arabia, Kuwait, and Nigeria are all government controlled prices and, as such, are beyond the control of any potential supplier of JP-4 for WESTPAC requirements (20; 37). Amongst the above three prices, Saudi Arabian Light crude oil (34 API) has, historically, been used as a pricing standard for all crude oil pricing by the OPEC countries. Adjustments in the prices of other crude oils were based upon differences in density (API), sulfur content, and transportation considerations (21:39). Saudi Arabian Light crude oil maintained its position as the "marker" or price leader for OPEC crude oil until 17 December 1976. On 17 December 1976 OPEC experienced its first split in pricing policies. Under a compromise agreement, eleven members of OPEC increased their crude oil prices by 10%, effective 1 January 1977; this 10% price increase was to be followed by a 5% increase on 1 July 1977. The remaining two members of OPEC, Saudi Arabia and the United Arab Emirates, refused to increase their crude oil prices more than 5% for the entire year of 1977 (27:8). Hence, a "two-tier" pricing system was created.

The current "two-tier" pricing system is now threatened to be replaced by a "three-tier" pricing system

on 1 July 1977. Under the "three-tier" pricing system, Arabian Gulf producers who increased crude oil prices by 10% on 1 January 1977 will not initiate the scheduled 5% increase that was proposed for 1 July 1977. However, Algeria, Libya, and Nigeria, the constituents of the new third tier, will most likely initiate the 5% increase in crude oil posted prices (26:1). The creation of a "three-tier" pricing system will place each of the three crude oil postings applicable to WESTPAC contracts in a different pricing tier; Saudi Arabia will be in the first tier, Kuwait in the second tier, and Nigeria in the third tier. As a result of the tier pricing system, a clear delineation of price leadership no longer exists for OPEC crude oil.

Refined Product Posted Prices

Specific posted prices for JP-4 do not exist in the petroleum industry. Further, if JP-4 postings did exist, the postings could not be used as reference prices because JP-4 is used exclusively by the military and, as such, is not a commercial item. Therefore, an alternate method has been devised for calculating a posted price value for JP-4. The method is based upon the fact that JP-4 is basically a blend of two refined oils, naptha and kerosene; both naptha and kerosene are commercial items. Since the

blend is approximately 70% naptha and 30% kerosene, the posted price value for JP-4 is determined by the following formula (20; 30):

JP-4 Posted Price = 0.3 (kerosene posted price)
+ 0.7 (naptha posted price) + 0.0033

The value of 0.0033 represents the additional cost of fuel system icing inhibitor (FSII) which is an additive in JP-4. The JP-4 posted price values applicable to WESTPAC can be derived from Platt's Oilgram postings for naptha and kerosene from either the Middle East area or the Far East. These postings are all international market prices.

Refined product control/leadership. All refined product postings are oil company controlled. In the Far East, oil company postings for naptha and kerosene include Shell Eastern, SPC Singapore, and Esso Singapore. Middle East oil company postings include Caltex Bahrain/Ras Tanura, Exxon Ras Tanura, and Mobil Ras Tanura. Amongst the above refined product postings for naptha and kerosene, the price leader for the Middle East is Caltex and the price leader for the Far East is Shell Eastern (20). Since Caltex is a supplier of WESTPAC JP-4 requirements, the Caltex postings should not be used as reference prices in JP-4 contracts between the DFSC and Caltex. However, the Caltex postings could be used as a reference price for WESTPAC JP-4 contracts between the DFSC and

other bidders/suppliers. The previous statement holds true for Shell Eastern and Shell Eastern postings in the Far East.

Additionally, with the 100% take-over of the Arabian American Oil Company (ARAMCO) in Saudi Arabia by the Saudi Arabian government scheduled for 1977, the Middle East postings for Ras Tanura will be obsolete and will be replaced by "Saudi ARAMCO" posted prices. The "Saudi ARAMCO" postings will be price leaders and also have the added advantage of not being controlled by any oil company currently bidding on WESTPAC JP-4 contracts (10).

Useable Posted Prices

In summary there are several posted prices that could be used as reference prices in WESTPAC JP-4 contracts. These posted prices include postings for:

(1) Saudi Arabian crude oil
(2) Kuwait crude oil
(3) Nigerian crude oil
(4) Caltex JP-4, calculated from posted prices for Caltex naptha and kerosene
(5) Shell Eastern JP-4, calculated from posted prices for Shell Eastern kerosene and naptha

Subquestion III

Have individual posted prices which may be used as JP-4 reference prices differed in their trend behavior for the years 1974, 1975, and 1976?

Crude Oil Posted Prices

Data from Table 1 and the visual picture from Graph 1 indicated that the posted prices for Saudi Arabian Light crude oil were more stable than the posted prices for Kuwait crude and Nigerian crude oils. Overall, in 1974, 1975, and 1976 there were fewer and smaller price changes for Saudi Arabian Light crude than the other two crude oils.

Although it appeared that Saudi Arabian Light crude oil posted prices were more stable, Table 2 indicated that Nigerian crude oil made relatively more uniform price changes in 1974 and 1976 than Saudi Arabian crude made.

Rankings

The ranking for crude oil stability is:

(1) Saudi Arabian Light crude oil

(2) Kuwait crude oil

(3) Nigerian crude oil

The ranking for uniform trend behavior is:

(1) Nigerian crude oil

Table 1

Crude Oil Posted Price Changes*

(Dollars/Bbl.)

Saudi Arabian Light Crude Oil (Reference Graph 1)

API Gravity 34.0 - 34.09

1974

1974 changes in government set tax reference figures:

January 1	11.651
November 1	11.251

1975

1975 changes in government set tax reference figures:

October 1	12.376

1976

No change

Kuwait Crude Oil (Reference Graph 1)

API Gravity 31.0 - 31.09

1974

The government posted prices figure (tax reference) of $11.545 per barrel remained in effect all year.

1975

1975 changes in government set tax reference figures:

January 1	11.145
October 1	12.26

1976

1976 changes in government set tax reference figure:

June 1	12.151

Table 1 (Continued)

Nigerian Crude Oil (Reference Graph 1)

API Gravity 34.0 - 34.09

1974

The government posted price figure (tax reference) of $14.691 per barrel remained in effect all year.

1975

1975 changes in government set tax reference prices:

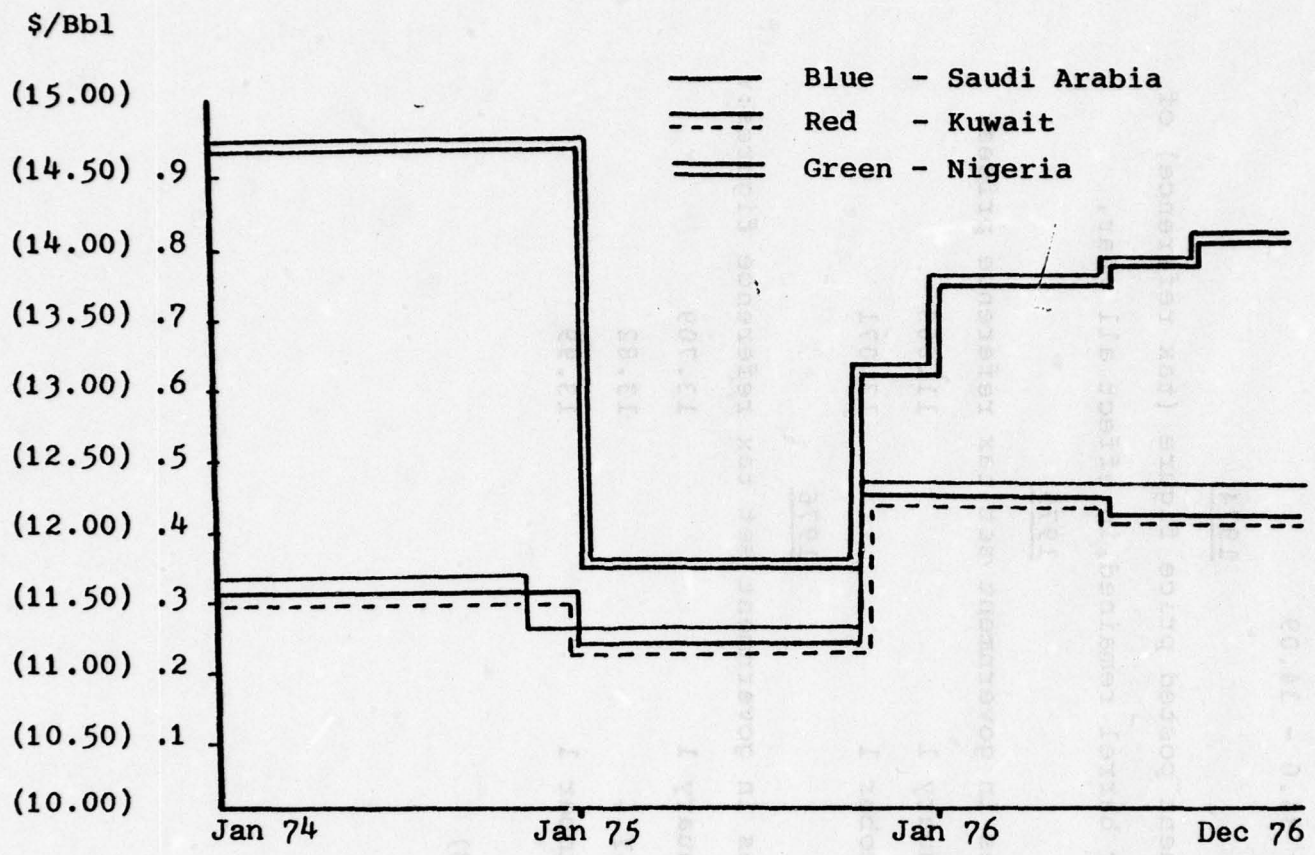
January 1	11.663
October 1	13.071

1976

1976 changes in government set tax reference figures:

January 1	13.709
July 1	13.82
October 1	13.99

*(Source:38)



Graph 1. Crude Oil Posted Prices

Table 2

Trend Analysis Summary of Posted Prices

for Crude Oil*

$\Sigma CA_i^2/w_i$:

1974

Saudi Arabian Crude:	1361.4		(Reference Table 3 and Figure 3)
Kuwait Crude	:	0 (no change)	
Nigerian Crude	:	0 (no change)	

1975

Saudi Arabian Crude:	537.12		(Reference Table 4 and Figure 4)
Kuwait Crude	:	537.12	(Reference Table 4 and Figure 5)
Nigerian Crude	:	537.12	(Reference Table 4 and Figure 6)

1976

Saudi Arabian Crude:	0 (no change)		
Kuwait Crude	:	1499.6	(Reference Table 5 and Figure 7)
Nigerian Crude	:	199.5	(Reference Table 5 and Figure 8)

*(Source:38)

(2) Saudi Arabian crude oil

(3) Kuwait crude oil

Kerosene Posted Prices

Data from Table 6 indicated that Caltex kerosene posted prices were more stable than Shell Eastern kerosene posted prices in 1974, 1975, and 1976. Caltex kerosene posted prices made fewer and smaller price changes during the above three-year period.

Data from Table 7 indicated that Caltex kerosene posted prices changed more uniformly than Shell Eastern kerosene posted prices in 1974 and 1976.

In general, therefore, Caltex kerosene posted prices showed more stable and uniform price trends.

Naptha Posted Prices

Because prices for Shell Eastern naptha were not posted in 1974, it was impossible to make price trend comparisons for 1974. However, in 1975 and 1976, Caltex naptha posted prices were more stable than Shell Eastern naptha posted prices, as shown in Table 6.

In 1976, Caltex naptha posted prices showed a relatively more uniform price trend than Shell Eastern naptha posted prices. However, Table 7 indicated that in 1975, Shell Eastern naptha posted prices showed a more uniform price change.

JP-4 Posted Prices

Because prices were not posted for Shell Eastern naptha in 1974, it was impossible to calculate a 1974 posted price for Shell Eastern JP-4. However, data from Table 6 indicated that Caltex JP-4 posted prices were more stable with fewer and smaller price adjustments, in 1975 and 1976.

Data from Table 7 indicated that Shell Eastern JP-4 posted prices showed relatively more uniform price changes in 1975 and 1976, than Caltex JP-4 posted prices showed.

Therefore in this analysis, Caltex JP-4 posted prices were more stable but Shell Eastern JP-4 posted prices showed more uniform price trends in 1975 and 1976.

Rankings

The ranking for kerosene stability is:

(1) Caltex kerosene

(2) Shell Eastern kerosene

The ranking for kerosene uniform trend behavior is:

(1) Caltex kerosene

(2) Shell Eastern kerosene

The ranking for naptha stability is:

(1) Caltex naptha

(2) Shell Eastern naptha

Ranking naptha uniform trend behavior was not possible because Caltex naptha showed a more uniform trend in 1976, but Shell Eastern naptha showed a more uniform trend in 1975.

The ranking for JP-4 stability is:

(1) Caltex JP-4

(2) Shell Eastern JP-4

The ranking for JP-4 uniform trend behavior is:

(1) Shell Eastern JP-4

(2) Caltex JP-4

In general, therefore, Caltex postings for refined products were more stable and showed a more uniform price trend during 1974, 1975, and 1976.

Table 3

Trend Analysis Calculations for 1974*

Saudi Arabian Crude Oil (Reference Figure 3)

$CA_1 = (40)(1.7) = 68$

$CA_2 = (.5)(40)(8.3) = 166.00$

$CA_3 = (.5)(8)(1.7) = 6.8$

$CA_4 = (8)(8.3) = 66.4$

$CA_1^2 = (68)^2/40 = 115.6$

$CA_2^2 = (166)^2/40 = 688.9$

$CA_3^2 = (6.8)^2/8 = 5.78$

$CA_4^2 = (66.4)^2/8 = 551.12$

$\Sigma CA_i^2/w_i = 1361.4$

Kuwait Crude Oil

No change.

Nigerian Crude Oil

No change.

*(Source:38)

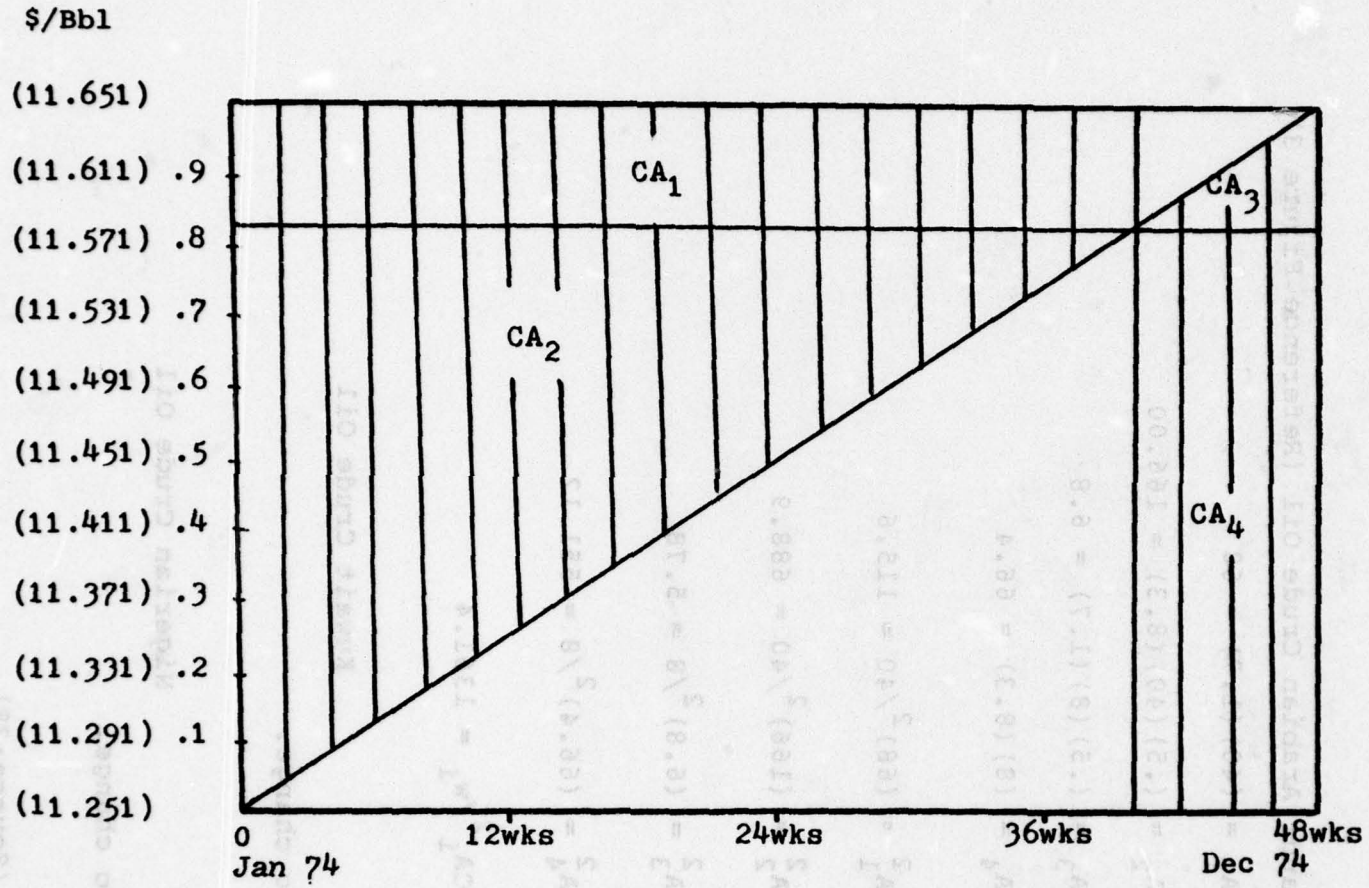


Figure 3. Trend Analysis for Saudi Arabian Crude Oil - 1974

Table 4

Trend Analysis Calculations for 1975*

Saudi Arabian Crude Oil (Reference Figure 4)

$CA_1 = (.5)(36)(7.6) = 136.8$

$CA_2 = (.5)(12)(2.4) = 14.4$

$CA_1^2/w_1 = (136.8)^2/36 = 519.84$

$CA_2^2/w_2 = (14.4)^2/12 = 17.28$

$\Sigma CA_i^2/w_i = 537.12$

Kuwait Crude Oil (Reference Figure 5)

$CA_1 = (.5)(36)(7.6) = 136.8$

$CA_2 = (.5)(12)(2.4) = 14.4$

$CA_1^2/w_1 = (136.8)^2/36 = 519.89$

$CA_2^2/w_2 = (14.4)^2/12 = 17.28$

$\Sigma CA_i^2/w_i = 537.12$

Nigerian Crude Oil (Reference Figure 6)

$CA_1 = (.5)(36)(7.6) = 136.8$

$CA_2 = (.5)(12)(2.4) = 14.4$

$CA_1^2/w_1 = (136.8)^2/36 = 519.84$

$CA_2^2/w_2 = (14.4)^2/12 = 17.28$

$\Sigma CA_i^2/w_i = 537.12$

*(Source:38)

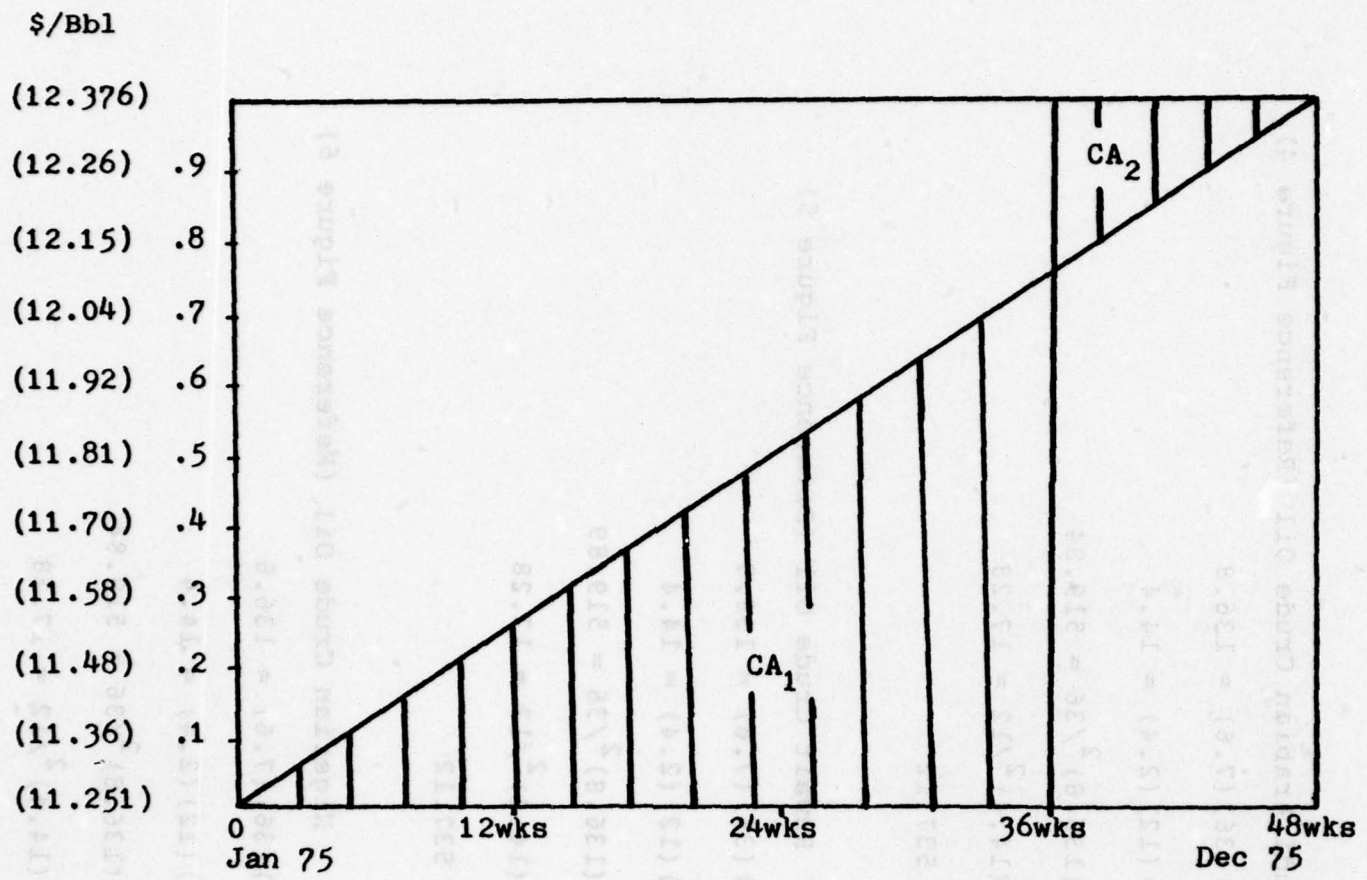


Figure 4. Trend Analysis for Saudi Arabian Crude Oil - 1975.

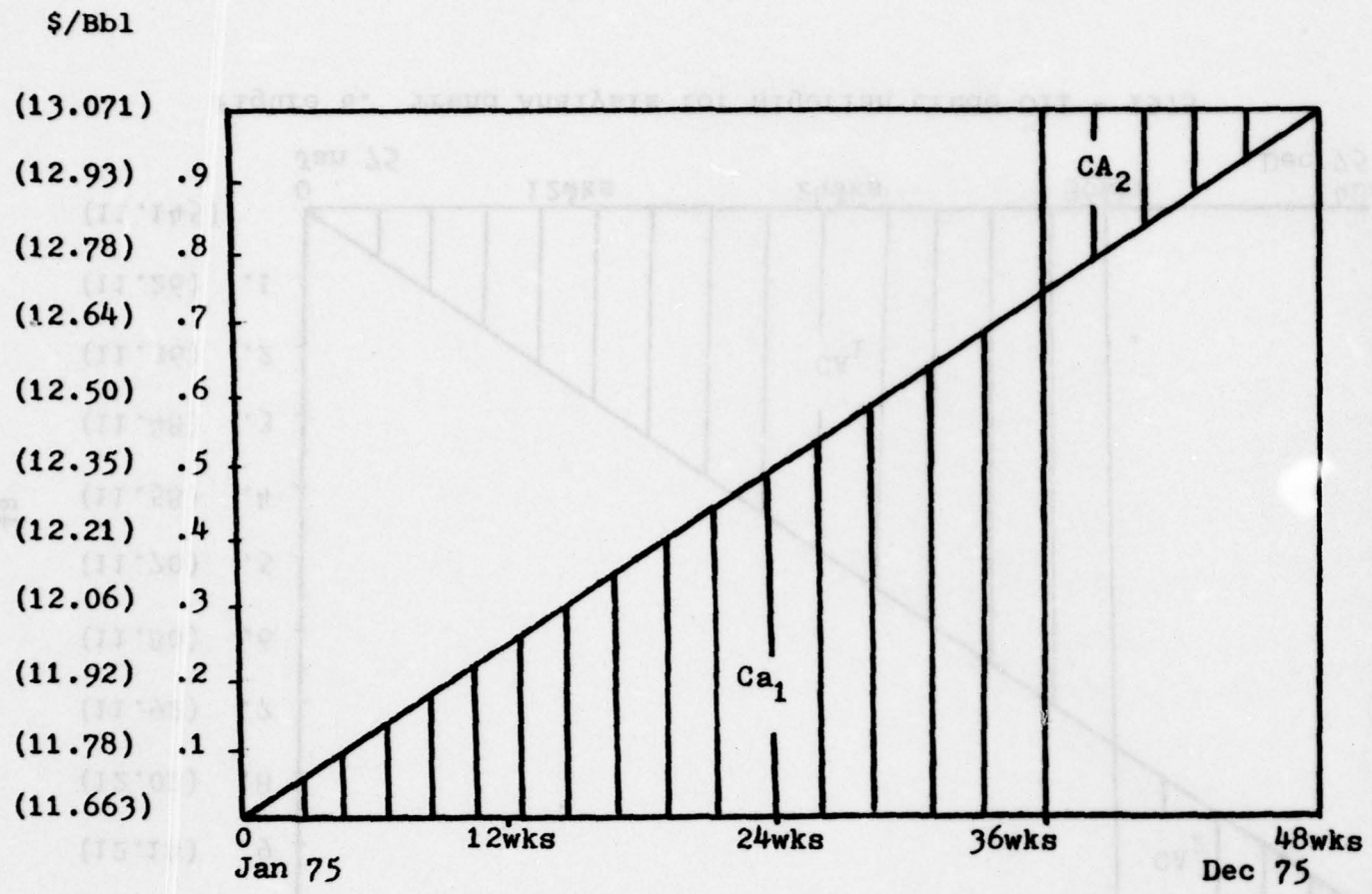


Figure 5. Trend Analysis for Kuwait Crude Oil - 1975

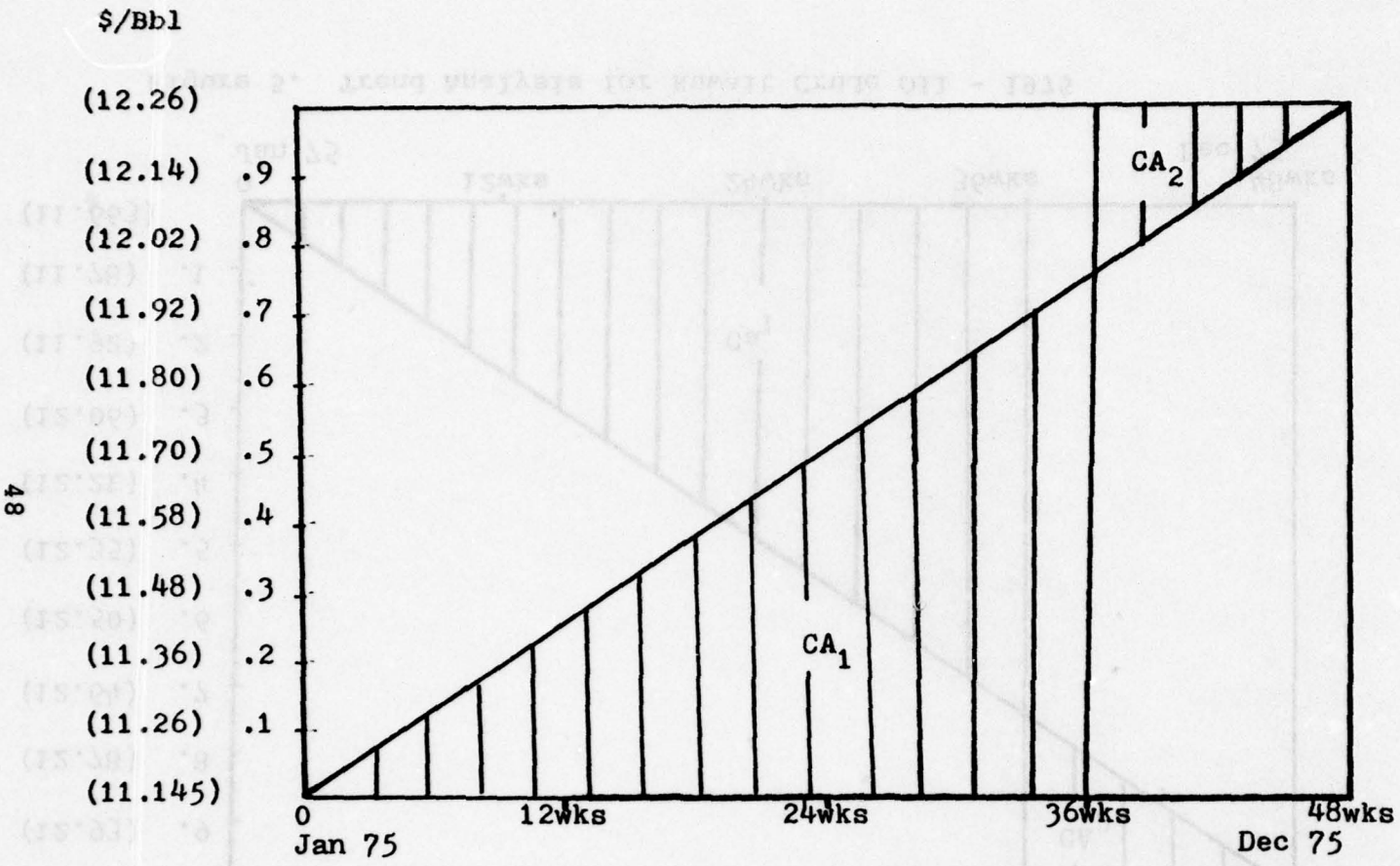


Figure 6. Trend Analysis for Nigerian Crude Oil - 1975

Table 5

Trend Analysis Calculations for 1976*

Saudi Arabian Crude Oil

No Change

Kuwait Crude Oil (Reference Figure 7)

$CA_1 = (.5)(20)(4.1) = 41$

$CA_2 = (20)(5.9) = 118$

$CA_3 = (.5)(28)(5.9) = 82.6$

$CA_4 = (28)(4.1) = 114.8$

$CA_1^2/w_1 = (41)^2/20 = 84.05$

$CA_2^2/w_2 = (118)^2/20 = 696.20$

$CA_3^2/w_3 = (82.6)^2/28 = 243.67$

$CA_4^2/w_4 = (114.8)^2/28 = 470.68$

$\Sigma CA_i^2/w_i = 149.46$

Nigerian Crude Oil (Reference Figure 8)

$CA_1 = (.5)(24)(5) = 60$

$CA_2 = (12)(1) = 12$

$CA_3 = (.5)(12)(2.5) = 15$

$CA_4 = (.5)(12)(2.5) = 15$

Table 5 (Continued)

$CA_1^2/w_1 = (60)^2/24 = 150$

$CA_2^2/w_2 = (12)^2/12 = 12$

$CA_3^2/w_3 = (15)^2/12 = 18.75$

$CA_4^2/w_4 = (15)^2/12 = 18.75$

$\Sigma CA_i^2/w_i = 199.5$

*(Source:38)

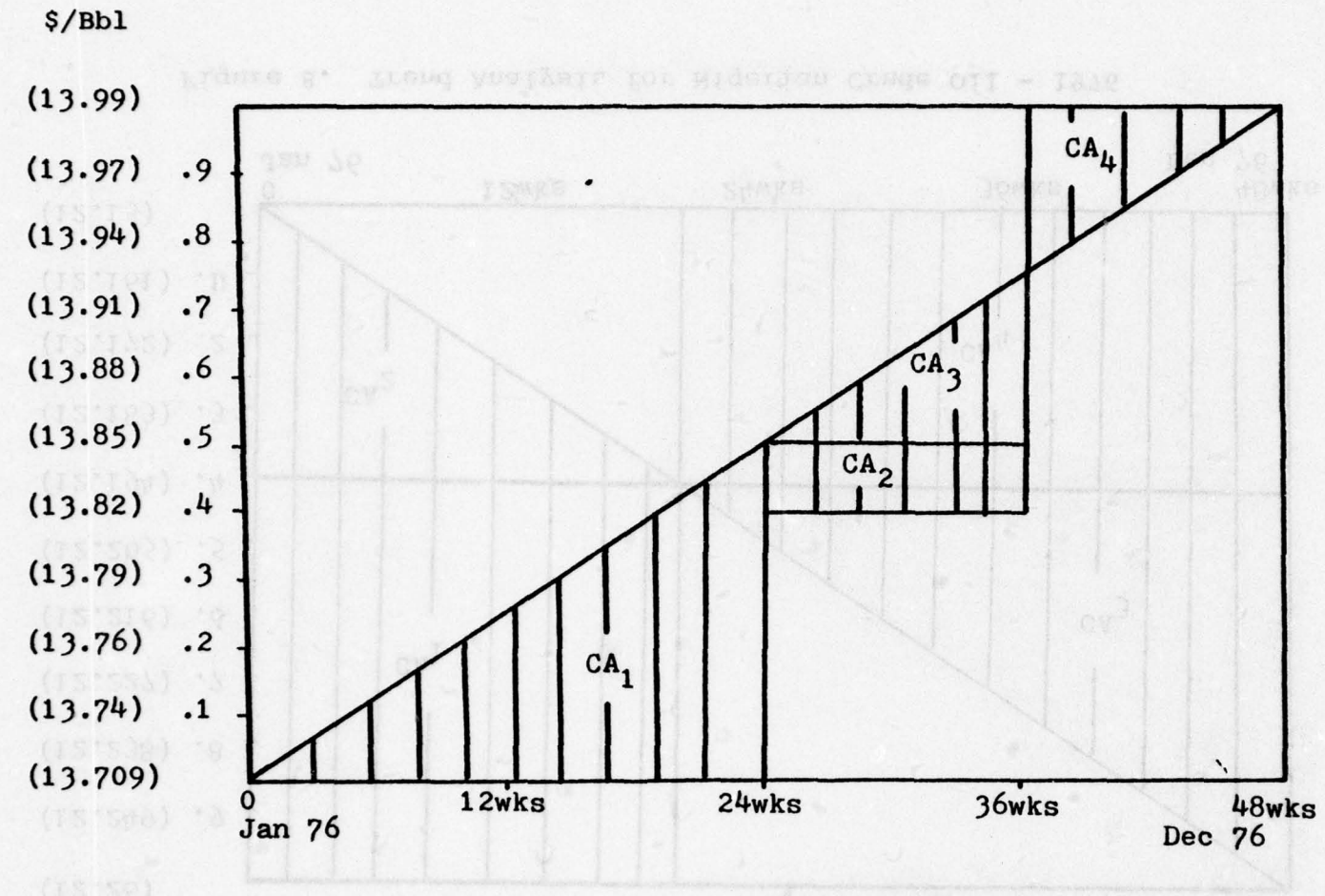


Figure 7. Trend Analysis for Kuwait Crude Oil - 1976.

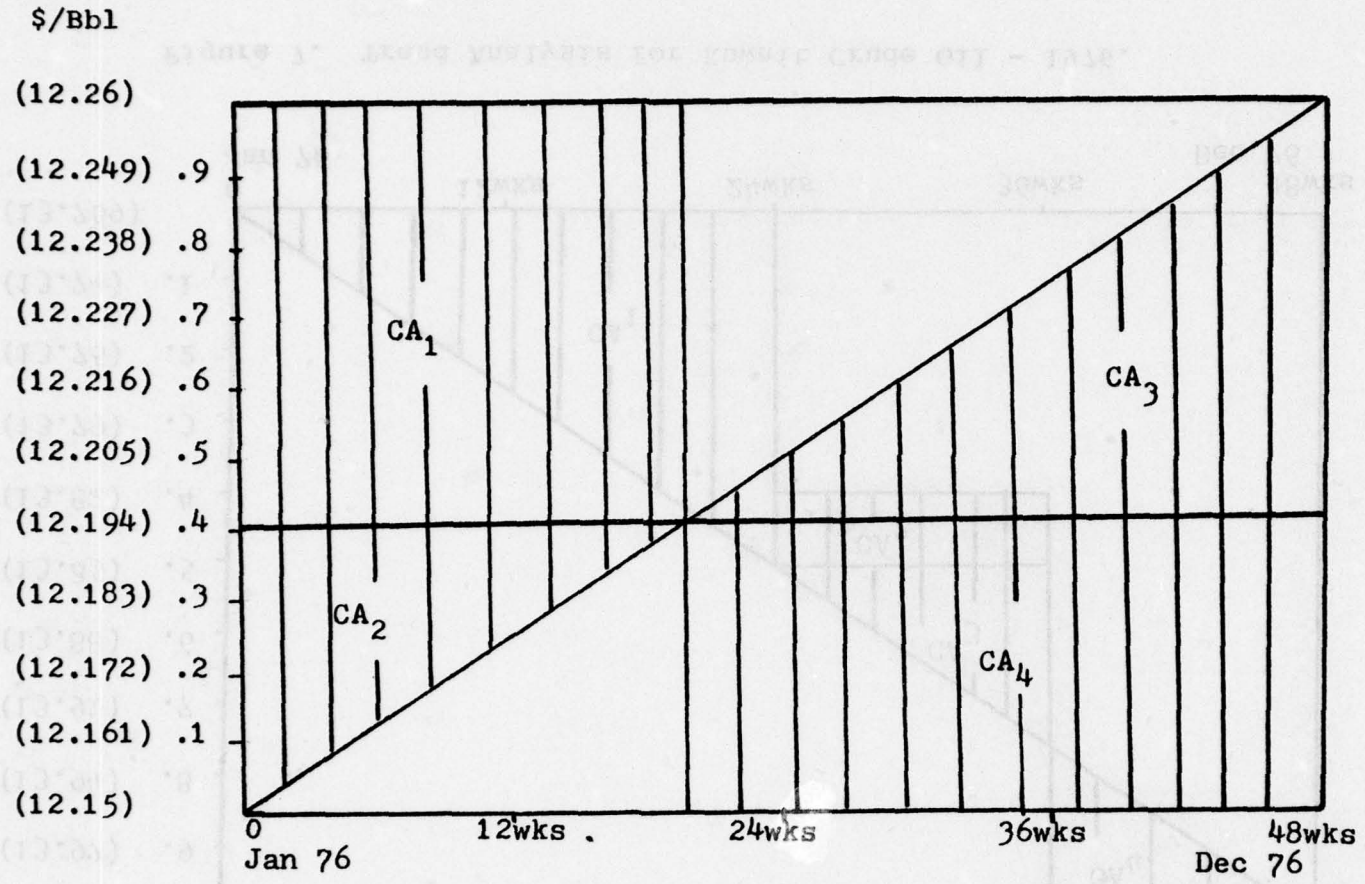


Figure 8. Trend Analysis for Nigerian Crude Oil - 1976

Table 6

Refined Products Posted Price Changes*

Caltex (Ras Tanura/Bahrain) - Kerosene	
Price December 31, 1973	18.40
1974 (Reference Graph 2)	
January 1	30.80
October 1	32.50
December 1	34.50
1975 (Reference Graph 3)	
October 8	38.60
1976 (Reference Graph 4)	
No Change	
Shell Eastern (Singapore) - Kerosene	
Price December 31, 1973	20.50
1974 (Reference Graph 2)	
January 9	36.70
February 7	32.70
April 1	35.70
October 14	36.00
October 28	34.50
December 1	35.50
1975 (Reference Graph 3)	
March 20	35.00
October 14	39.00
1976 (Reference Graph 4)	
March 22	38.00

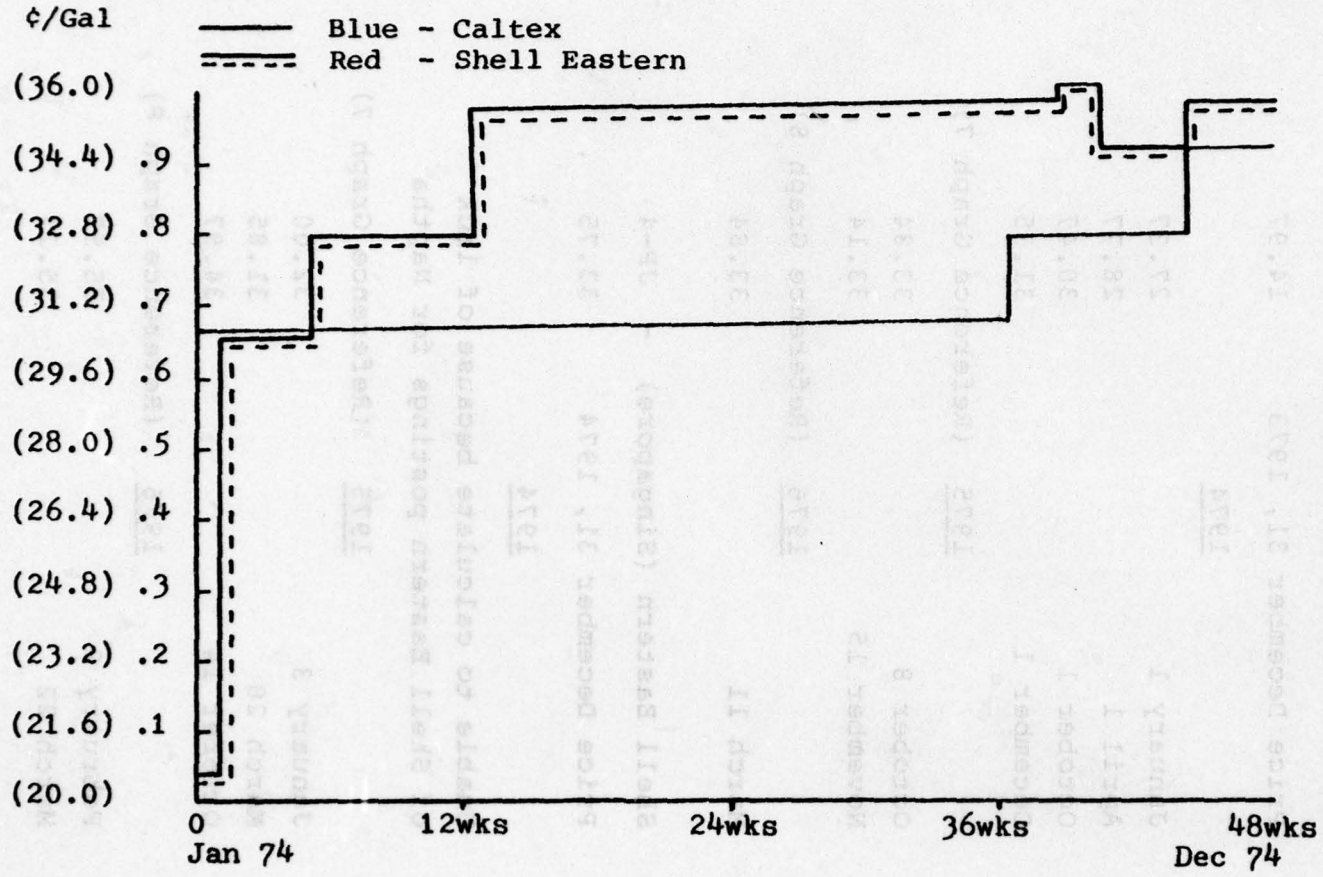
Table 6 (Continued)

Caltex (Ras Tanura/Bahrain) - Naptha	
Price December 31, 1973	13.50
1974	
January 1	25.90
April 1	27.90
October 1	29.60
December 1	30.00
1975 (Reference Graph 5)	
October 8	31.80
November 15	30.80
1976 (Reference Graph 6)	
March 11	31.8
Shell Eastern (Singapore) - Naptha	
Price December 31, 1974	33.00
1974	
No Postings	
1975 (Reference Graph 5)	
January 3	30.50
October 14	33.10
1976 (Reference Graph 6)	
February 9	34.1

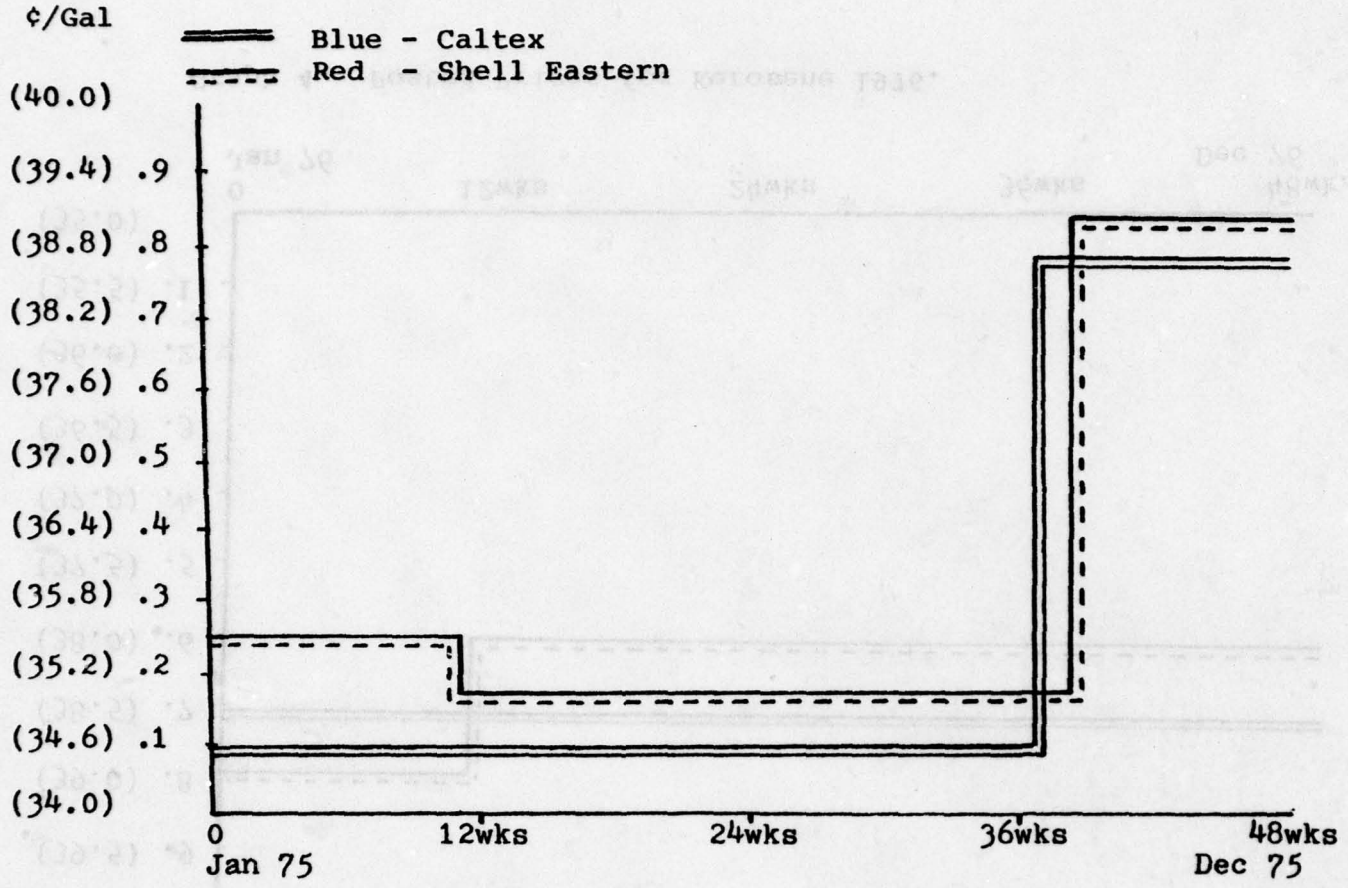
Table 6 (Continued)

Caltex (Ras Tanura/Bahrain) - JP-4	
Price December 31, 1973	14.97
1974	
January 1	27.37
April 1	28.77
October 1	30.47
December 1	31.35
1975 (Reference Graph 7)	
October 8	33.84
November 15	33.14
1976 (Reference Graph 8)	
March 11	33.84
Shell Eastern (Singapore) - JP-4	
Price December 31, 1974	33.75
1974	
Unable to calculate because of lack of Shell Eastern postings for Naptha	
1975 (Reference Graph 7)	
January 3	32.00
March 20	31.85
October 14	34.87
1976 (Reference Graph 8)	
February 9	35.57
March 22	35.27

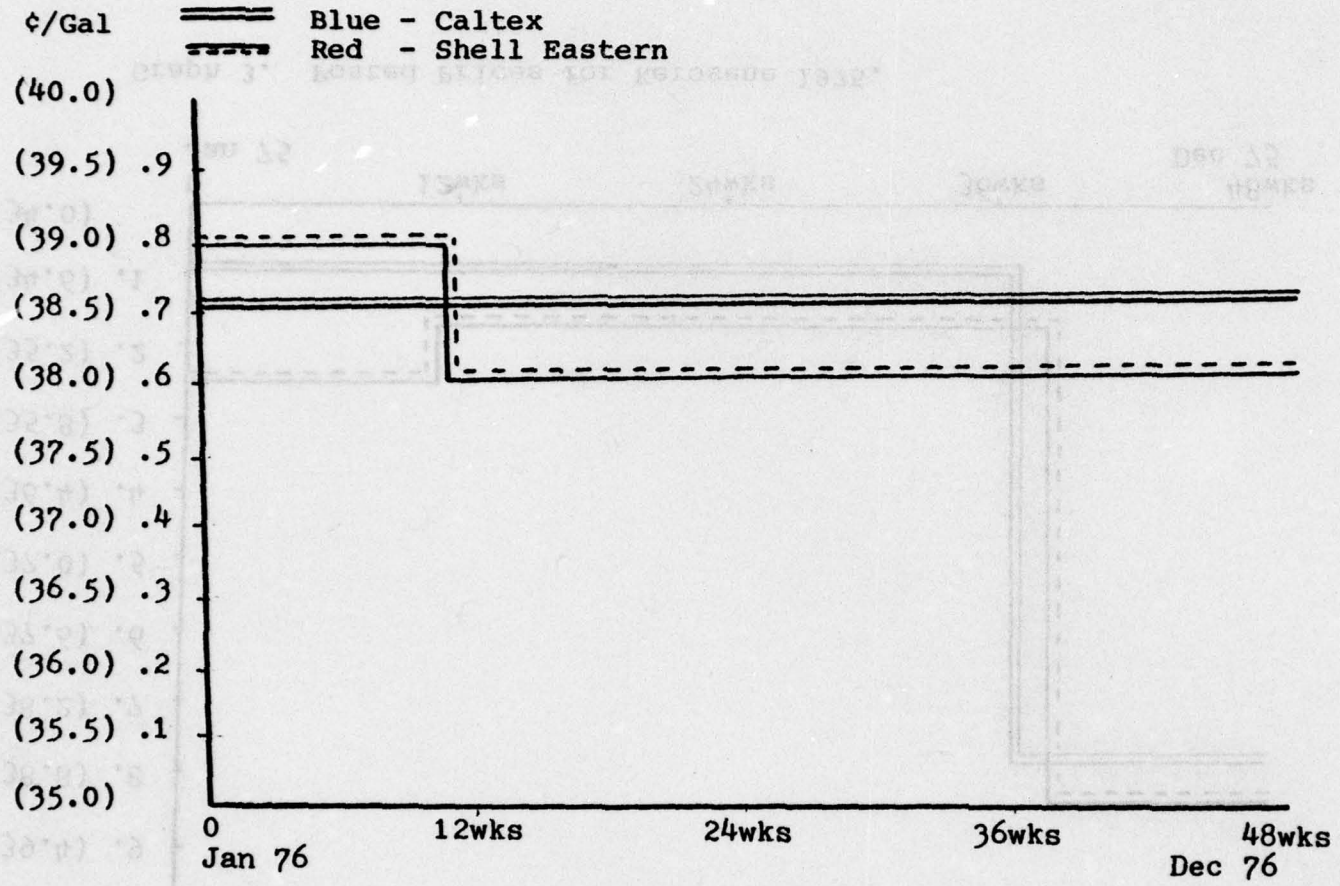
*(Source:38)



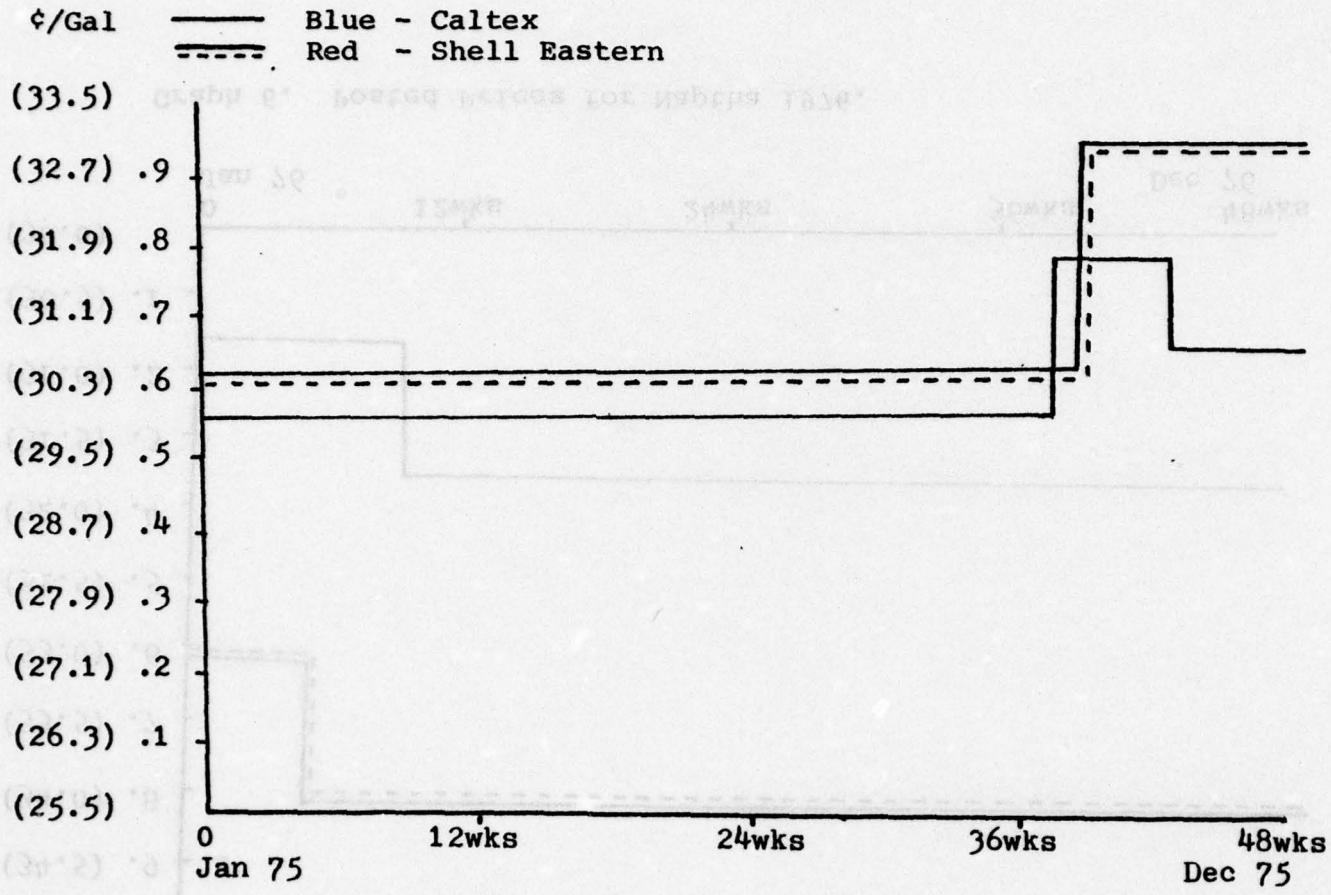
Graph 2. Posted Prices for Kerosene 1974



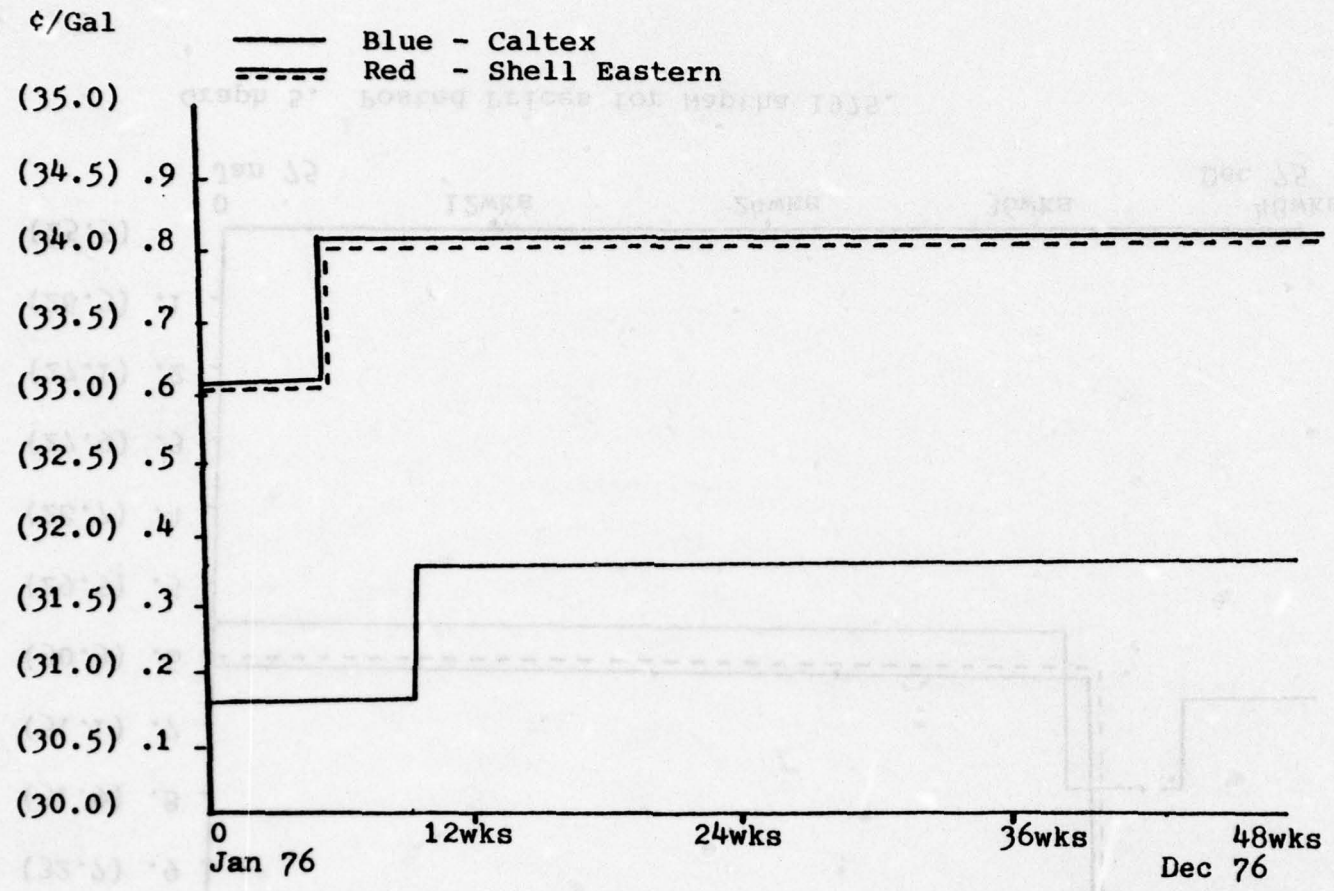
Graph 3. Posted Prices for Kerosene 1975.



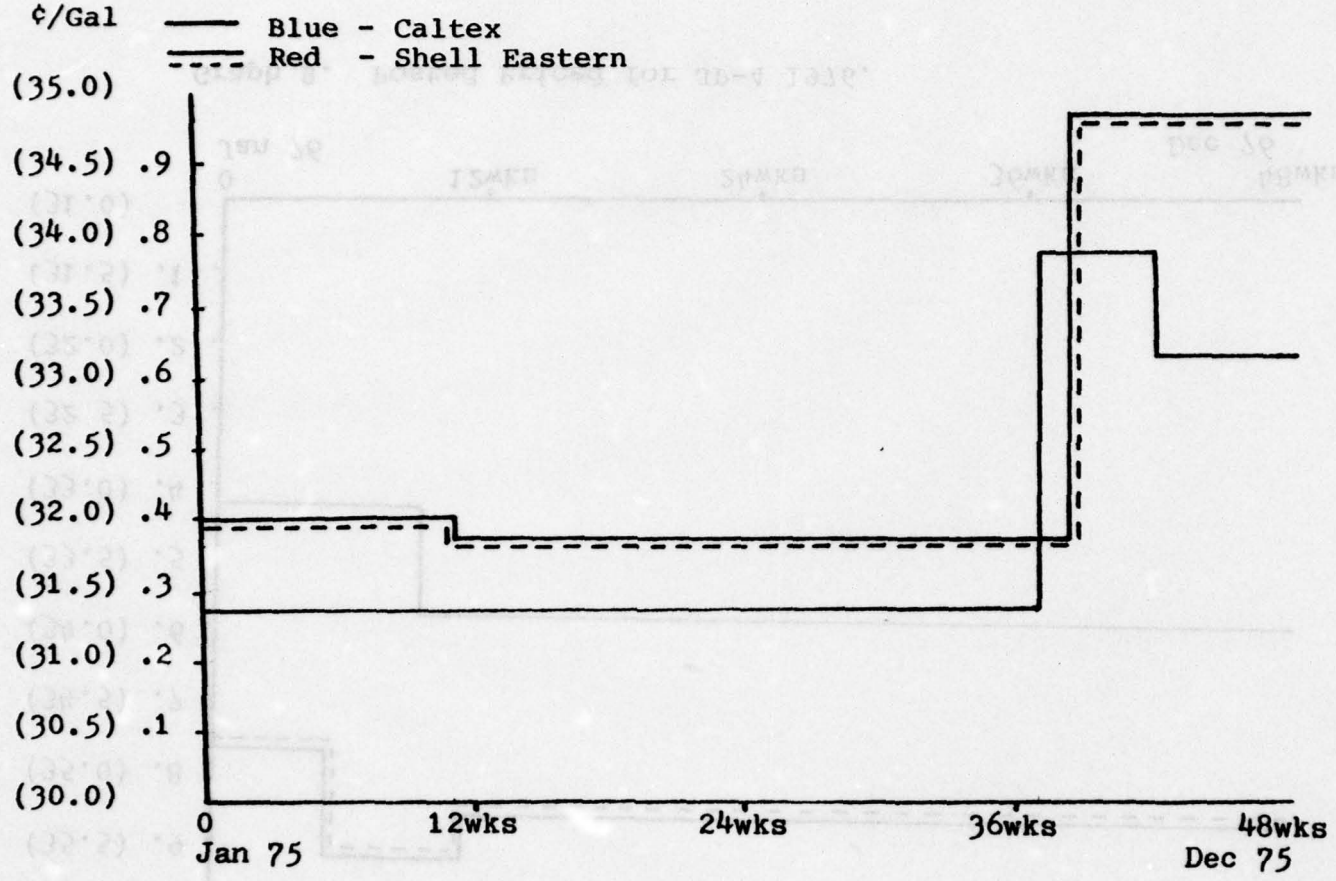
Graph 4. Posted Prices for Kerosene 1976.



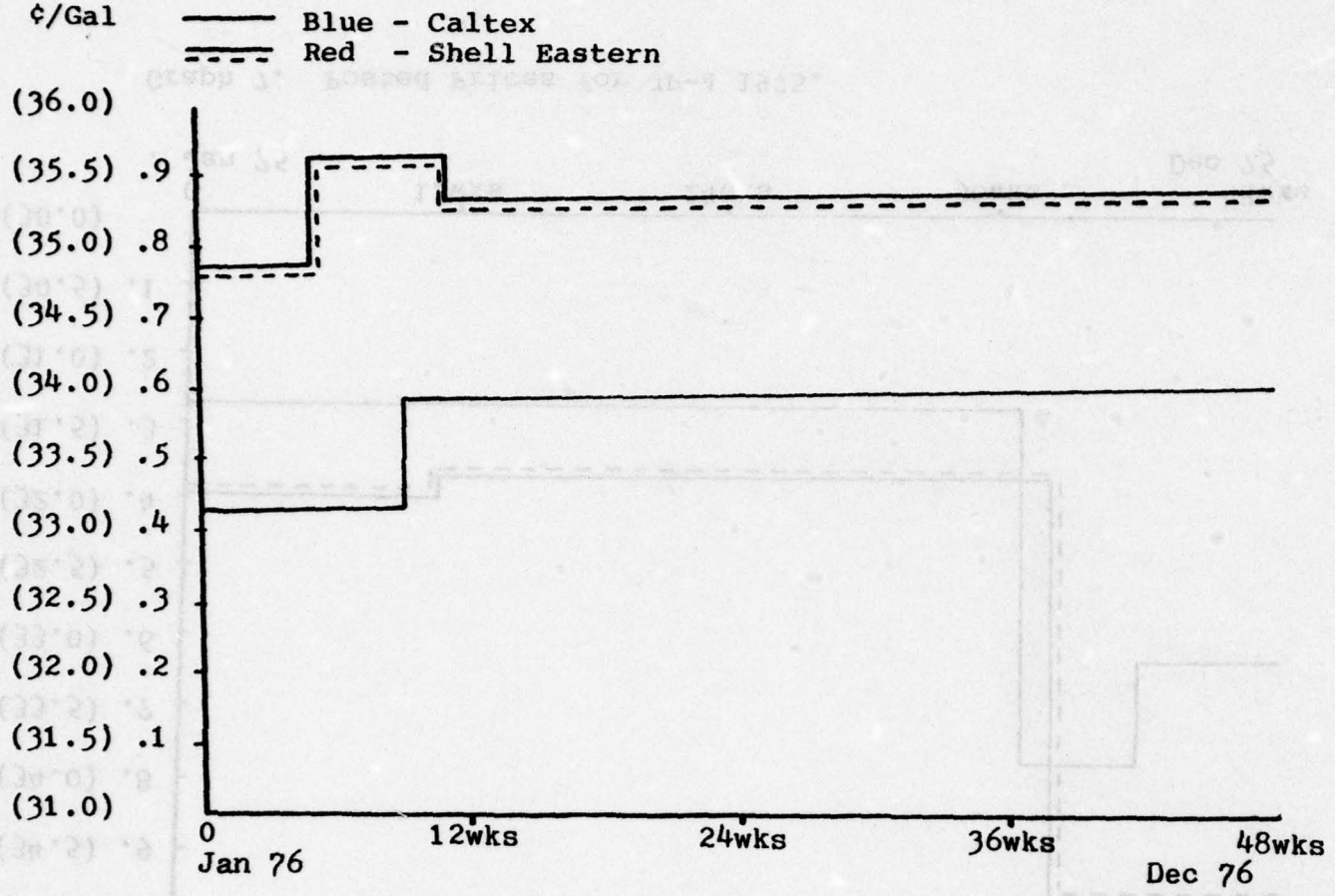
Graph 5. Posted Prices for Naptha 1975.



Graph 6. Posted Prices for Naptha 1976.



Graph 7. Posted Prices for JP-4 1975.



Graph 8. Posted Priced for JP-4 1976.

Table 7

Trend Analysis Summary of Posted

Prices for Refined Products*

$\Sigma CA_i^2/w_i$

1974

Caltex Kerosene	:	597.60 (Reference Table 8 and Figure 9)
Shell Eastern Kerosene	:	615.70 (Reference Table 8 and Figure 10)
Caltex Naptha	:	61.75 (Reference Table 9 and Figure 11)
Shell Eastern Naptha	:	No Postings
Caltex JP-4	:	105.92 (Reference Table 10 and Figure 12)
Shell Eastern JP-4	:	Not able to compute because of lack of Shell Eastern Naptha postings for 1974

1975

Caltex Kerosene	:	562.98 (Reference Table 11 and Figure 13)
Shell Eastern Kerosene	:	411.18 (Reference Table 11 and Figure 14)
Caltex Naptha	:	683.57 (Reference Table 12 and Figure 15)
Shell Eastern Naptha	:	590.08 (Reference Table 12 and Figure 16)
Caltex JP-4	:	595.79 (Reference Table 13 and Figure 17)
Shell Eastern JP-4	:	503:93 (Reference Table 13 and Figure 18)

1976

Caltex Kerosene	:	0 (No Change)
Shell Eastern Kerosene	:	1424.4 (Reference Table 14 and Figure 19)

Table 7 (Continued)

Caltex Naptha	:	647.82 (Reference Table 15 and Figure 20)
Shell Eastern Naptha	:	872.00 (Reference Table 15 and Figure 21)
Caltex JP-4	:	647.82 (Reference Table 16 and Figure 22)
Shell Eastern JP-4	:	510.56 (Reference Table 16 and Figure 23)

*(Source:38)

Table 8

Trend Analysis Calculations

for Kerosene in 1974*

Caltex (Reference Figure 9)

$CA_1 = (.5)(36)(7.6) = 136.8$

$CA_2 = (8)(3) = 24$

$CA_3 = (.5)(8)(1.6) = 6.4$

$CA_4 = (.5)(4)(.8) = 1.6$

$CA_1^2/w_1 = (136.8)^2/36 = 519.84$

$CA_2^2/w_2 = (24^2/8)^2/8 = 72$

$CA_3^2/w_3 = (6.4)^2/8 = 5.12$

$CA_4^2/w_4 = (1.6)^2/4 = .64$

$\sum_{i=1}^{4} CA_i^2/w_i = 597.6$

Shell Eastern (Reference Figure 10)

$CA_1 = (.5)(1)(.25) = .125$

$CA_2 = (.5)(4)(.8) = 1.6$

$CA_3 = (4)(5.5) = 22$

$CA_4 = (.5)(7)(1.4) = 4.9$

$CA_5 = (7)(5.35) = 37.45$

$CA_6 = (.5)(26)(5.25) = 68.25$

$CA_7 = (26)(2) = 52$

Table 8 (Continued)

$CA_8 = (2)(1.75) = 3.5$

$CA_9 = (.5)(2)(.4) = .4$

$CA_{10} = (.5)(4)(.8) = 1.6$

$CA_{11} = (.5)(2.5)(.6) = .75$

$CA_{12} = (.5)(1.5)(.3) = .225$

$CA_1^2/w_1 = (.125)^2/1 = .02$

$CA_2^2/w_2 = (1.6)^2/4 = .64$

$CA_3^2/w_3 = (22)^2/4 = 121$

$CA_4^2/w_4 = (4.9)^2/7 = 3.43$

$CA_5^2/w_5 = (37.45)^2/7 = 200.36$

$CA_6^2/w_6 = (68.25)^2/26 = 179.16$

$CA_7^2/w_7 = (52)^2/26 = 104$

$CA_8^2/w_8 = (3.5)^2/2 = 6.12$

$CA_9^2/w_9 = (.4)^2/2 = .08$

$CA_{10}^2/w_{10} = (1.6)^2/4 = .64$

$CA_{11}^2/w_{11} = (.75)^2/2.5 = .225$

$CA_{12}^2/w_{12} = (.225)^2/1.5 = .03$

$\sum_{i=1}^{12} = CA_i^2/w_i = 615.7$ *(Source:38)

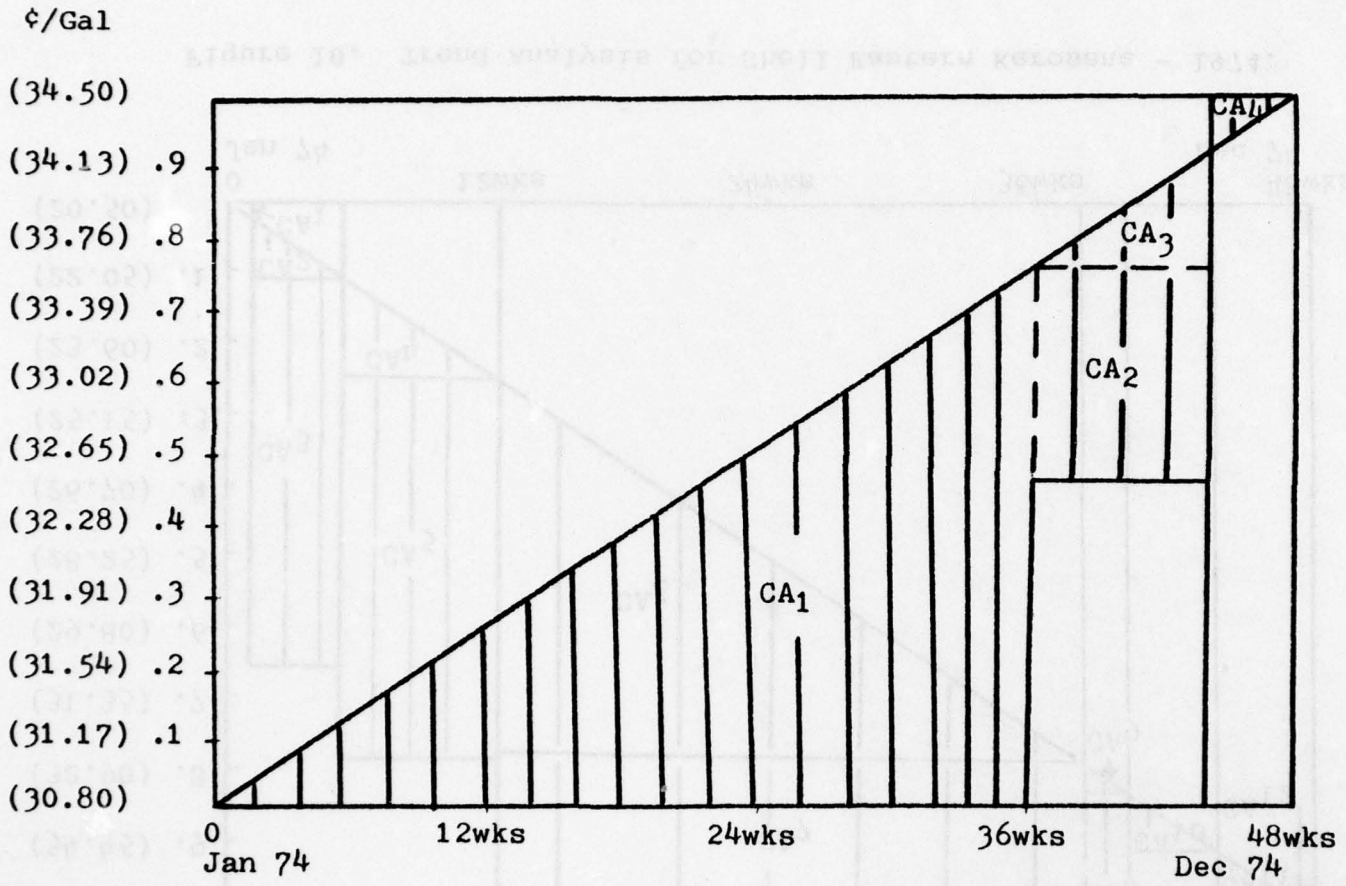


Figure 9. Trend Analysis for Caltex Kerosene - 1974.

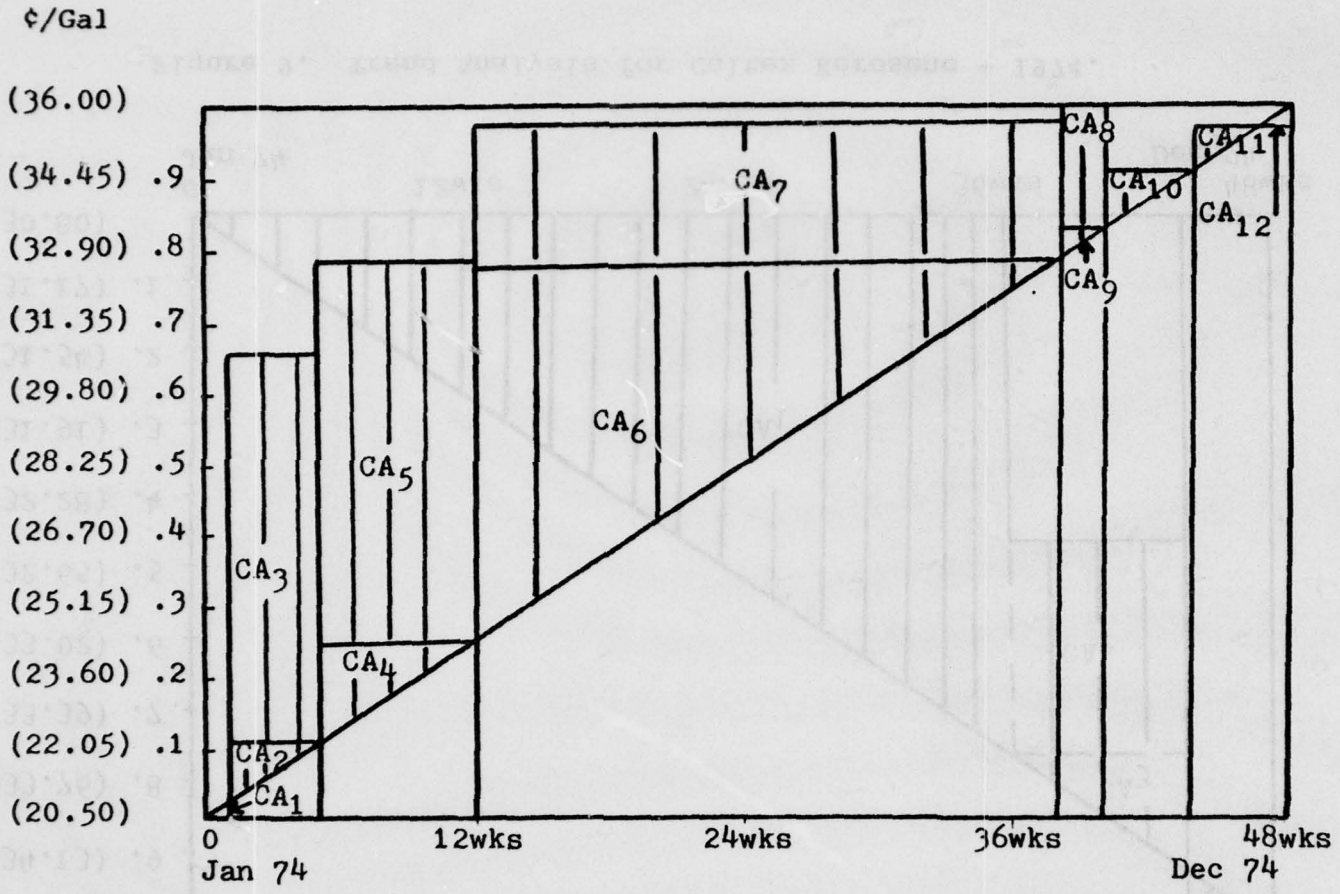


Figure 10. Trend Analysis for Shell Eastern Kerosene - 1974.

Table 9

Trend Analysis Calculations

for Naptha in 1974*

Caltex (Reference Figure 11)

$CA_1 = (.5)(12)(2.5) = 15$

$CA_2 = (.5)(12)(2.5) = 15$

$CA_3 = (.5)(12)(2.5) = 15$

$CA_4 = (.5)(8)(1.5) = 6$

$CA_5 = (.5)(4)(1) = 2$

$CA_1^2/w_1 = (15)^2/12 = 18.75$

$CA_2^2/w_2 = (15)^2/12 = 18.75$

$CA_3^2/w_3 = (15)^2/12 = 18.75$

$CA_4^2/w_4 = (6)^2/8 = 4.5$

$CA_5^2/w_5 = (2)^2/4 = 1$

$$\sum_{i=1}^{5} CA_i^2/w_i = 61.75$$

*(Source:38)

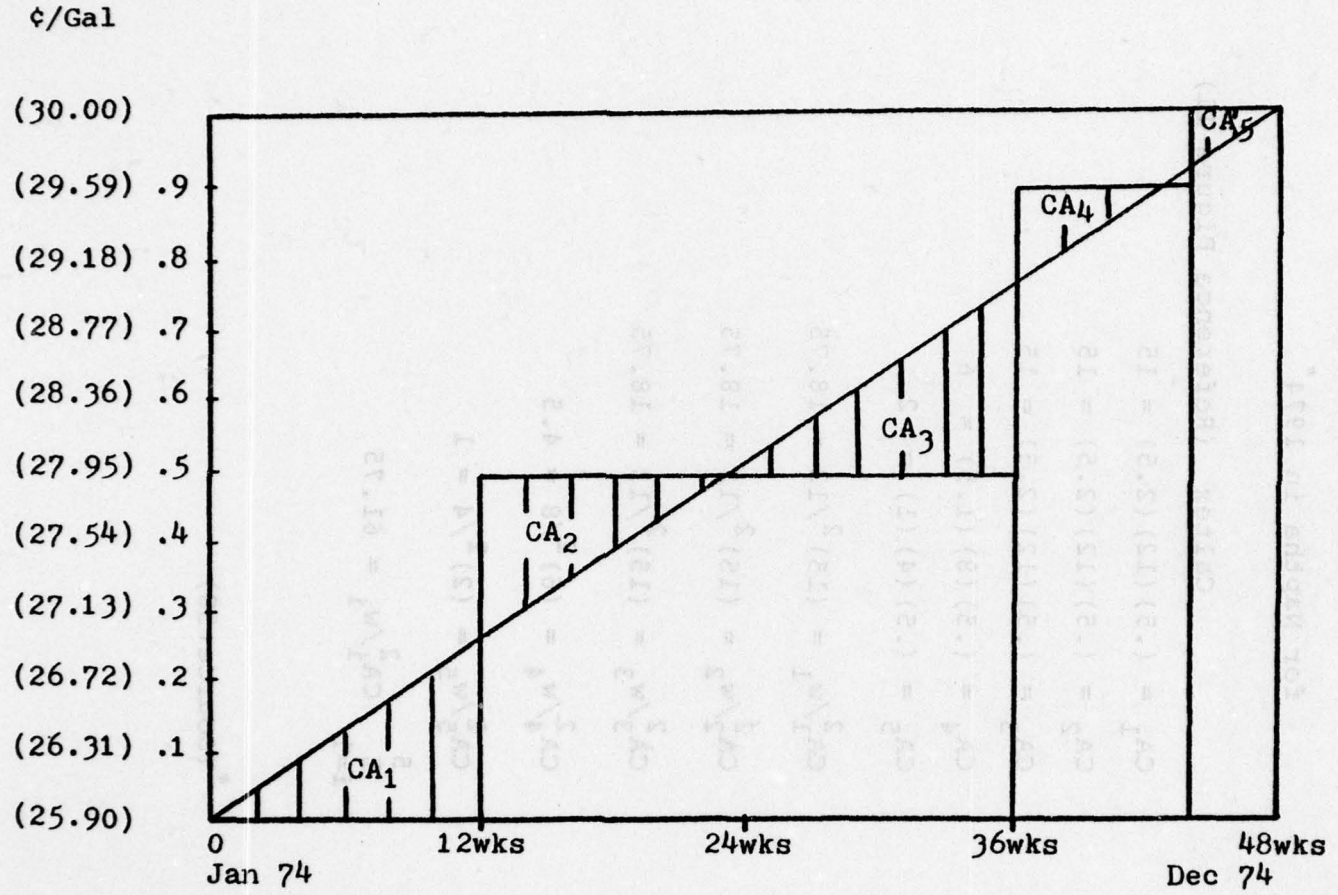


Figure 11. Trend Analysis for Caltex Naptha - 1974.

Table 10

Trend Analysis Calculations

for JP-4 in 1974*

Caltex (Reference Figure 12)

$CA_1 = (.5)(12)(2.5) = 15$

$CA_2 = (.5)(4.5)(1) = 2.25$

$CA_3 = (.5)(19.5)(4.1) = 39.98$

$CA_4 = (.5)(1)(.2) = .1$

$CA_5 = (.5)(7)(1.4) = 4.9$

$CA_6 = (.5)(4)(.8) = 1.6$

$CA_1^2/w_1 = (15)^2/12 = 18.75$

$CA_2^2/w_2 = (2.25)^2/4.5 = 1.12$

$CA_3^2/w_3 = (39.98)^2/19.5 = 81.97$

$CA_4^2/w_4 = (.1)^2/1 = .01$

$CA_5^2/w_5 = (4.9)^2/7 = 3.43$

$CA_6^2/w_6 = (1.6)^2/4 = .64$

$$\sum_{i=1}^{6} CA_i^2/w_i = 105.92$$

*(Source:38)

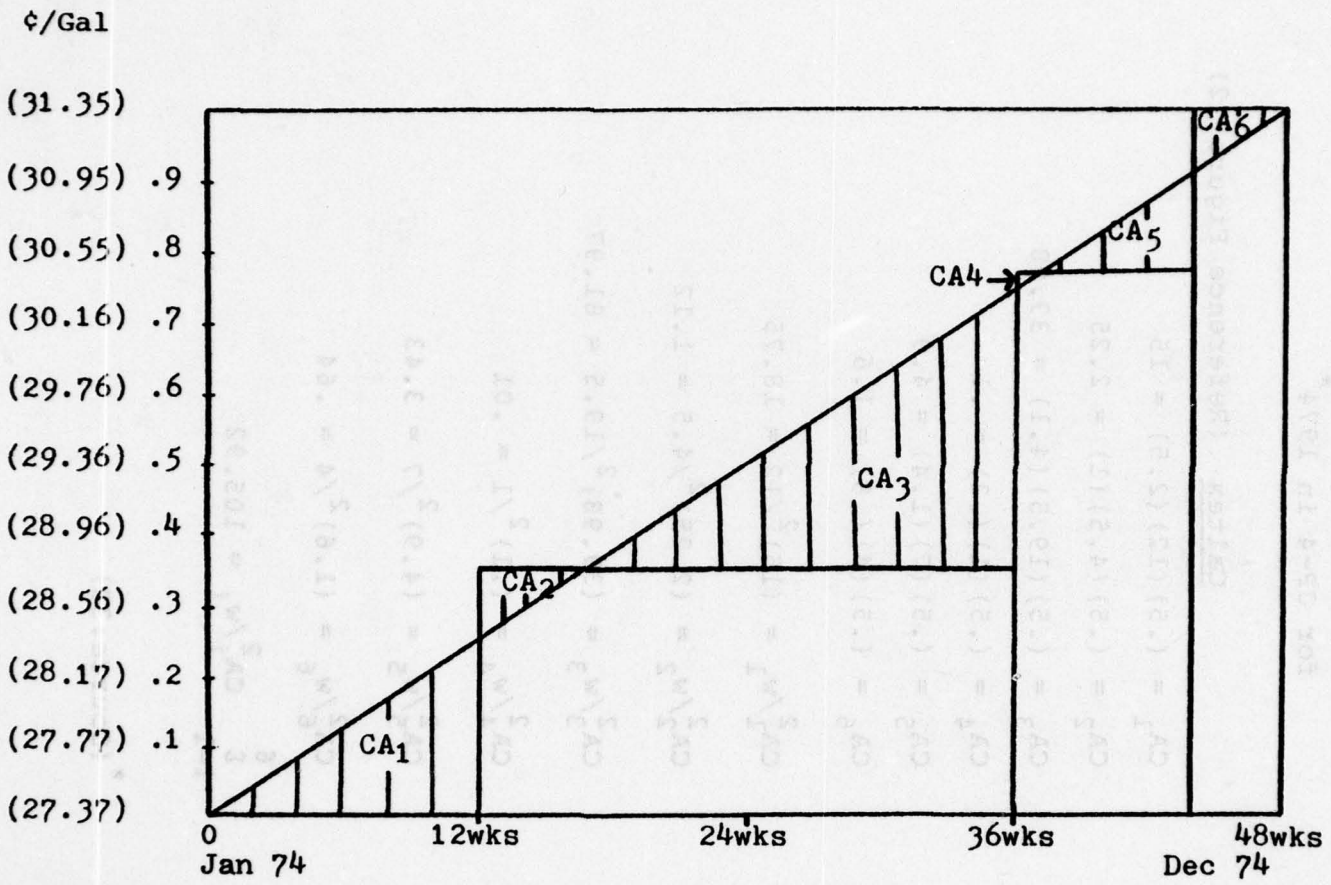


Figure 12. Trend Analysis for Caltex JP-4 - 1974

Table 11

Trend Analysis Calculations

for Kerosene in 1975*

Caltex (Reference Figure 13)

$CA_1 = (.5)(37)(7.7) = 142.45$

$CA_2 = (.5)(11)(2.3) = 12.65$

$CA_1^2/w_1 = (142.45)^2/37 = 548.43$

$CA_2^2/w_2 = (12.65)^2/11 = 14.55$

$\sum_{i=1}^{2} CA_i^2/w_i = 562.98$

Shell Eastern (Reference Figure 14)

$CA_1 = (.5)(6)(1.2) = 3.6$

$CA_2 = (1.2)(27) = 32.4$

$CA_3 = (.5)(32)(6.7) = 107.2$

$CA_4 = (.5)(10)(2.1) = 10.5$

$CA_1^2/w_1 = (3.6)^2/6 = 2.16$

$CA_2^2/w_2 = (32.4)^2/27 = 38.88$

$CA_3^2/w_3 = (107.2)^2/32 = 359.12$

$CA_4^2/w_4 = (10.5)^2/10 = 11.02$

$\sum_{i=1}^{4} CA_i^2/w_i = 411.18$

*(Source:38)

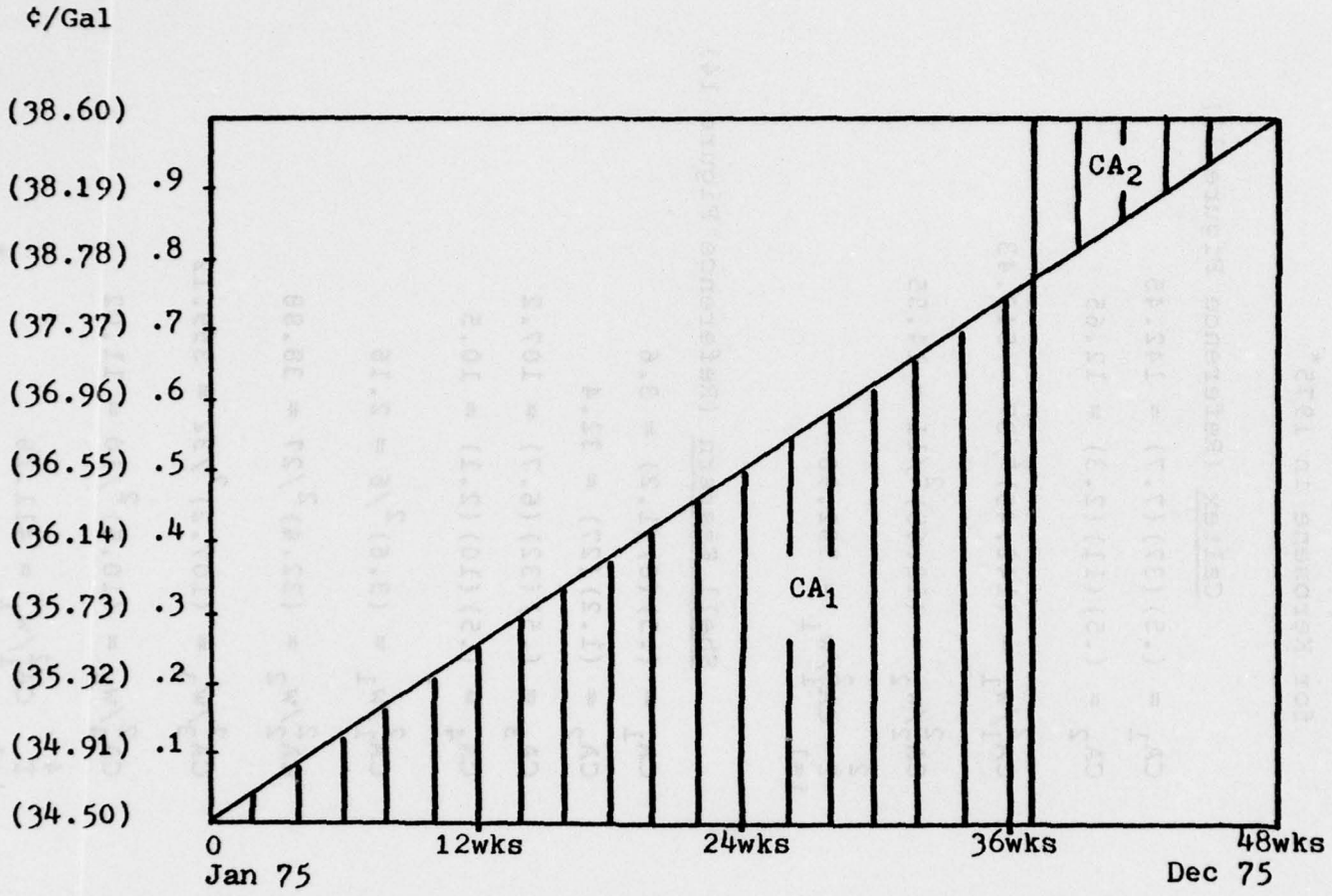


Figure 13. Trend Analysis for Caltex Kerosene - 1975.

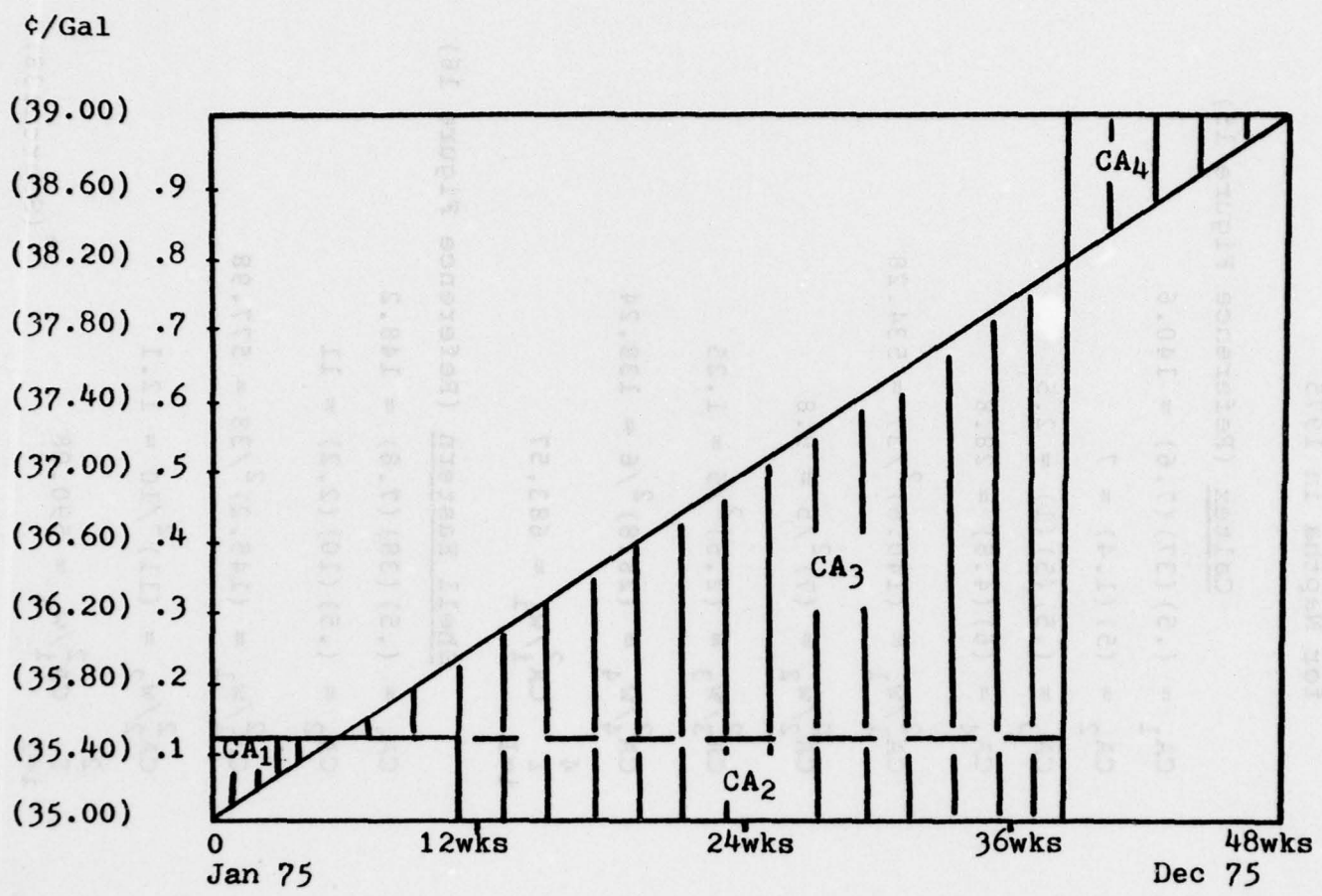


Figure 14. Trend Analysis for Shell Eastern Kerosene - 1975

Table 12

Trend Analysis Calculations

for Naptha in 1975*

Caltex (Reference Figure 15)

$CA_1 = (.5)(37)(7.6) = 140.6$

$CA_2 = (5)(1.4) = 7$

$CA_3 = (.5)(5)(1) = 2.5$

$CA_4 = (6)(4.8) = 28.8$

$CA_1^2/w_1 = (140.6)^2/37 = 534.28$

$CA_2^2/w_2 = (7)^2/5 = 9.8$

$CA_3^2/w_3 = (2.5)^2/5 = 1.25$

$CA_4^2/w_4 = (28.8)^2/6 = 138.24$

$\sum_{i=1}^{4} CA_i^2/w_i = 683.57$

Shell Eastern (Reference Figure 16)

$CA_1 = (.5)(38)(7.8) = 148.2$

$CA_2 = (.5)(10)(2.2) = 11$

$CA_1^2/w_1 = (145.2)^2/38 = 577.98$

$CA_2^2/w_2 = (11)^2/10 = 12.1$

$\sum_{i=1}^{2} CA_i^2/w_i = 590.08$

*(Source:38)

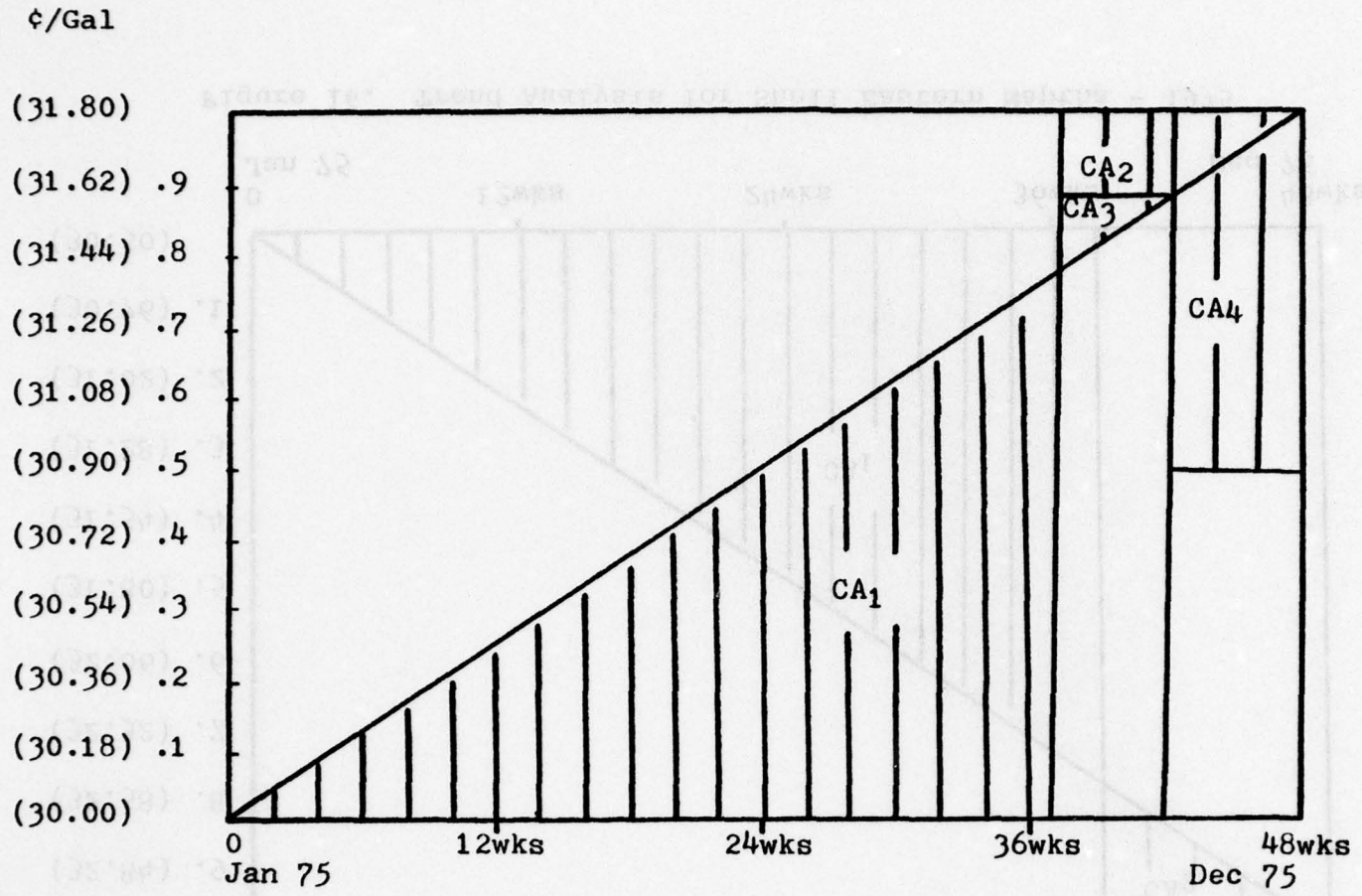


Figure 15. Trend Analysis for Caltex Naptha - 1975.

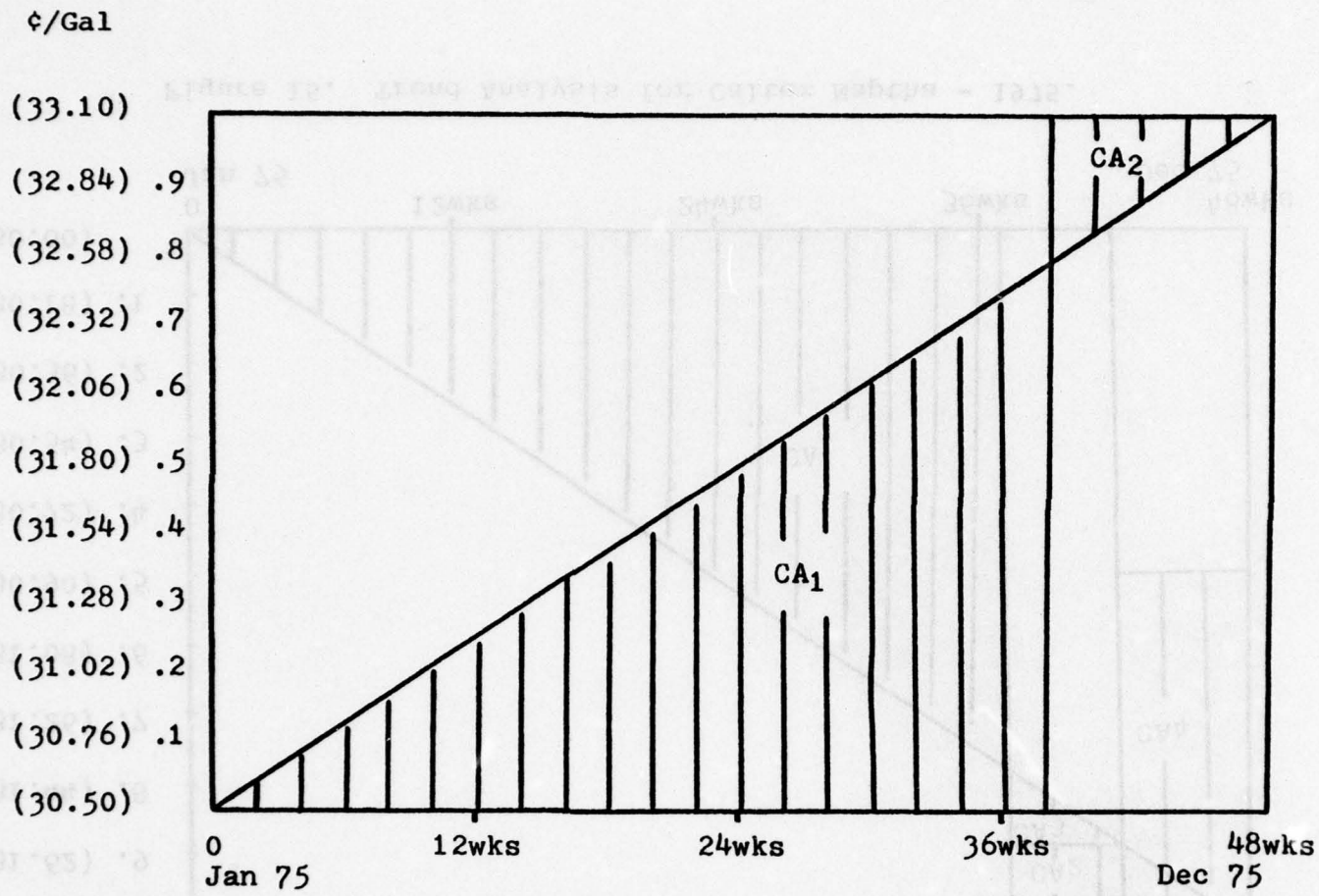


Figure 16. Trend Analysis for Shell Eastern Naptha - 1975

Table 13

Trend Analysis Calculations

for JP-4 in 1975*

Caltex (Reference Figure 17)

$CA_1 = (5)(37)(7.6) = 140.6$

$CA_2 = (.5)(5)(1) = 2.5$

$CA_3 = (5)(1.4) = 7$

$CA_4 = (6)(2.9) = 17.4$

$CA_1^2/w_1 = (140.6)^2/37 = 534.28$

$CA_2^2/w_2 = (2.5)^2/5 = 1.25$

$CA_3^2/w_3 = (7)^2/5 = 9.8$

$CA_4^2/w_4 = (17.4)^2/6 = 50.46$

$\sum_{i=1}^{4} CA_i^2/w_i = 595.79$

Shell Eastern (Reference Figure 18)

$CA_1 = (.5)(2.5)(.5) = .625$

$CA_2 = (27)(.5) = 13.5$

$CA_3 = (.5)(35.5)(7.4) = 131.35$

$CA_4 = (.5)(10)(2.1) = 10.5$

$CA_1^2/w_1 = (.625)^2/2.5 = .16$

$CA_2^2/w_2 = (13.5)^2/27 = 6.75$

Table 13 (Continued)

$$CA_3^2/w_3 = (131.35)^2/35.5 = 486$$

$$CA_4^2/w_4 = (10.5)^2/10 = 11.02$$

$$\sum_{i=1}^{4} CA_i^2/w_i = 503.93$$

*(Source:38)

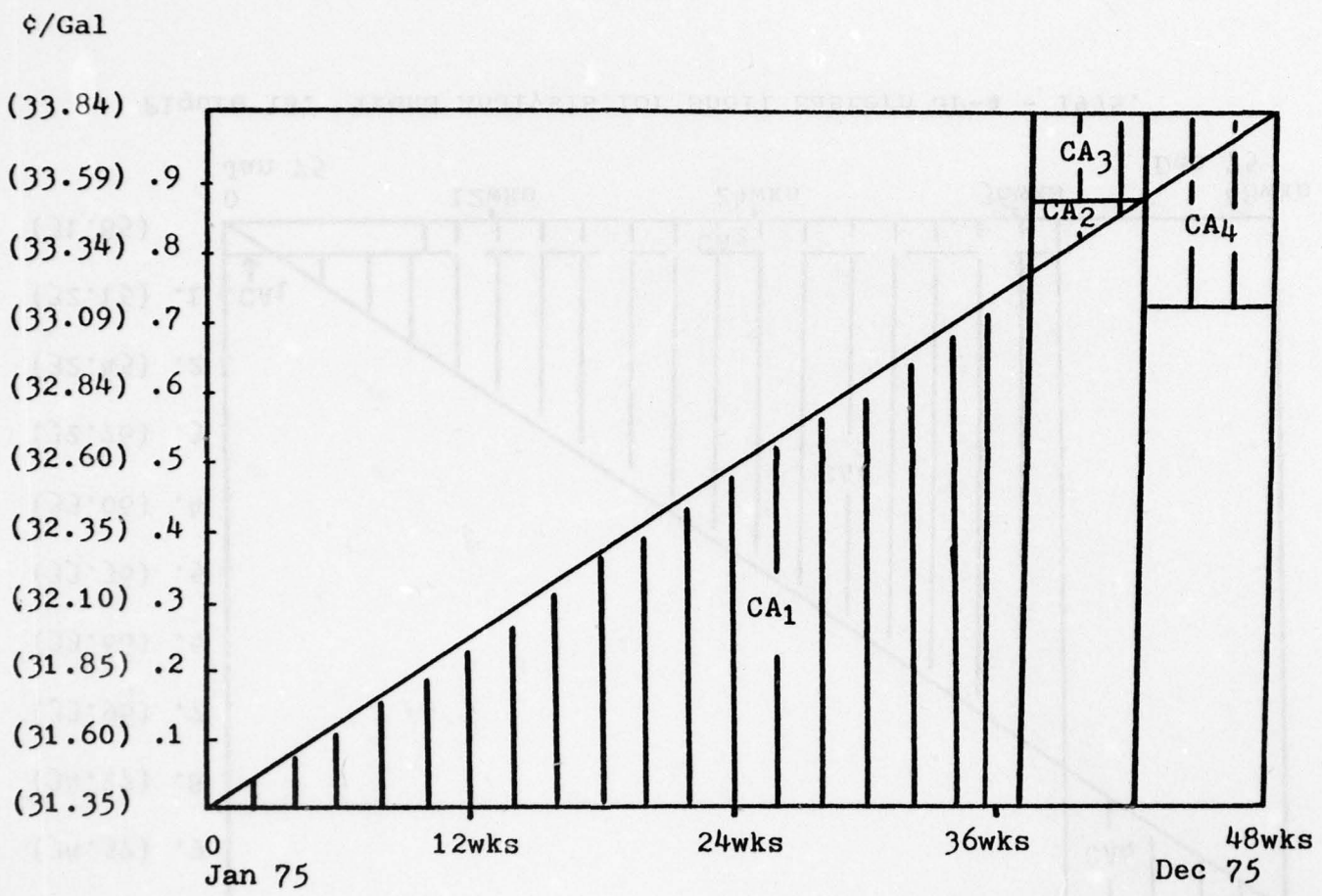
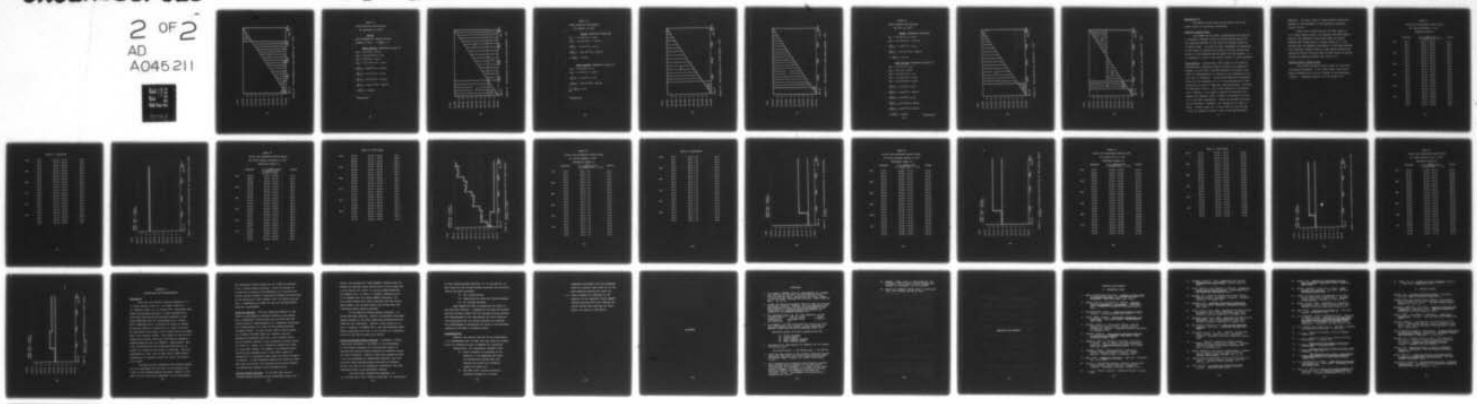


Figure 17. Trend Analysis for Caltex JP-4 - 1975.

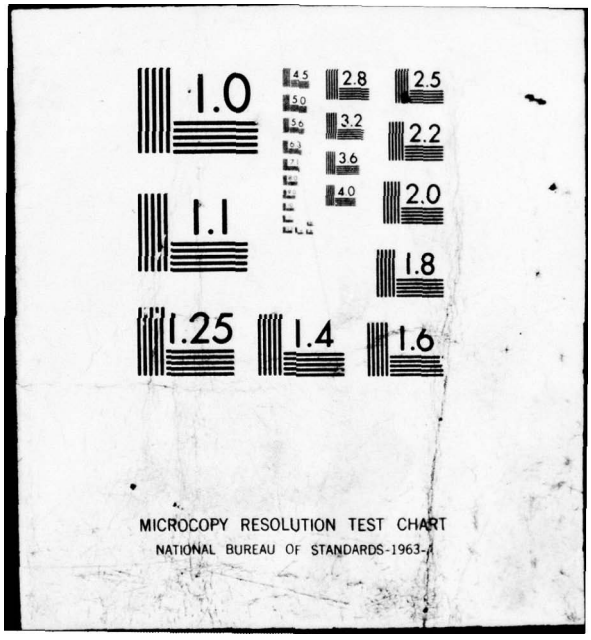
AD-A045 211 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCHO--ETC F/G 21/4
AN ANALYSIS OF REFERENCE PRICES FOR WESTPAC JP-4 PROCUREMENT.(U)
JUN 77 E P BRADSHAW, D M HERRICK

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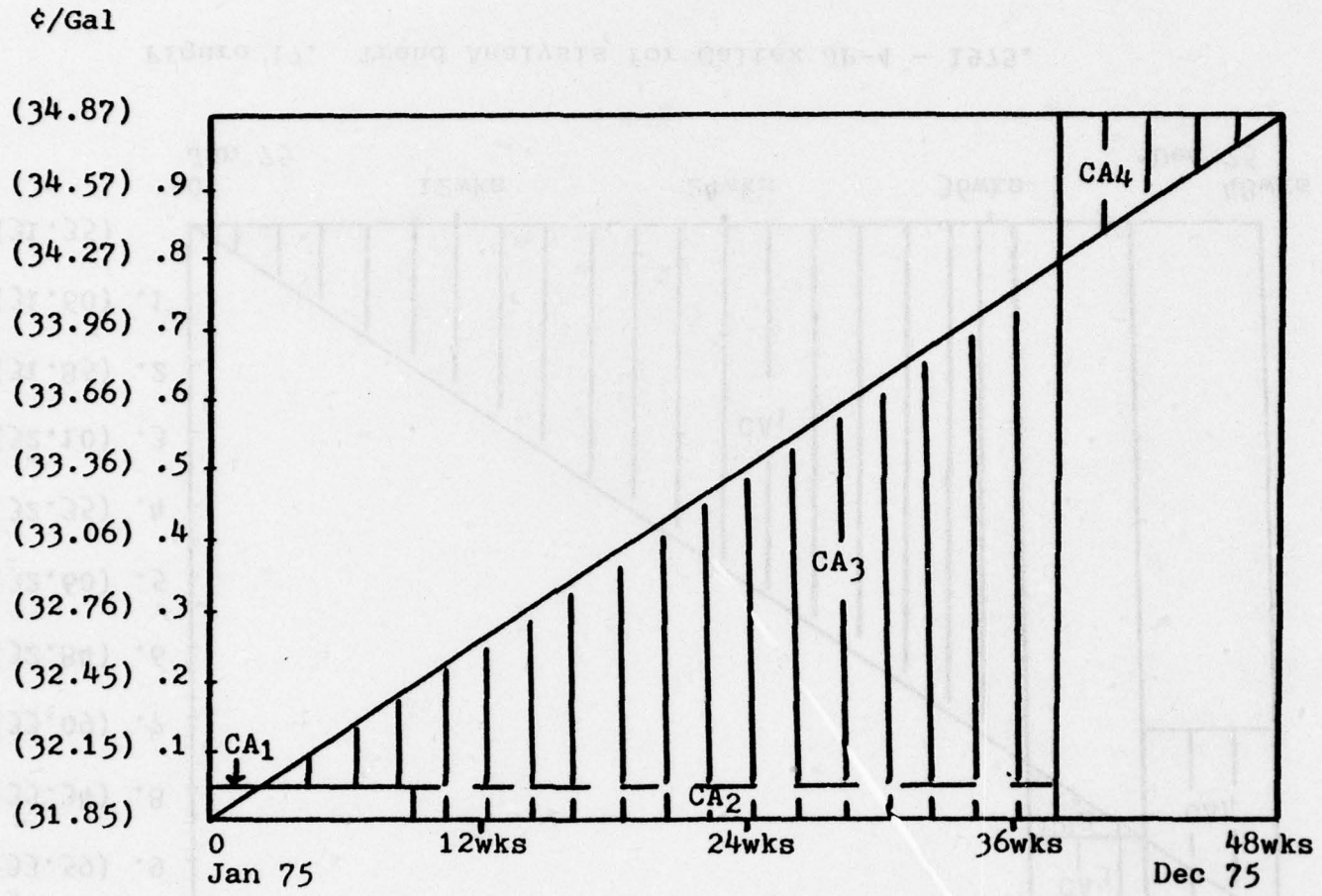


Figure 18. Trend Analysis for Shell Eastern JP-4 - 1975.

Table 14

Trend Analysis Calculations

for Kerosene in 1976*

Caltex

Note Kerosene for Caltex did not change in 1976. $\Sigma\ CA_i^2/w_i = 0$

Shell Eastern (Reference Figure 19)

$CA_1 = (11)(7.8) = 85.8$

$CA_2 = (.5)(11)(2.2) = 12.1$

$CA_3 = (37)(2.2) = 81.4$

$CA_4 = (1.5)(37)(7.5) = 144.3$

$CA_1^2/w_1 = (85.8)^2/11 = 669.24$

$CA_2^2/w_2 = (12.1)^2/11 = 13.31$

$CA_3^2/w_3 = (81.4)^2/37 = 179.08$

$CA_4^2/w_4 = (144.3)^2/37 = 562.77$

$\Sigma\ CA_i^2/w_i = 1424.4$

*(Source:38)

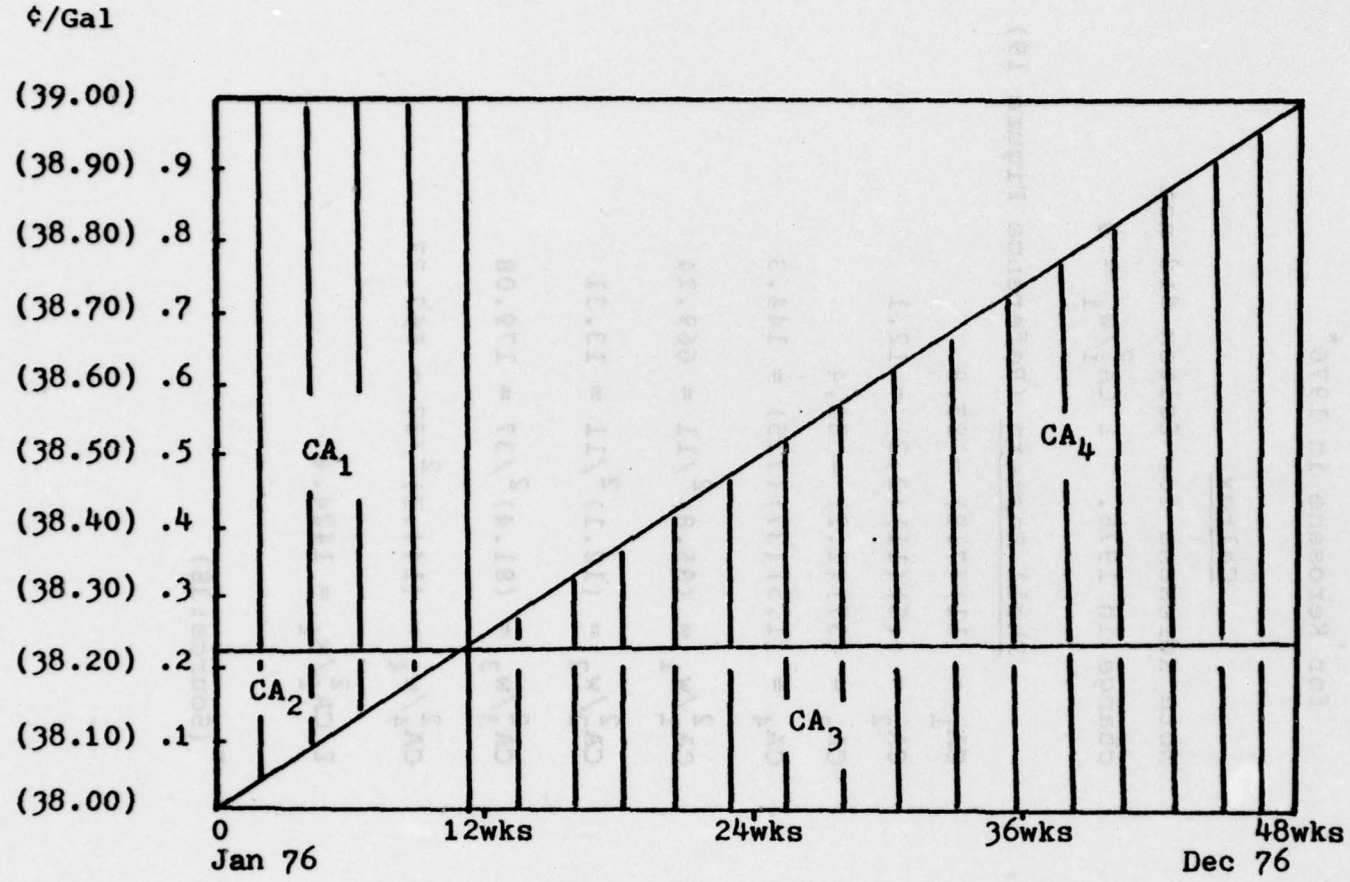


Figure 19. Trend Analysis for Shell Eastern Kerosene - 1976

Table 15

Trend Analysis Calculations

for Naptha in 1976*

Caltex (Reference Figure 20)

$CA_1 = (.5)(9)(1.9) = 8.55$

$CA_2 = (.5)(39)(8.1) = 157.95$

$CA_1^2/w_1 = (8.55)^2/9 = 8.12$

$CA_2^2/w_2 = (157.95)^2/39 = 639.70$

$\Sigma\ CA_i^2/w_i = 647.82$

Shell Eastern (Reference Figure 21)

$CA_1 = (.5)(5)(1) = 2.5$

$CA_2 = (.5)(43)(9) = 193.5$

$CA_1^2/w_1 = (2.5)^2/5 = 1.25$

$CA_2^2/w_2 = (193.5)^2/43 = 870.75$

$\sum_{i=1}^{2} CA_i^2/w_i = 872$

*(Source:38)

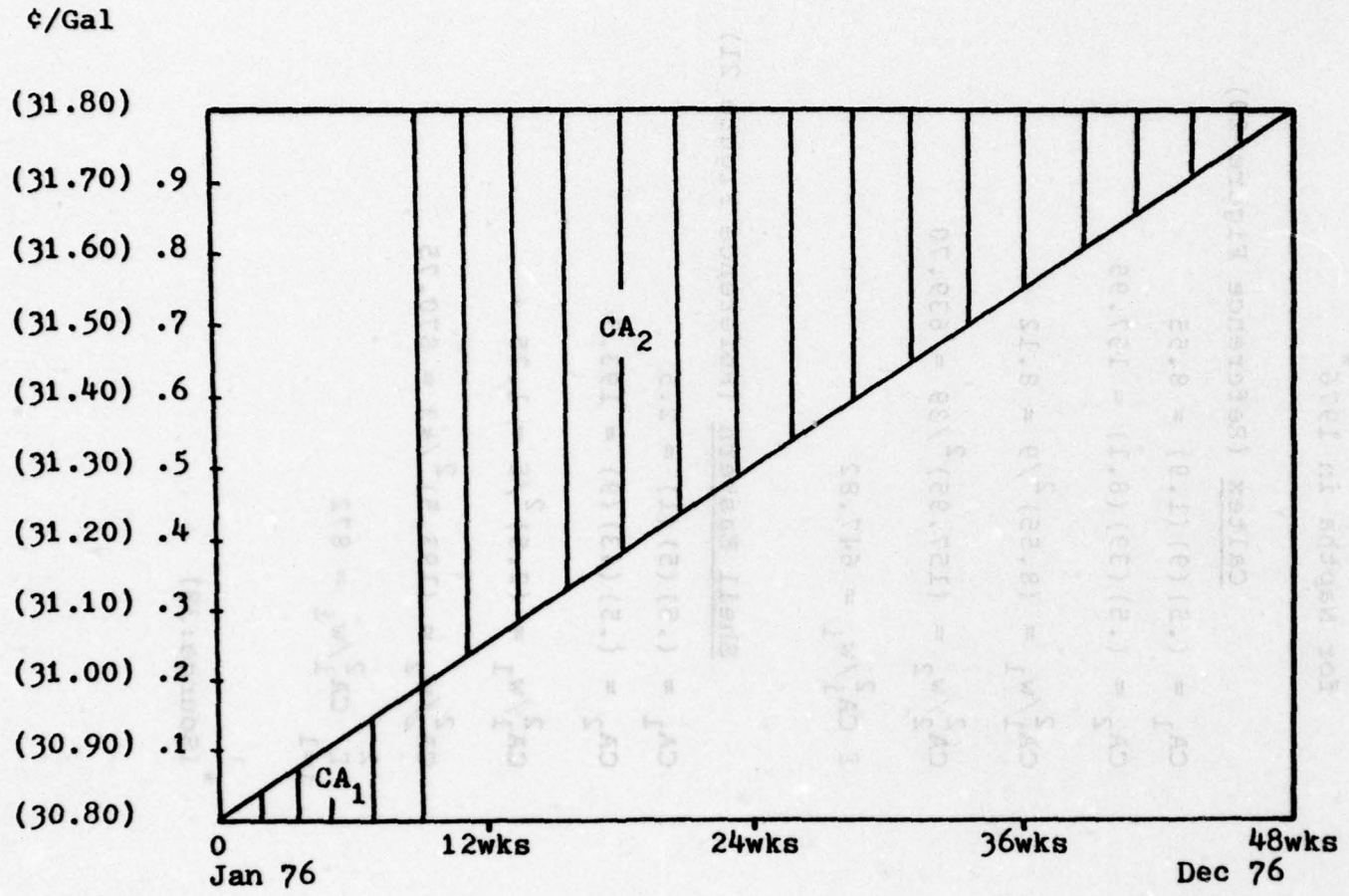


Figure 20. Trend Analysis for Caltex Naptha - 1976.

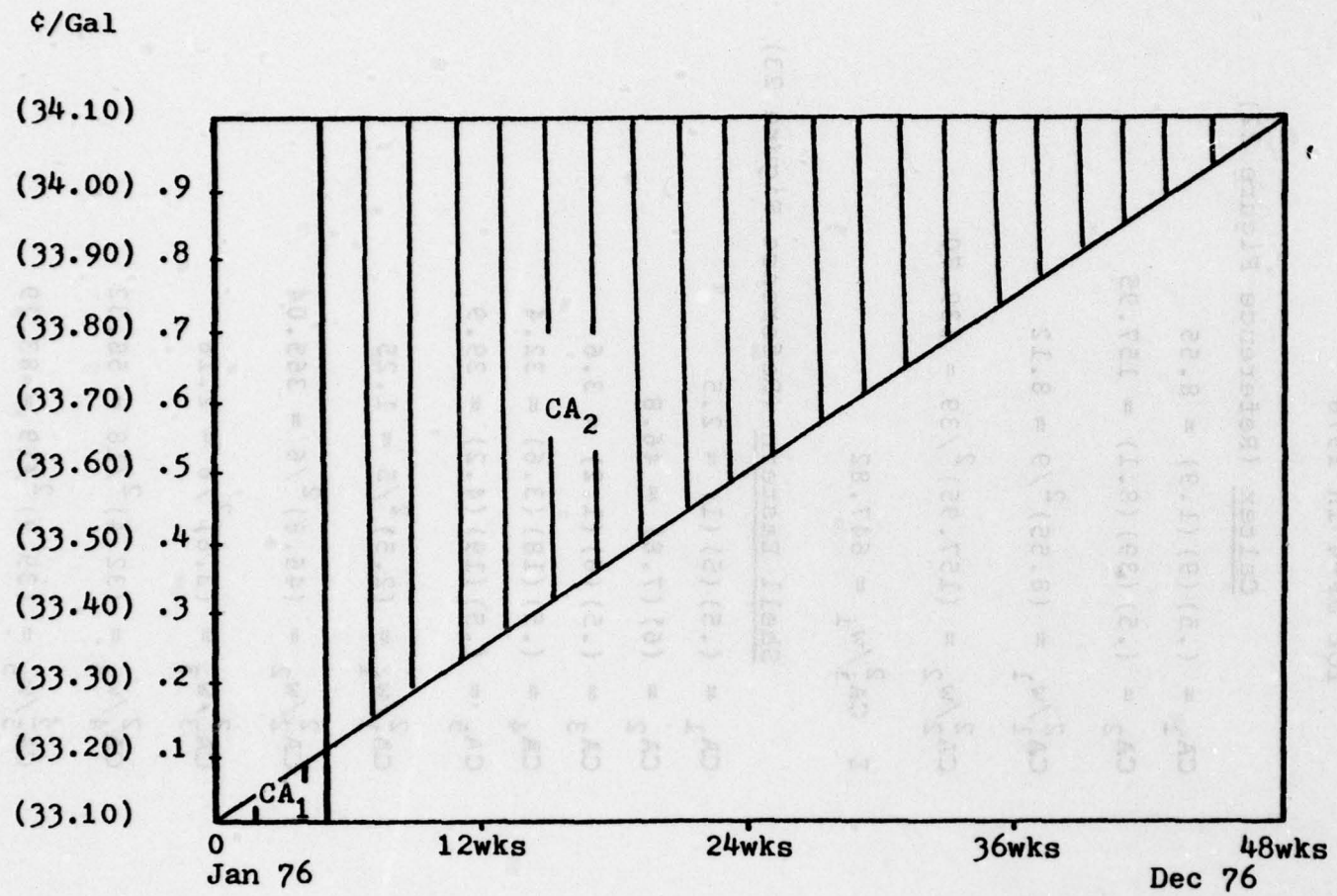


Figure 21. Trend Analysis for Shell Eastern Naptha - 1976.

Table 16

Trend Analysis Calculations

for JP-4 in 1976*

Caltex (Reference Figure 22)

$CA_1 = (.5)(9)(1.9) = 8.55$

$CA_2 = (.5)(39)(8.1) = 157.95$

$CA_1^2/w_1 = (8.55)^2/9 = 8.12$

$CA_2^2/w_2 = (157.95)^2/39 = 639.70$

$\Sigma \ CA_i^2/w_i = 647.82$

Shell Eastern (Reference Figure 23)

$CA_1 = (.5)(5)(1) = 2.5$

$CA_2 = (6)(7.8) = 46.8$

$CA_3 = (.5)(6)(1.2) = 3.6$

$CA_4 = (.5)(18)(3.6) = 32.4$

$CA_5 = (.5)(19)(4.2) = 39.9$

$CA_1^2/w_1 = (2.5)^2/5 = 1.25$

$CA_2^2/w_2 = (46.8)^2/6 = 365.04$

$CA_3^2/w_3 = (3.6)^2/6 = 2.16$

$CA_4^2/w_4 = (32.4)^2/18 = 58.32$

$CA_5^2/w_5 = (39.9)^2/19 = 83.79$

$\Sigma \ CA_i^2/w_i = 510.56$

*(Source:38)

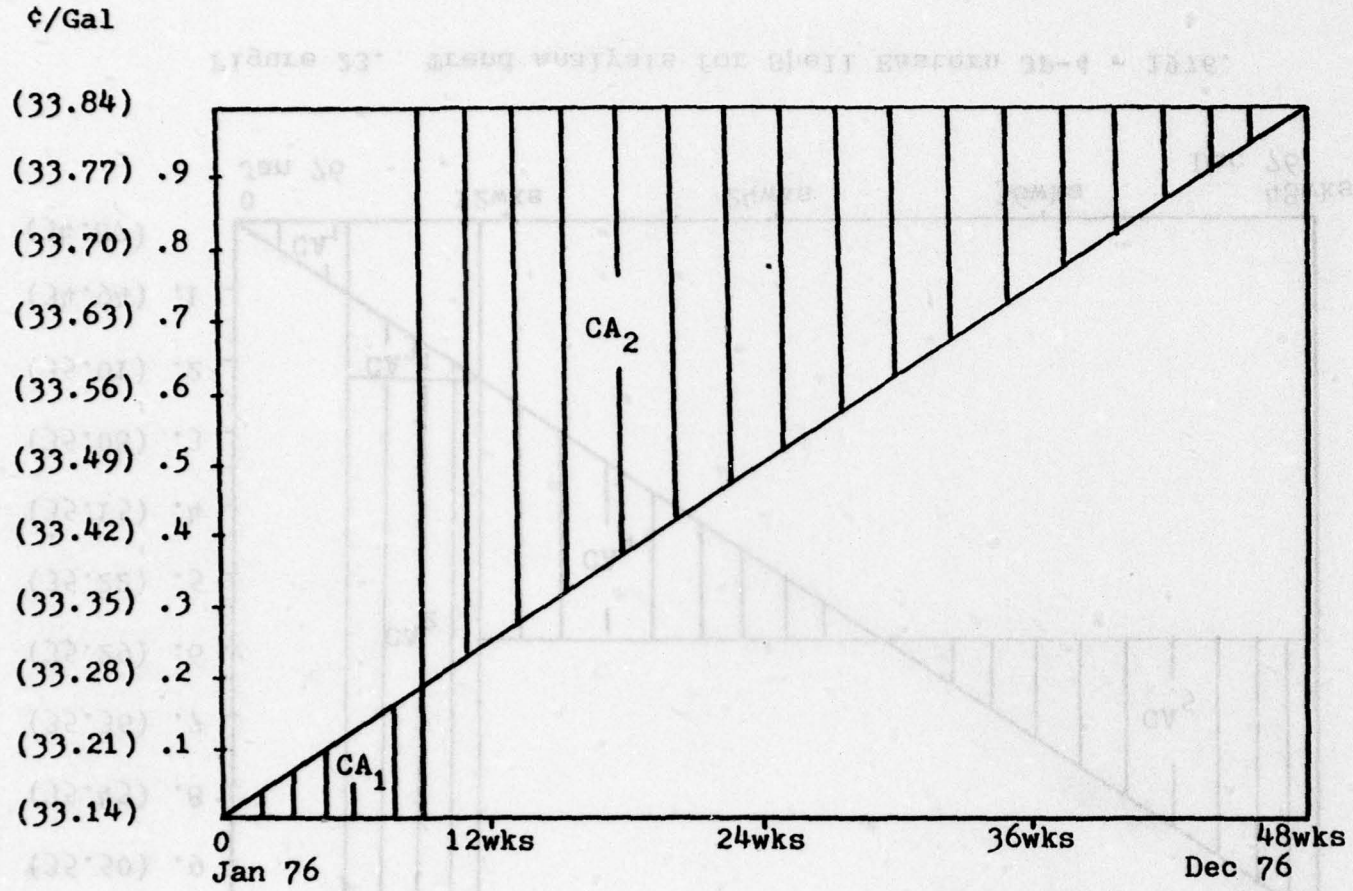


Figure 22. Trend Analysis for Caltex JP-4 - 1976.

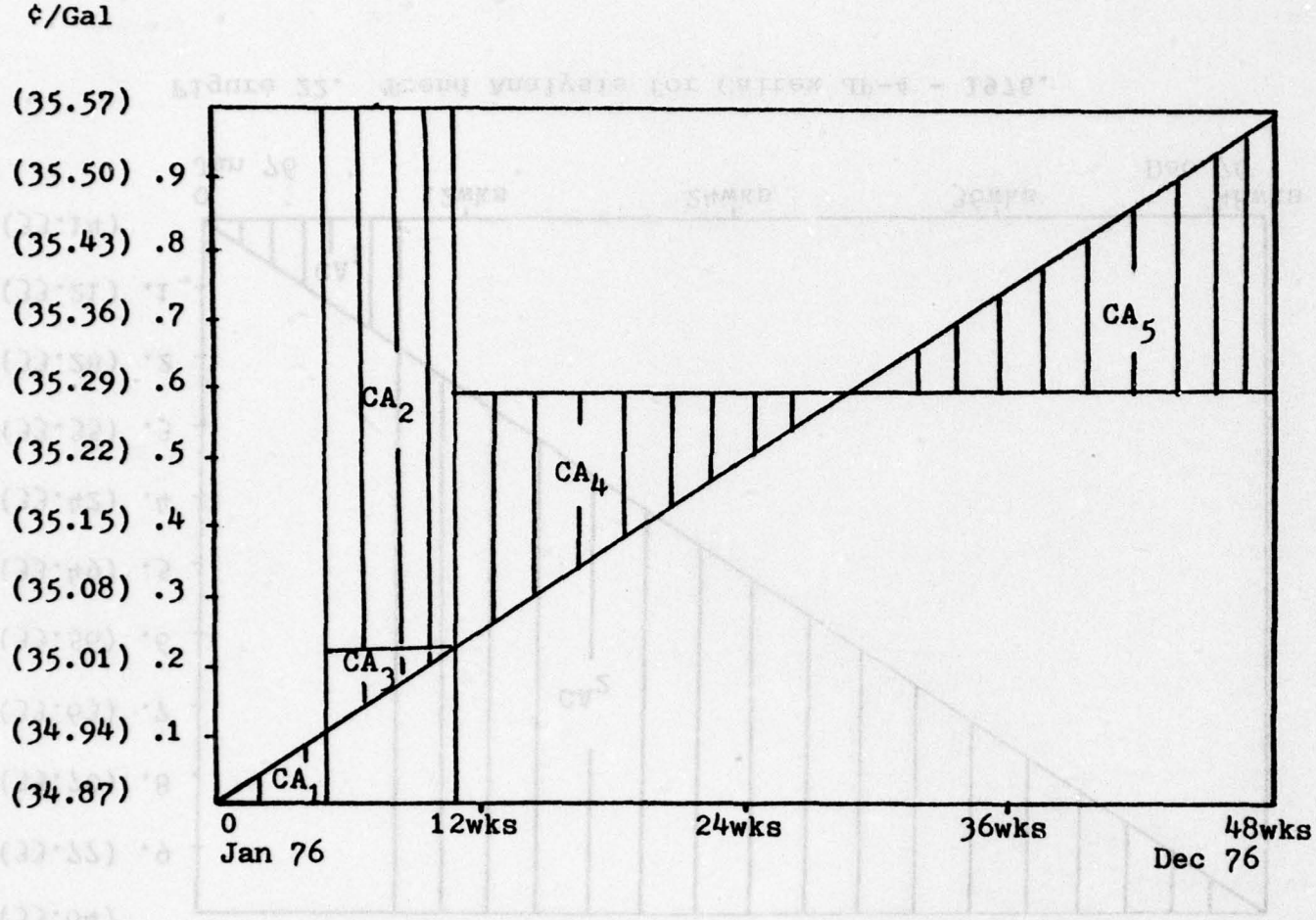


Figure 23. Trend Analysis for Shell Eastern JP-4 - 1976.

Subquestion IV

Can posted prices which may be used as JP-4 reference prices be accurately forecasted?

Crude Oil Posted Prices

An attempt was not made to substantiate the ability to accurately forecast crude oil posted prices because of the impending downfall of the crude oil posting system as it exists today. In order to fully comprehend the mechanism of the crude oil posted price system in effect through the period of this research and the reason for the downfall, it is necessary to look at the current system of "participation."

Participation. Historically, OPEC crude oil was owned by concessionaire companies formed by western oil companies.[7] However, in the 1970's the OPEC community initiated a plan known as "participation;" a sharing in the ownership of oil with the oil companies. Initial participation arrangements called for 25% ownership of oil by the governments of OPEC countries with the oil companies (concessionaires) retaining 75% ownership (25:22). The current meaning of "participation," however, is no longer a sharing of ownership but a gradual and complete (100%) transfer of ownership of crude oil to the OPEC governments. Within the current participation environment, therefore, two categories of crude oil exist. "Equity crude oil" is the crude oil that belongs to the oil companies owning a part of the concessionaire

companies. The rest, known as "participation crude oil," belongs to the government of the applicable producing country (23:31).

Since Platt's posted prices for OPEC crude oil (i.e. Saudi Arabia, Kuwait, and Nigeria) are OPEC government set tax reference figures that apply to royalty payments and income taxes on "equity crude oil," it is obvious that the impending attainment of 100% participation will eliminate "equity crude oil" and render obsolete the prevailing fiscal structure based on OPEC crude oil posted prices/tax reference figures (10; 28:372; 37).

Refined Product Posted Prices

Only Caltex kerosene posted prices for 1976 were accurately forecasted. In all other cases, more than 9 weekly forecasts for 1976 fell outside of the confidence interval. (Reference Tables 17-22 and Graph 9-14.)

Table 17

Actual and Forecasted Posted Prices

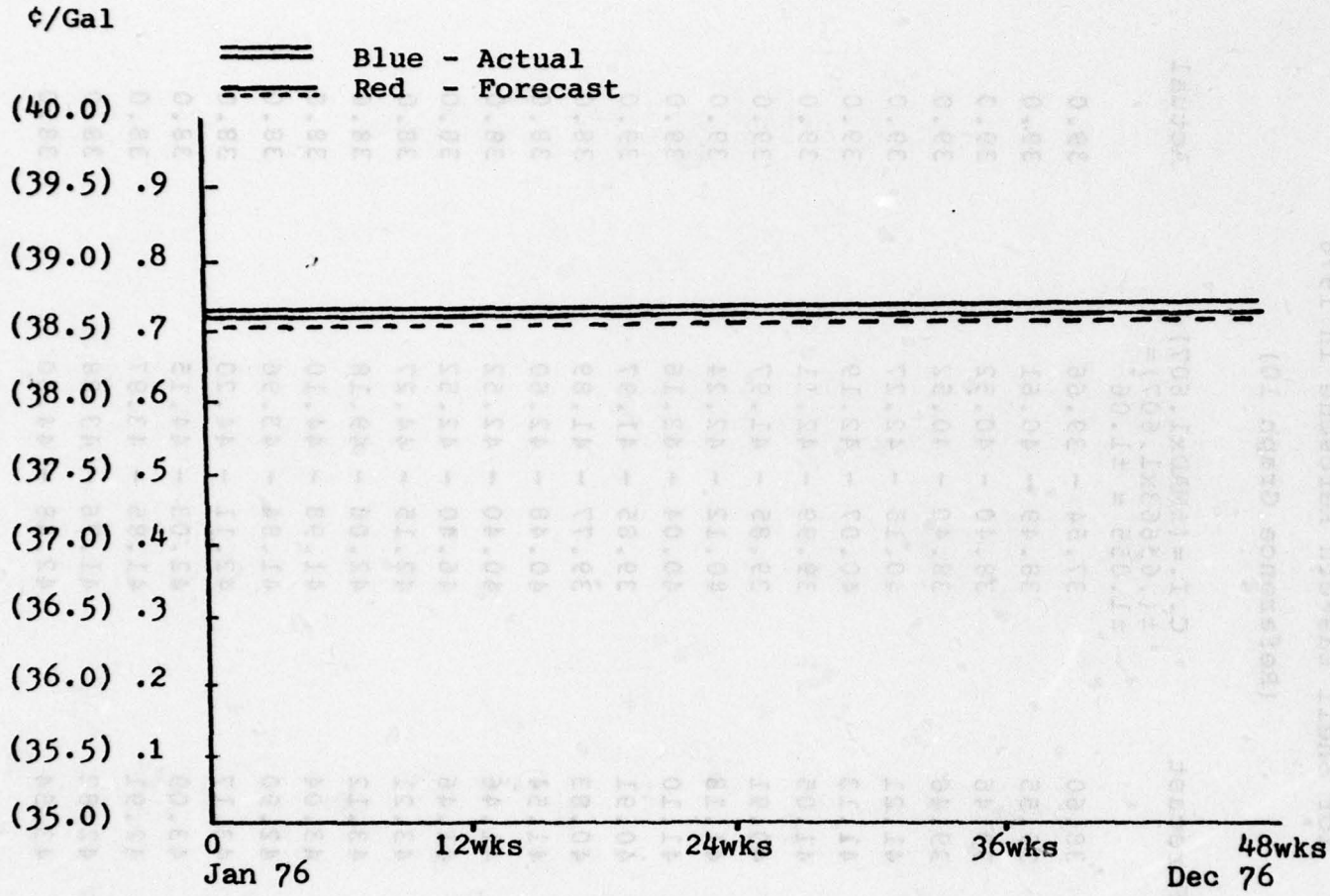
for Caltex Kerosene in 1976

(Reference Graph 9)

	Forecast	C.I.=(±MADx1.607) = ±(.16608)(1.607)=±.27	Actual
Jan	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Feb	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Mar	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Apr	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
May	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Jun	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6

Table 17 (Continued

July	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Aug	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Sep	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Oct	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Nov	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
Dec	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6
	38.6	38.33 - 38.87	38.6



Graph 9. Actual vs Forecasted Posted Prices for Caltex Kerosene in 1976.

Table 18

Actual and Forecasted Posted Prices

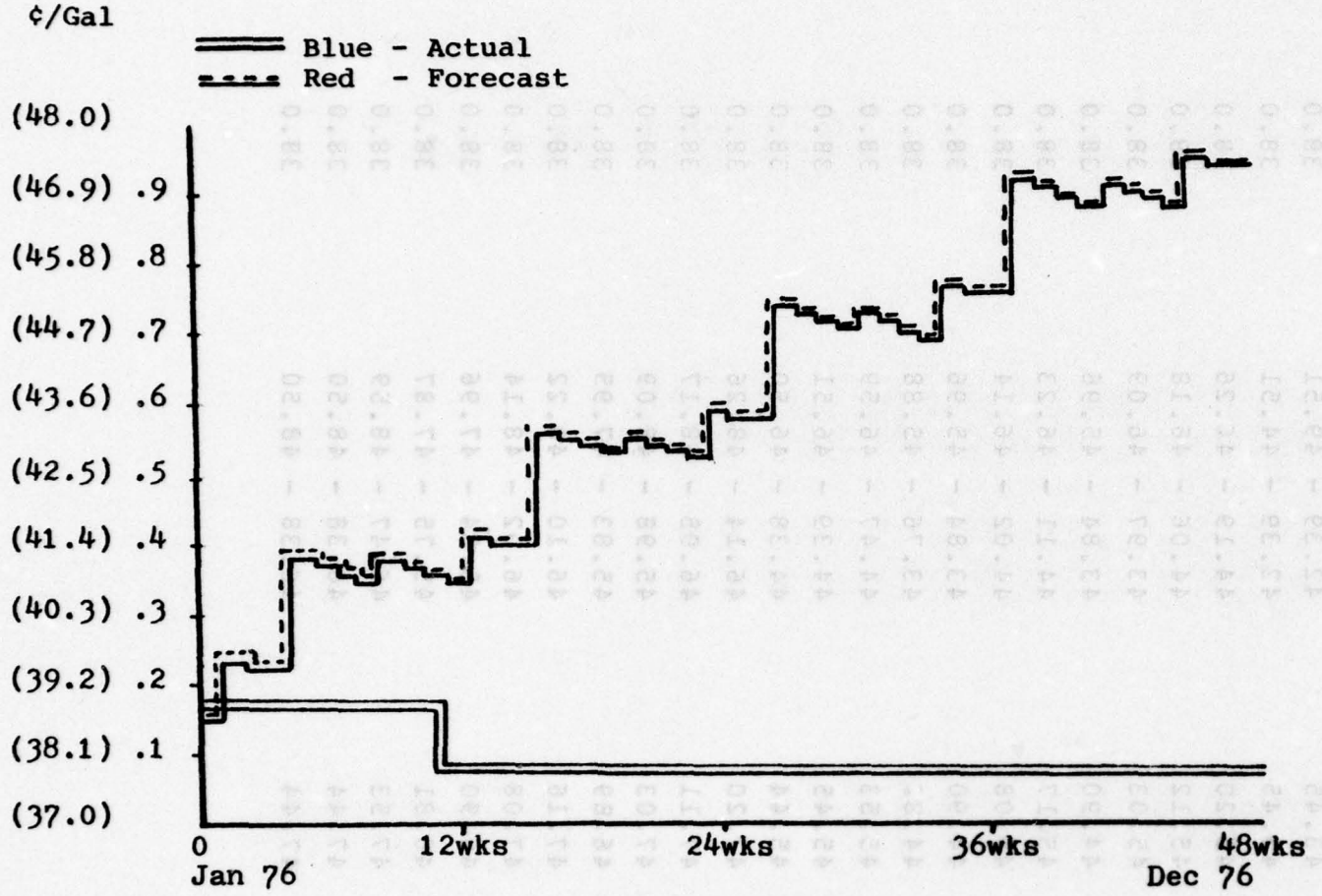
for Shell Eastern Kerosene in 1976

(Reference Graph 10)

	Forecast	C.I.=(±MADx1.607)= ±(.65663x1.607)= ±1.055 ≃ ±1.06	Actual
Jan	38.60	37.54 - 39.66	39.0
	39.55	38.49 - 40.61	39.0
	39.46	38.40 - 40.52	39.0
	39.46	38.40 - 40.52	39.0
Feb	41.21	40.15 - 42.27	39.0
	41.13	40.07 - 42.19	39.0
	41.05	39.99 - 42.11	39.0
	40.91	39.85 - 41.97	39.0
Mar	41.18	40.12 - 42.24	39.0
	41.10	40.04 - 42.16	39.0
	40.91	39.85 - 41.97	39.0
	40.83	39.77 - 41.89	38.0
Apr	41.54	40.48 - 42.60	38.0
	41.46	40.40 - 42.52	38.0
	41.46	46.40 - 42.52	38.0
	43.21	42.15 - 44.27	38.0
May	43.12	42.06 - 49.18	38.0
	43.04	41.98 - 44.10	38.0
	42.90	41.84 - 43.96	38.0
	43.17	42.11 - 44.23	38.0
Jun	43.09	42.03 - 44.15	38.0
	42.91	41.85 - 43.97	38.0
	42.82	41.76 - 43.88	38.0
	43.54	42.48 - 44.60	38.0

Table 18 (Continued)

July	43.45	42.39 - 49.51	38.0
	43.45	42.39 - 44.51	38.0
	45.20	44.19 - 46.26	38.0
	45.12	44.06 - 46.18	38.0
Aug	45.03	43.97 - 46.09	38.0
	44.90	43.84 - 45.96	38.0
	45.17	44.11 - 46.23	38.0
	45.08	44.02 - 46.14	38.0
Sep	44.90	43.84 - 45.96	38.0
	44.82	43.76 - 45.88	38.0
	45.53	44.47 - 46.59	38.0
	45.45	44.39 - 46.51	38.0
Oct	45.44	44.38 - 46.50	38.0
	47.20	46.14 - 48.26	38.0
	47.11	46.05 - 48.17	38.0
	47.03	45.98 - 48.09	38.0
Nov	46.89	45.83 - 47.95	38.0
	47.16	46.10 - 48.22	38.0
	47.08	46.02 - 48.14	38.0
	46.90	45.84 - 47.96	38.0
Dec	46.81	45.75 - 47.87	38.0
	47.53	46.47 - 48.59	38.0
	47.44	46.38 - 48.50	38.0
	47.44	46.38 - 48.50	38.0



Graph 10. Actual vs Forecasted Posted Prices for Shell Eastern Kerosene in 1976.

Table 19

Actual and Forecasted Posted Prices

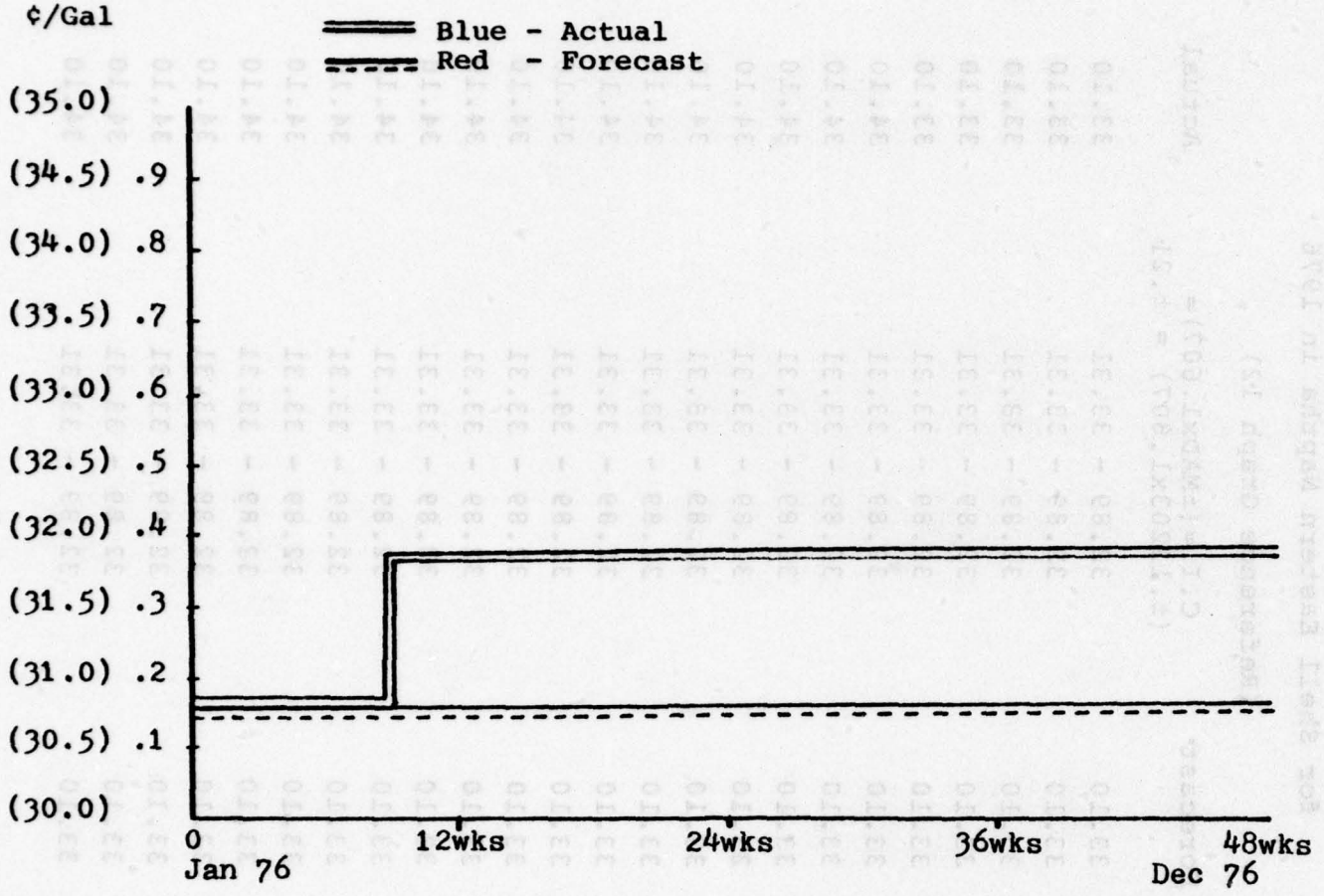
for Caltex Naptha in 1976

(Reference Graph 11)

	Forecast	C.I.=(±MADx1.607)= ±(.12318x1.607) = ±.20	Actual
Jan	30.8	30.6 - 31	30.8
	30.8	30.6 - 31	30.8
	30.8	30.6 - 31	30.8
	30.8	30.6 - 31	30.8
Feb	30.8	30.6 - 31	30.8
	30.8	30.6 - 31	30.8
	30.8	30.6 - 31	30.8
	30.8	30.6 - 31	30.8
Mar	30.8	30.6 - 31	30.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
Apr	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
May	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
Jun	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8

Table 19 (Continued)

July	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
Aug	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
Sep	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
Oct	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
Nov	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
Dec	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8
	30.8	30.6 - 31	31.8



Graph 11. Actual vs Forecasted Posted Prices for Caltex Naptha in 1976.

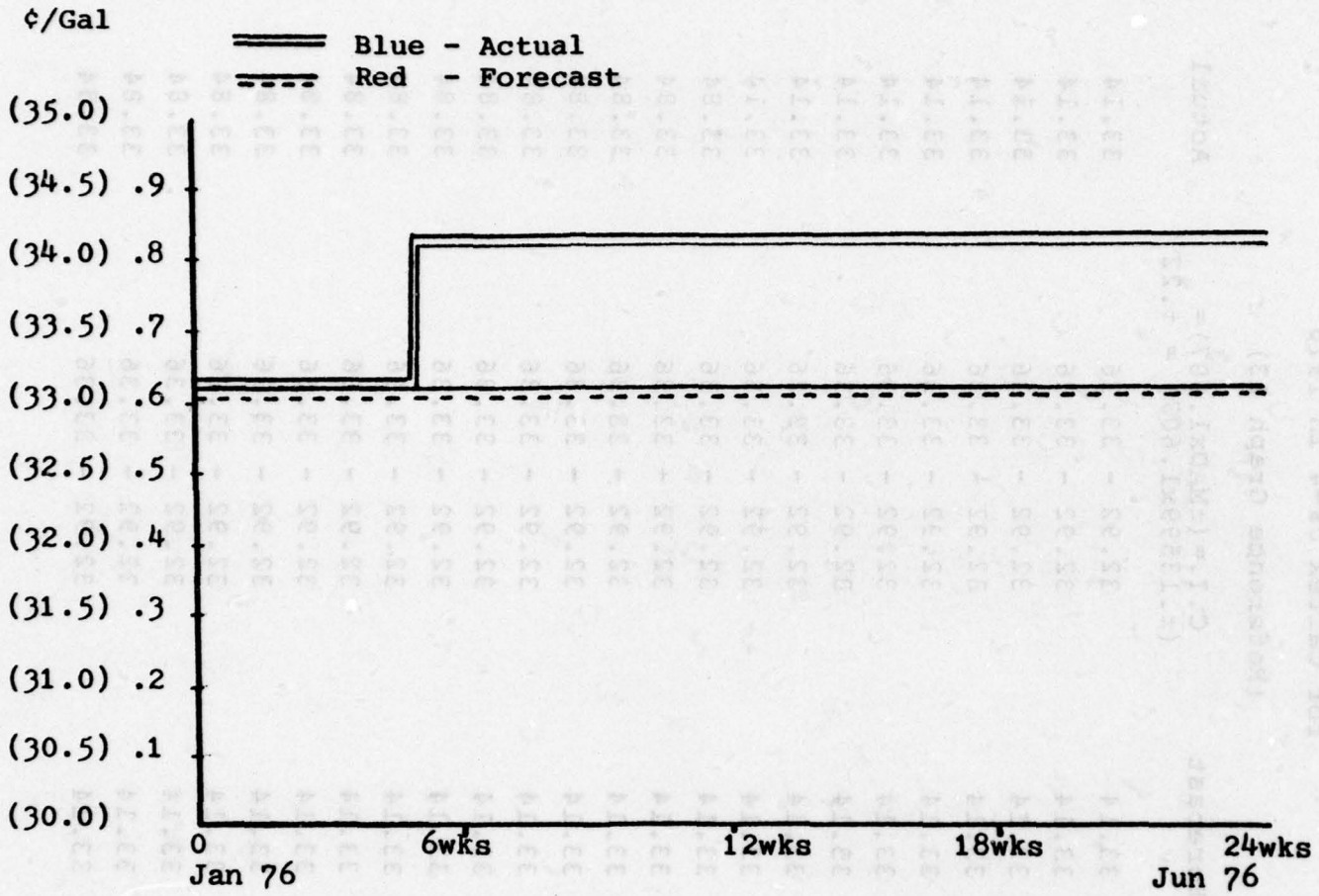
Table 20

Actual and Forecasted Posted Prices

for Shell Eastern Naptha in 1976

(Reference Graph 12)

	Forecast	C.I.=(±MADx1.607)= (±.13203x1.607) = ±.21	Actual
Jan	33.10	32.89 - 33.31	33.10
	33.10	32.89 - 33.31	33.10
	33.10	32.89 - 33.31	33.10
	33.10	32.89 - 33.31	33.10
Feb	33.10	32.89 - 33.31	33.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
Mar	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
Apr	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
May	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
Jun	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10
	33.10	32.89 - 33.31	34.10



Graph 12. Actual vs Forecasted Posted Prices for Shell Eastern Naptha in 1976.

Table 21

Actual and Forecasted Posted Prices

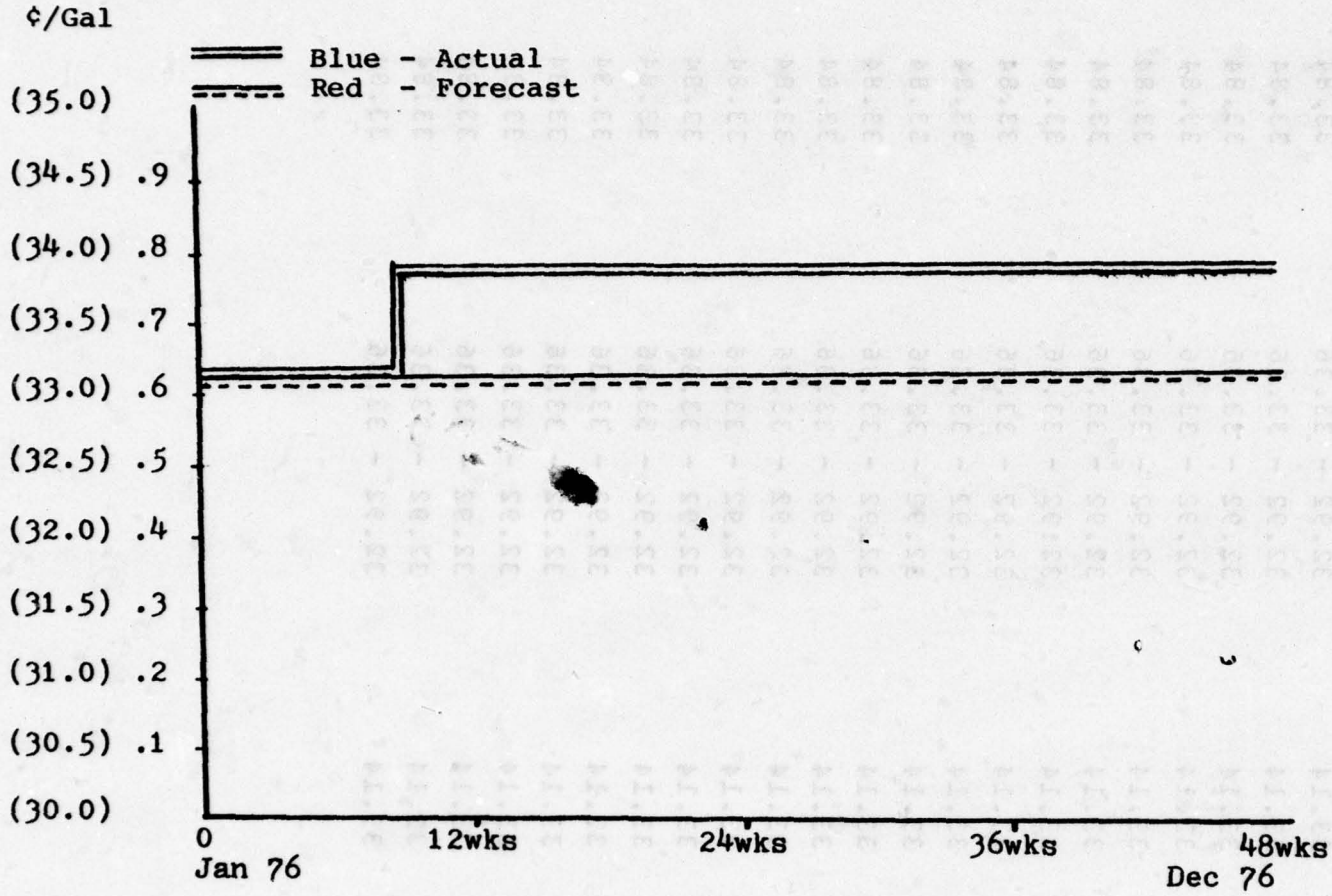
for Caltex JP-4 in 1976

(Reference Graph 13)

	Forecast	C.I.=(±MADx1.607)= (±.13599x1.607) = ±.22	Actual
Jan	33.14	32.92 - 33.36	33.14
	33.14	32.92 - 33.36	33.14
	33.14	32.92 - 33.36	33.14
	33.14	32.92 - 33.36	33.14
Feb	33.14	32.92 - 33.36	33.14
	33.14	32.92 - 33.36	33.14
	33.14	32.92 - 33.36	33.14
	33.14	32.92 - 33.36	33.14
Mar	33.14	32.92 - 33.36	33.14
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
Apr	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
May	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
Jun	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84

Table 21 (Continued)

July	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
Aug	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
Sep	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
Oct	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
Nov	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
Dec	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84
	33.14	32.92 - 33.36	33.84



Graph 13. Actual vs Forecasted Posted Prices for Caltex JP-4 in 1976.

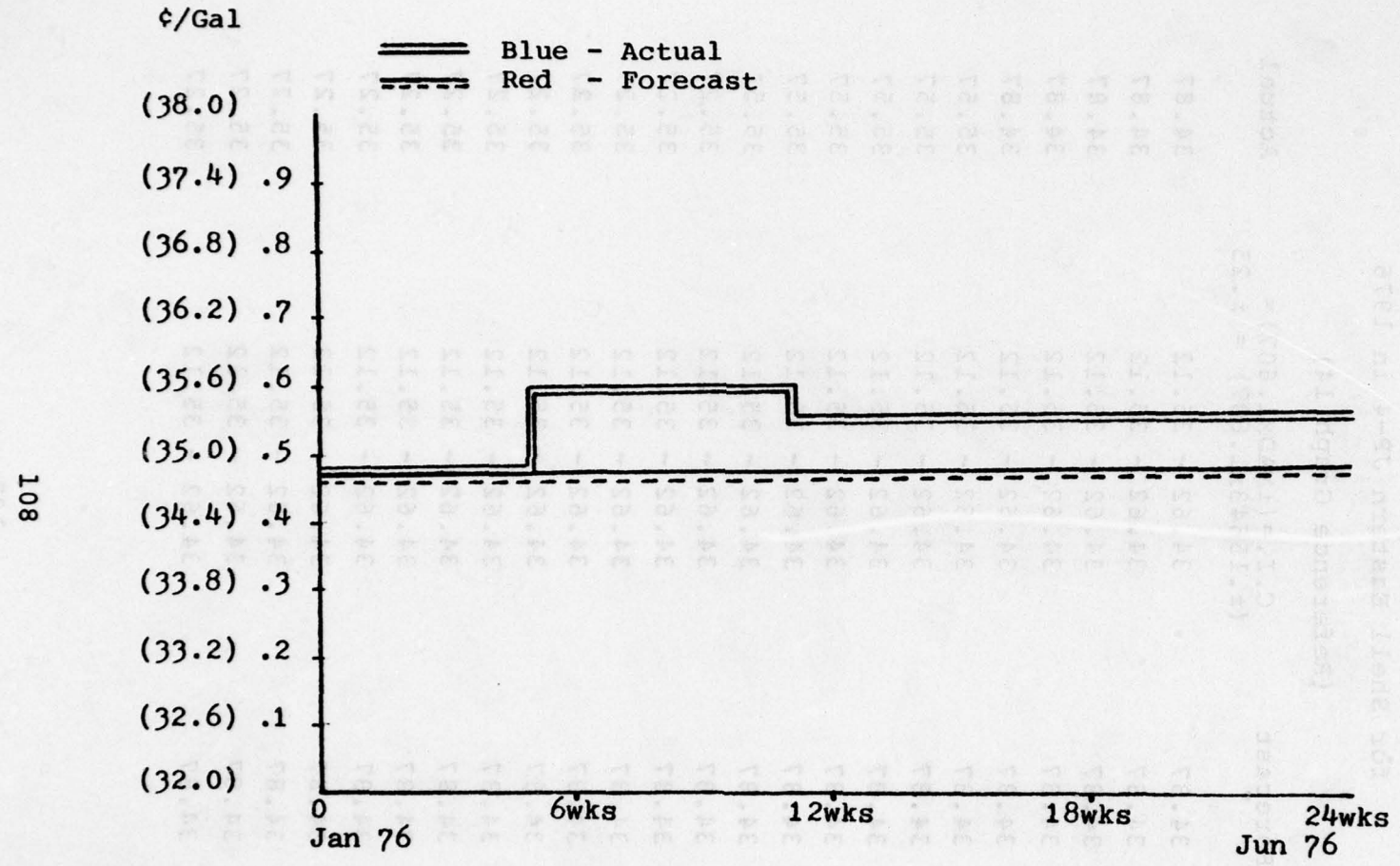
Table 22

Actual and Forecasted Posted Prices

for Shell Eastern JP-4 in 1976

(Reference Graph 14)

	Forecast	C.I.=(±MADxl.607)= (±.15643xl.607) = ±.25	Actual
Jan	34.87	34.62 - 35.12	34.87
	34.87	34.62 - 35.12	34.87
	34.87	34.62 - 35.12	34.87
	34.87	34.62 - 35.12	34.87
Feb	34.87	34.62 - 35.12	34.87
	34.87	34.62 - 35.12	35.57
	34.87	34.62 - 35.12	35.57
	34.87	34.62 - 35.12	35.57
Mar	34.87	34.62 - 35.12	35.57
	34.87	34.62 - 35.12	35.57
	34.87	34.62 - 35.12	35.57
	34.87	34.62 - 35.12	35.27
Apr	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27
May	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27
Jun	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27
	34.87	34.62 - 35.12	35.27



Graph 14. Actual vs Forecasted Posted Prices for Shell Eastern JP-4 in 1976.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

From the five possible postings examined (i.e. (1) Saudi Arabian crude oil, (2) Kuwait crude oil, (3) Nigerian crude oil, (4) Caltex JP-4, calculated from naptha and kerosene postings (5) Shell Eastern JP-4, calculated from naptha and kerosene postings) no one price adequately met the requirements for a "single best" reference price. Although the crude oil posted prices met almost all conditions, no single one could be identified as an overall price leader with the present OPEC "tier pricing" system. With regard to the two JP-4 posted price values, both are controlled by companies bidding/supplying JP-4 for WESTPAC. Additionally, more risk is involved and the refined postings are not as stable nor uniform as the crude oil postings. The next consideration, then, was if there was an identifiable combination of reference prices for use in the escalation clause.

The most crucial difference that existed between the five candidates was the level of risk between the crude oil and refined product postings. Hence, if the DFSC is to be "fair and reasonable" to all contractors,

the combination should ideally be all crude oil postings or all refined product postings. Since the purpose of a fixed price contract with escalation is to provide protection against changes ("significant economic fluctuations") in the contractor's cost schedule that lie beyond his control, a combination of crude oil and not refined product postings is preferable.

Crude oil postings. With the impending downfall of the crude oil postings/tax reference figures, a new system will, undoubtedly, evolve which will be based upon the current price of "participation oil;" presently calculated as a fixed percent (i.e. 93%) of the posted price/tax reference figure. As long as the "tier" pricing system is in effect for OPEC crude oil, however, the only appropriate reference price for a JP-4 contract would be one directly related to the contractor's actual source of crude oil. Hence, if a contractor obtains his crude oil from Saudi Arabia, for example, the reference price should be the purchase price of the Saudi crude oil; likewise for a contractor whose crude oil source is Kuwait or Nigeria. If the contractor obtains his crude oil from more than one source, the reference price should reflect the appropriate average of the purchase prices.

Refined product postings. If the DFSC opts for all refined product postings and the associated larger risk

factor, the prospective "Saudi ARAMCO" posted prices for naptha and kerosene would provide both a price leader and a price beyond the control of current bidder/suppliers for WESTPAC JP-4, in short, a "single" reference price. It is assumed that the "Saudi ARAMCO" postings, like the current Middle East Caltex postings from Ras Tanura, Saudi Arabia, will be more stable and uniform than the alternative Shell Eastern postings.

Of the existing refined product postings (i.e. Caltex and Shell Eastern), Caltex is preferable over Shell Eastern because of the above mentioned characteristics of stability and uniformity. However, since Caltex is, in fact, a supplier of WESTPAC JP-4, the less desirable Shell Eastern postings would have to be utilized as a reference price for the DFSC contract with Caltex.

Crude oil/refined product postings. Obviously, a third alternative available to the DFSC, is the continuance of the present procedure of utilizing both crude oil postings and refined product postings as reference prices for their contracts. However, under this system the DFSC is not only assuming an unwarranted financial risk with contracts using refined product postings as reference prices, but also is not presently a consistent "fair and reasonable face" to the petroleum industry.

From the three alternatives proposed (i.e. (1) utilization of only crude oil postings, (2) utilization

of only refined product postings, or (3) utilization of both crude oil and refined product postings) the following ranking has been concluded:

(1) All crude postings

(2) Combination of crude and refined products

(3) All refined postings

Even though the DFSC is presenting two faces to the petroleum industry, a combination of crude and refined postings has been chosen over all refined postings because the disadvantages of the unwarranted and large financial risk associated with all refined products far outweigh the disadvantages of presenting two faces to the petroleum industry as the DFSC is presently doing.

Recommendations

Based on the ranking obtained by the researchers, it is recommended that the DFSC use only crude oil posted prices as reference prices in WESTPAC JP-4 contracts.

Additionally, the researchers recommend that:

(1) Future research be conducted on the behavior of the impending new crude oil posted price system that will replace the current tax reference system for equity oil.

(2) The OPEC "tier" pricing system be carefully watched for a future

compromise settlement and the subsequent return of Arabian light crude oil as the OPEC reference posting for crude oil.

(3) Future research be conducted on the behavior of the impending "Saudi ARAMCO" refined postings which will replace the current Middle East postings for Mobil, Exxon, and Caltex at Ras Tanura.

FOOTNOTES

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1. For example, WESTPAC contract requirements for calendar year 1977 are as follows: JP-4/341,600,000 gals., JP-5/123,000,000 gals., DFM/323,904,000 gals., Mogas/ 31,500,000 gals., Kerosene/546,000 gals., NSFO/1,950,000 Bbls. (31; 32:1).

2. Clause L42 Foreign Government Take on Crude Oil was also previously utilized. However, with the impending 100% participation of crude oil by the governments of the Organization of Petroleum Exporting Countries the clause will be rendered obsolete (20).

3. The reference price may, in a few instances, be the purchase price of crude oil rather than the actual posted price. The purchase price is usually 93% of the posted price (11).

4. For example, the DFSC contracted for fiscal year 1976 JP-4 requirements with Caltex, a major supplier for WESTPAC, using the following reference price (20):

   Weighted average of Platt's posted prices for:

   (1) Caltex kerosene
   (2) Caltex naptha
   (3) Shell Eastern kerosene
   (4) Shell Eastern naptha

5. Estimated JP-4 requirements for WESTPAC for 1977 equals 341,600,000 gals.

   341,600,000 gals. x .005 dollars/gal. = $1,708,000

6. TCAST has been chosen as the forecast technique because experience indicates that trend projections are good for medium range (3 months to 2 years) forecasting (7:57).

7. Most concessionaire companies were formed by arrangements between various members of the eight major international oil companies (i.e. Exxon, Mobil, Gulf, Texaco, Standard Oil Company of California, British Petroleum, Shell, and Compagnie Francaise des Petroles) (18:14). Two examples of concessionaire companies are (18:12):

(1) ARAMCO; owned, prior to participation, 30% by Texaco, 30% by Exxon, 30% by Standard Oil Company of California, and 10% by Mobil

(2) Kuwait Oil Company; owned, prior to participation, 50% by Shell and 50% by Gulf

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