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MULTINATIONAL CORPORATIONS, TRANSFER PRICES, AND TAXES: EVIDENCE FROM THE U.S. PETROLEUM INDUSTRY

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ABSTRACT

Economic research on transfer-pricing behavior by multinational corporations has emphasized theoretical modeling and institutional description. This paper presents the first systematic empirical analysis of transfer prices, using data from the petroleum industry. On the basis of oil imported into the United States over the period 1973 - 1984, we test two propositions:

i) Are prices set by integrated companies for their internal transfers different from those prevailing in arm's-length (i.e., inter-company) trade, when other variables, such as oil quality, are controlled for?

ii) Do average effective corporate income tax rates explain observed patterns of transfer pricing?

Regression analysis leads to the following conclusions:

i) Transfer and arm's-length prices differ significantly for oil originating in some countries, but not all. When multiplied by the relevant import volumes, these differences are relatively small. The revenue transferred through deviations from arm's-length prices represents two percent or less of the value of the crude oil imported by multinational companies each year.

ii) The observed differences between arm's-length and transfer prices are not easily explained by average effective tax rates in exporting countries.

Our results provide little support for the claim that multinational petroleum companies set their transfer prices to evade taxes. We offer several hypotheses to explain our findings.

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Introduction

Whenever goods cross national borders within the channels of a multinational corporation (MNC), a transfer price must be calculated for tax purposes. When corporate tax rates differ on the two sides of the border, the MNC has an incentive to set its transfer prices in a way so as to reduce its tax burden by reporting higher profits in the country where corporate profits are taxed more lightly.

The ability of MNCs to set transfer prices to minimize taxes, however, is circumscribed by the tax regulations of the home and host countries. In the United States, Section 482 of the Internal Revenue Code requires that transfer prices for imports and exports of goods and services be set equal to "arm's-length prices."

Defining "arm's-length prices" is often non-trivial. Unless the good transferred is perfectly homogeneous and has a well-functioning arm's-length market, determination of "arm's-length" prices will involve some arbitrariness. The process of determining arm's-length prices in practice is one of negotiation with the U.S. Internal Revenue Service. The numerous court cases involving arm's-length pricing (LaMont 1975) is an indication that the process is not cut-and-dried.

Allegation of "abuses" of transfer pricing is widespread, where "abuse" is very loosely defined as a divergence between transfer prices and some notion of arm's-length prices. These allegations are supported by some indirect evidence (Lall 1973, Vaitsos 1974, Jenkins and Wright 1975, Roumeliotis 1977, Bertrand 1981), but there have been no direct comparisons of interaffiliate and arm's-length prices. This paper carries out such a study for the U.S. petroleum industry.

The main reason for choosing the petroleum industry is that data are available. The main limitation in examining this industry is that its tax history, for both purely domestic companies

and multinationals, has been quite different in the United States from that of manufacturing. Thus one should be extremely cautious in generalizing results from petroleum to other industries.

Nevertheless, there is much to be said for examining petroleum, quite apart from data availability. As seen in Table 1, in the last decade for which tax data are available, the oil and gas industry has accounted for between one-third and two-thirds of US taxable income from abroad, paid well over half of foreign taxes, and earned a similar fraction of the foreign tax credits. Roughly speaking, the petroleum industry from this standpoint is about as large as all other industries combined.

Table 1 is also useful for obtaining a rough idea of the tax position of the industry. From column (5) the average foreign tax rate is very high, more than double that for other industries. From column (6) the ratio of the foreign tax credit to US taxable income from abroad is very close to the US statutory corporate tax rate, suggesting that there was little tax left to be paid at home. From column (7), whereas other industries were able to utilize almost every dollar of foreign tax paid to offset US taxes, the petroleum industry was able to offset only half to three-quarters of its foreign taxes paid. These figures are averages across all countries; as discussed below, situations vary from one country to the next.

The US petroleum industry has been alleged to be a notorious abuser of transfer pricing (see e.g., U.S. Congress 1977, Bertrand 1981). In addition to purely political considerations, there are at least three reasons for this. First, until the mid-1970s, US MNCs were permitted by the IRS to treat virtually all payments to governments for oil abroad as foreign income taxes, enabling the companies to deduct these costs directly from their US tax liabilities, rather than from their taxable income.[1] Their incentive was thus very strong to make these payments appear as large as possible.

TABLE 1: US FOREIGN INCOME, TAX, AND TAX CREDIT

Oil and Gas Industry vs. All Industries
(million $)

	(1) US Taxable Income from foreign sources	(2) Foreign Tax paid or accrued	(3) Foreign Tax Carryover	(4) Foreign Tax Credit computed	(5) Foreign Tax as % of US Taxable Income (2)/(1)	(6) Foreign Tax Credit as % of US Income (4)/(1)	(7) Foreign Tax Credit as % of Foreign Tax (4)/(2)	(8) Foreign Tax Carryover as % of Credit (3)/(4)
1972								
oil and gas	6760	5415	1429	3252	0.801	0.481	0.601	0.439
other industries	9726	3514	323	3365	0.361	0.346	0.958	0.096
all industries	16486	8929	1752	6617	0.542	0.401	0.741	0.265
oil and gas/ all industries	0.410	0.607	0.816	0.492				
1974								
oil and gas	32186	26668	4366	15516	0.829	0.482	0.582	0.281
other industries	14584	5040	363	4740	0.346	0.325	0.940	0.077
all industries	46770	31708	4729	20256	0.678	0.433	0.639	0.233
oil and gas/ all industries	0.688	0.841	0.923	0.766				

	(1) US Taxable Income from foreign sources	(2) Foreign Tax paid or accrued	(3) Foreign Tax Carryover	(4) Foreign Tax Credit computed	(5) Foreign Tax as % of US Taxable Income (2)/(1)	(6) Foreign Tax Credit as % of US Income (4)/(1)	(7) Foreign Tax Credit as % of Foreign Tax (4)/(2)	(8) Foreign Tax Carryover as % of Credit (3)/(4)
				1976				
oil and gas	37459	33368	3999	17820	0.891	0.476	0.534	0.224
other industries	17955	5841	655	5760	0.325	0.321	0.986	0.114
all industries	55414	39209	4654	23580	0.708	0.426	0.601	0.197
oil and gas/ all industries	0.676	0.851	0.859	0.756				
				1978				
oil and gas	36148	31148	18270	17111	0.862	0.473	0.549	1.068
other industries	29002	9504	990	9235	0.328	0.318	0.972	0.107
all industries	65150	40652	19260	26346	0.624	0.404	0.648	0.731
oil and gas/ all industries	0.555	0.766	0.949	0.649				

	(1) US Taxable Income from foreign sources	(2) Foreign Tax paid or accrued	(3) Foreign Tax Carryover	(4) Foreign Tax Credit computed	(5) Foreign Tax as % of US Taxable Income (2)/(1)	(6) Foreign Tax Credit as % of US Income (4)/(1)	(7) Foreign Tax Credit as % of Foreign Tax (4)/(2)	(8) Foreign Tax Carryover as % of Credit (3)/(4)
				1980				
oil and gas	31515	18859	3175	14080	0.598	0.447	0.747	0.225
other industries	39026	11137	1036	10801	0.285	0.277	0.970	0.096
all industries	70541	29996	4211	24881	0.425	0.353	0.829	0.169
oil and gas/ all industries	0.447	0.629	0.754	0.566				
				1982				
oil and gas	20670	12430	15872	9022	0.601	0.436	0.726	1.759
other industries	38812	10365	1598	9922	0.267	0.256	0.957	0.161
all industries	59482	22795	17470	18944	0.383	0.318	0.831	0.922
oil and gas/ all industries	0.348	0.545	0.909	0.476				

Source: U.S. Dept. of Treasury, Internal Revenue Service, Statistics of Income, various publications.

The second reason is the nature of the petroleum market. Crude oil, a raw material, accounts for most of the petroleum moving in international trade. Until the 1980s, there was virtually no spot-auction market in crude oil (see Hubbard and Weiner 1989). The arm's-length market was one of long-term contracts. Crude oil is not a homogeneous product, and contract terms depend, *inter alia*, on its sulfur and gravity, size of ship transporting the cargo, and terms of credit. In addition, as Hines (1988b) points out, the contractual relationship itself can have value, e.g., in mitigating moral hazard problems (referred to in the contracting literature as "opportunism;" see Williamson 1975). Moreover, the market for crude oil is not competitive, but rather has been dominated by OPEC, a cartel whose power has waxed and waned over time. Oligopolistic interaction among sellers is likely to lead to varying degrees of freight absorption in markets with geographically-dispersed production, so that the arm's-length price will depend on the exporting country and point of destination. In the case of petroleum, the Atlantic and Pacific markets are particularly likely to differ, because moving the product between them is quite costly.

The final reason is the sheer size of the industry. While crude oil is not perfectly homogeneous, it is certainly more homogeneous than other products often cited for transfer-price abuse, e.g., pharmaceuticals. The scope for transfer-price manipulation is probably substantially smaller as a percentage of arm's-length price, but when multiplied by the enormous volume of petroleum moving in international trade, the revenue transferred, and tax avoided, is potentially great.

Suspicions of tax evasion through transfer-pricing by the industry have not been limited to researchers and politicians. The U.S. Internal Revenue Service created a special unit, the Petroleum Industry Program, in 1978 to monitor the industry, and *inter alia*, make determinations regarding arm's-length prices. The U.S. Department of Energy (DOE) monitored transfer prices in the course of administering the regulatory program imposed on the

domestic petroleum industry in the 1970s. This monitoring process is the source of the data used in this study, which were required to be submitted to the U.S. Energy Information Administration (EIA, the data-collection branch of DOE) by American companies that import crude oil.

The approach in this paper is as follows. First, we use regression methods to isolate systematic differences between third-party and interaffiliate prices, controlling for the factors discussed above. One hypothesis we examine is whether the rise of the spot market and centralization of IRS petroleum expertise at the end of the 1970s resulted in a reduced scope for creative transfer-pricing. We then go on to relate these differences to the tax regimes of exporting countries.

Data

The data were obtained from EIA, which deleted any information that would allow identification of individual firms. The data are described in some detail in Weiner (1986) and Anderson (1988);[2] the discussion here is limited to attributes salient to this paper. The data cover the period October 1973 - October 1984,[3] a period that encompasses tremendous variation in oil prices, changes in the structure of the petroleum industry, and tax rates. The database contains information on dates of loading and importation, exporting country, port of landing, f.o.b. and landed prices, sulfur and gravity, credit terms, volume, and transaction type for cargoes of crude oil imported into the United States during this period.[4] While some previous analysts have concluded that the absence of a "market price" precludes assessment of transfer-price manipulation (Rugman 1985), we are able to take advantage of this information in the regression analysis, thereby correcting for much of the heterogeneity discussed above.

For our purposes, the most interesting aspect of the database is the breakdown of imports by type of transaction--interaffiliate transfers (designated type *A* below) and arm's-length purchases. The latter is further broken down into purchases directly from host governments (type *H*), "third-party" purchases (purchases from other firms, designated type *T*), and arm's-length purchases with type of seller unreported (type *U*). The decline of the major multinational oil companies and rise of state enterprises in oil-exporting countries is reflected in the falling share over time of interaffiliate transfers relative to arm's-length transactions. The breakdown of transaction types for purchases from each oil-exporting country is provided for an illustrative year in Table 2.

Hypotheses Regarding Transfer Pricing

The hypotheses about transfer-price behavior are straightforward: Multinational petroleum companies set transfer prices that differ from their arm's-length prices when they have the incentive and the ability to do so. *Ceteris paribus*, firms that produce crude oil in countries with effective marginal corporate tax rates (t_f) that exceed the rate in the United States (t_{us}) will reduce their tax obligations by reporting transfer prices as low as possible. At the margin the dollar in profit "lost" in the host country will reduce firms' tax obligations by t_f, while increasing their US tax obligation by an amount $t_{us} < t_f$. Similarly, when $t_{us} > t_f$, firms have an incentive to report greater profits in the host country, in order for as much of their revenue as possible to be taxed at the lower rate abroad.

In practice, calculations of tax obligations are complicated by the fact that US MNC's must pay US corporate tax on income earned by their foreign subsidiaries. In order to avoid double taxation, the IRS allows US MNC's to credit foreign taxes paid against their US tax obligations. In terms of this very simple model, the US MNC would owe US tax of $t_{us} - t_f$ on the marginal

dollar of profit if $t_{us} > t_f$. If the foreign rate exceeds the US rate, the US MNC owes no tax to the United States at the margin.

When $t_{us} > t_f$, US MNC's nonetheless have an incentive to report profits abroad because the US tax owed is payable only when the profit is repatriated to the United States. By investing their profits abroad, US MNC's can thus defer their US tax obligations. When t_f exceeds t_{us}, the difference is an excess foreign tax credit, which the US MNC can carry forward against future US tax obligations. Thus the incentives for transfer-price manipulation described above are present even when foreign taxes are creditable against US taxes.[4a]

Because the comparison we undertake is so straightforward, we do not present a formal theoretical model of transfer pricing in this paper. A model that integrates some features of the theoretical literature in this area can be found in Eden (1985), where it is demonstrated that tariff rates, as well as corporate tax rates, can influence transfer-price decisions. In this case, the United States has imposed a tariff on crude oil imports since 1973 (when it switched from a quota). The tariff is very small however ($0.20/barrel, corresponding to a rate of roughly one percent), and is neglected in our analysis.

Of course, transfer prices serve purposes other than reduction of tax obligations, e.g., providing signals for managerial incentives within the firm (see Eccles 1985). These other considerations will confound efforts to examine hypotheses regarding tax factors only if they vary systematically with tax rates, which appears unlikely.

The scope for multinational firms to set transfer prices so as to minimize their tax obligations is constrained by the tax regulations of their home and host countries, and by the ability of the tax authorities to enforce these regulations. In the United States, the relevant regulation is Section

TABLE 2

Number of Transactions by type, 1981

COUNTRY	TYPE OF TRANSACTION H	T	A	OTHER	TOTAL
ABU DHABI	2	7	60	0	69
ALGERIA	18	73	150	1	242
ANGOLA	0	10	20	0	30
BRUNEI	0	11	0	0	11
CAMEROON	0	12	14	0	26
CANADA	0	13	145	0	158
CHINA	0	2	0	0	2
CONGO	0	23	0	0	23
DUBAI	5	0	4	0	9
ECUADOR	6	5	19	0	30
EGYPT	2	1	11	0	14
GABON	0	5	26	0	31
INDONESIA	24	94	196	0	314
IRAQ	4	0	0	0	4
LIBYA	32	55	125	3	215
MALAYSIA	0	4	15	0	19
MEXICO	232	38	342	2	614
NEUTRAL ZONE	0	0	25	0	25
NIGERIA	26	181	218	4	429
NORWAY	8	75	60	1	144
OMAN	0	13	7	0	20
PERU	3	6	12	0	21
QATAR	3	3	0	0	6
SAUDI ARABIA	0	162	592	4	758
SHARJAH	0	0	6	0	6
SYRIA	2	1	0	0	3
TRINIDAD	3	27	97	0	127
UNITED KINGDOM	17	56	92	2	167
VENEZUELA	100	83	117	2	302
ZAIRE	0	0	23	0	23
UNKNOWN	12	52	66	0	130
TOTAL	499	1012	2442	19	3972
(%)	(13)	(25)	(61)	(1)	(100)

482 of the Internal Revenue Code, which requires that transfer prices be set at arm's-length. The regulations acknowledge the difficulty often involved in the establishment of arm's-length prices. Section 482 specifies that if "comparable" third-party transactions exist, then they must be used in determining arm's-length prices. Firms have considerable discretion in deciding what constitutes "comparable," however. In the event that no comparable transactions exist, firms are instructed to choose, in descending hierarchy, the "resale price" method (which uses downstream arm's-length prices to impute upstream transfer prices), the "cost-plus" method, or any other pricing method that can be justified to the IRS.[5] Using Federal Trade Commission (FTC) line-of-business data for 1975, Benvignati (1985) estimated that 24 percent of transfer-prices set for goods exported from the United States to affiliates abroad were established using the comparable-third-party and resale-price methods, 57 percent using the cost-plus method, and 19 percent using other methods. Unfortunately, the FTC data do not cover interaffiliate imports into the United States. In contrast, the breakdown for interaffiliate transfers within the United States (where tax considerations do not enter) in 1975 was 49 percent comparable-third-party and resale-price methods, 29 percent cost-plus method, 22 percent other methods.

The null hypothesis here is that the US tax authorities are sufficiently knowledgeable about the arm's-length market in crude oil, and sufficiently capable at enforcing transfer-price regulations, that MNC's are obliged to set the prices for their interaffiliate transactions equal to prices prevailing for third-party transactions. As noted above the heterogeneity of the product and third-party contract terms will tend to complicate efforts to establish arm's-length prices with which to compare a firm's transfer prices. However, IRS enforcement of the arm's-length yardstick need not be perfect to deter the practice of using transfer prices to avoid taxes. As detailed in Robbins and Stobaugh (1973), there are many channels through which MNC's can shift funds between affiliates besides trade transactions, including dividend payments, loans, service fees and overhead charges, and royalties. Depending on the costs of doing so, MNC's

may choose one or more of these other channels as a means of shifting profits among tax jurisdictions.

In addition to testing for differences between arm's-length and transfer prices, we examine below the hypothesis that MNC's transfer funds between tax jurisdictions by charging themselves above- or below-market rates of interest on their credit transactions. The effective interest rates charged are imputed from the sensitivity of f.o.b. prices to credit terms. The higher the effective interest rate, the more should an increase in the number of days credit raise the purchase price. In other words, the effective interest rate rises with *d(price)/d(credit days)*.

The hypothesis here is that U.S. multinationals would like their affiliates in countries with relatively low marginal corporate tax rates to "charge" high interest rates on their transfers to affiliates in countries where such rates are relatively high, thereby transferring income to jurisdictions where it is taxed more lightly. Effective interest rates are of course unobservable, but this hypothesis can nonetheless be tested using a two-step procedure similar to the one mentioned above for prices. The first step is a comparison of regression coefficients for *d(price)/d(credit days)* for arm's-length and interaffiliate transactions, in order to locate significant differences. The second is to relate any such differences to tax rates abroad. If MNC's are transferring funds in this manner, the correlation between foreign tax rates and "excess" effective interest rates, as measured by $d/(price)/d(credit\ days)_{interaffiliate} - d(price)/d(credit\ days)_{third\text{-}party}$, should be negative.

The statistical work below constitutes the first systematic test of the effectiveness of transfer-price regulations. Scattered indirect evidence suggests that the IRS is active in attempting to enforce Section 482. Plasschaert (1979) reports that in 1968-69, the IRS investigated 871 cases of international interaffiliate transactions. The largest number (roughly a third of the total) of

potential adjustments concerned transfer prices in trade transactions. Only 26.9 percent of the adjustments were actually implemented, but those that were implemented involved fairly large dollar figures. According to Plasschaert, two-thirds of the firms surveyed by the Conference Board in 1970 and 1971 has been subject to adjustments under Section 482.

Empirical Tests

Our objectives for the empirical work are three. First, we want to determine whether interaffiliate prices and third-party prices differ significantly, both in an economic and a statistical sense, and whether any such differences vary systematically over time. Second, we wish to identify the exporting countries, if any, that exhibit such differences. Our final desire is to relate any country-specific differences we find to tax rates in oil-exporting countries.

The approach we adopt is as follows. We conduct OLS regressions with the purchase price as the dependent variable. Crude oil transactions have traditionally been conducted on an f.o.b. basis, and with a few exceptions, our purchase price data are quoted f.o.b. point of export.[6] To control for any systematic differences in prices caused by factors other than the relationship between parties in the transaction, the following explanatory variables were included: gravity, sulfur content, size of shipment, and dummy variables for spot transactions, port of entry into the United States (East and Gulf Coasts, West Coast, Hawaii, Guam, and unknown), and credit terms.

Separate regressions were run for each year, both because the effect of the control variables on price is likely to vary with changing conditions in the oil market over time, and because we are interested in changes over time in differences between third-party and transfer prices, for the reasons discussed above.[7] A dummy variable was used for each loading month to control for intrayear fluctuations in oil prices.

To conduct hypothesis tests, we include separate dummy variables for each transaction type (interaffiliate transfer, third-party purchase, host-government purchase) for each country that exported crude oil to the United States in a given year.[8] We test whether the regression coefficients for third-party transactions and interaffiliate transfers are equal for each exporting country. In equation form, the null hypothesis is $t_{ij} - a_{ij} = 0, i = 1, \ldots, q_j$ where t_{ij} and a_{ij} are the regression coefficients on the third-party and interaffiliate dummy variables for country i in the regression for year j, and q_j is the number of countries that exported crude oil to the United States in year j through both these transaction types.[8a]

The standard technique for testing the null hypothesis that the q_j length vector $\mathbf{t_j} - \mathbf{a_j} = \mathbf{0}$ is to construct an *F* ratio based on the squared errors from the constrained (the constraints being the equality of all the t and a coefficients) and the unconstrained regressions. Here we instead use the Bonferroni *t* test (as described in Savin 1980), which rejects the null hypothesis at the α level if any of the q_j *t* values for the difference in coefficients exceeds the t_α critical point in absolute value. The reasons for using the Bonferroni *t* test are two. First, the standard *F* test can reject the null hypothesis at the α level even when none of the $\mathbf{t_j} - \mathbf{a_j}$ coefficients differ significantly from zero at the α level, a result that is not meaningful here, because we are primarily interested not in whether the restrictions are accepted universally, but rather in where the violations of these restrictions arise. The second reason is that the Bonferroni *t* test indicates which of the coefficients in the vector $\mathbf{t_j} - \mathbf{a_j}$ cause the rejection of the null hypothesis when it is rejected, whereas the *F* test does not.

The difficulty with the Bonferroni *t* test is that the distribution of the test statistic $B = \max_i |t_i|$ is not easily calculated because the t_i are not independent. It should be intuitively clear, however, that rejection of the null hypothesis at the α level entails using a critical *t* value at a level smaller than α if more than one *t* value is being calculated. Although the exact

distribution of B will not in general be known, Savin (1980) shows that using a critical level of α/q_j for the q_j individual t_i's will result in the test's rejecting the null hypothesis at a level $\leq\alpha$.[9] In this paper we use the levels $\alpha = .05$ and $\alpha = .10$; our q_j's vary from year to year but are around 20 exporters, so that the individual t-statistics must exceed the critical value (for the two-tailed test with a large number of degrees of freedom, so that we use the standard normal distribution to approximate) $t_{.0025} = 3.03$, $t_{.005} = 2.81$.

Canada is treated separately on the grounds that Canadian crude oil shipments enter the United States via pipeline, primarily in the North-Central region (Indiana to Montana), where there is relatively little immediate competition with other foreign sources of crude oil, which are shipped by tanker to the U.S. East, West, of Gulf Coasts.[10] Otherwise, the same regression model is applied to Canadian data.

An illustrative example for 1981 of the overall regression results appears in Table 3. The dummy variables have been chosen so that the constant represents the average price paid to the Venezuelan government for crude oil shipped to the East coast during the month of January with zero credit days. API gravity and sulfur content have the expected positive and negative signs respectively. This result is quite robust over time. Volume or size of shipment displays an expected negative sign due to size discount, however this result is far from robust as the coefficients turn out to be significantly positive for a number of years. As expected, the spot transaction variable yields a mixture of positive and negative signs over the sample period. Although this is not the case in 1981, oil delivered to the West coast is usually significantly cheaper than to the East coast due to the added cost of moving oil south of Africa, or through the Panama Canal. The dummy variables for loading month display a pattern of falling prices.

The variable for credit days was introduced in the years for which data are available (1979 to 1984) with the intent of measuring an implicit interest rate across transaction types, as

TABLE 3
OLS REGRESSION RESULTS FOR 1981

Dependent variable: PURCHASE PRICE
Number of observations = 2942
adjusted R^2 = .787

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T-STATISTIC
CONSTANT	29.738	0.462	64.331
GRAVITY	0.152	0.011	13.606
SULFUR	-1.610	0.076	-21.225
VOLUME	-0.326	0.129	-2.533
SPOT	-0.791	0.331	-2.390
Transaction type T			
ABU DHABI	6.710	0.813	8.252
ALGERIA	3.298	0.468	7.047
ANGOLA	1.198	0.714	1.679
BRUNEI	3.404	0.750	4.536
CAMEROON	4.547	0.654	6.953
CHINA	-2.384	1.551	-1.537
CONGO	2.204	0.631	3.494
ECUADOR	2.627	0.948	2.772
EGYPT	6.638	2.032	3.267
GABON	2.648	0.990	2.676
INDONESIA	1.551	0.431	3.601
LIBYA	3.454	0.444	7.780
MALAYSIA	2.406	1.098	2.192
MEXICO	3.736	0.514	7.269
NIGERIA	4.048	0.367	11.020
NORWAY	3.710	0.424	8.759

TABLE 3 (continued)

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T-STATISTIC
OMAN	4.723	0.677	6.980
PERU	4.440	0.896	4.955
QATAR	2.994	1.209	2.477
SAUDI ARABIA	3.657	0.331	11.034
SYRIA	8.557	2.030	4.216
TRINIDAD	3.240	0.480	6.753
UNITED KINGDOM	3.060	0.437	6.995
VENEZUELA	2.391	0.324	7.370
Transaction type A			
ABU DHABI	3.313	0.441	7.504
ALGERIA	3.859	0.406	9.496
ANGOLA	3.274	0.568	5.763
CAMEROON	4.357	0.742	5.873
DUBAI	5.501	1.059	5.195
ECUADOR	2.294	0.553	4.146
EGYPT	3.095	0.693	4.464
GABON	2.812	0.502	5.598
INDONESIA	2.262	0.378	5.985
LIBYA	5.481	0.374	14.640
MALAYSIA	5.564	0.629	8.852
MEXICO	5.047	0.286	17.642
NEUTRAL ZONE	5.856	0.482	12.159
NIGERIA	4.894	0.348	14.059
NORWAY	3.718	0.534	6.962
OMAN	4.825	1.452	3.323
PERU	3.806	0.651	5.844
SAUDI ARABIA	2.350	0.316	7.448

TABLE 3 (continued)

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T-STATISTIC
SHARJAH	1.604	1.209	1.326
TRINIDAD	6.641	0.373	17.784
UNITED KINGDOM	3.312	0.393	8.436
VENEZUELA	-0.316	0.444	-0.712
ZAIRE	2.710	0.626	4.328
Transaction type H			
ABU DHABI	3.272	1.461	2.239
ALGERIA	3.875	0.679	5.707
DUBAI	6.576	1.042	6.313
ECUADOR	2.342	0.867	2.700
EGYPT	4.111	1.454	2.827
INDONESIA	2.069	0.648	3.194
IRAQ	8.644	1.057	8.175
LIBYA	6.850	0.508	13.476
MEXICO	5.206	0.294	17.729
NIGERIA	4.753	0.575	8.262
NORWAY	5.160	0.962	5.365
PERU	0.857	1.199	0.715
QATAR	9.943	2.034	4.889
TRINIDAD	3.179	1.455	2.185
UNITED KINGDOM	4.135	0.599	6.906
Transaction type U			
ALL COUNTRIES	4.226	0.975	4.333

TABLE 3 (continued)

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T-STATISTIC
Port of entry			
HAWAII	1.358	0.381	3.564
GUAM	2.206	0.401	5.507
USA	0.392	0.171	2.297
WEST	-0.109	0.236	-0.461
UNKNOWN	-0.773	0.471	-1.639
Number of credit days			
0-9	0.504	0.598	0.842
10	-0.191	0.229	-0.833
11-29	-0.936	0.272	-3.443
30	-0.105	0.101	-1.042
31-59	2.575	0.407	6.324
60	0.773	0.583	1.327
61-179	3.060	0.467	6.547
180 or more	-0.168	0.196	-0.856
Loading month			
FEBRUARY	0.219	0.188	1.170
MARCH	0.036	0.178	0.202
APRIL	-0.372	0.181	-2.054
MAY	-0.546	0.184	-2.969
JUNE	-1.680	0.185	-9.098
JULY	-1.992	0.187	-10.634
AUGUST	-2.305	0.179	-12.864
SEPTEMBER	-2.555	0.188	-13.593
OCTOBER	-2.606	0.190	-13.716
NOVEMBER	-2.373	0.195	-12.162
DECEMBER	-2.195	0.188	-11.675

TEST FOR DIFFERENCES BETWEEN THIRD-PARTY AND AFFILIATE PRICES

COUNTRIES	ESTIMATED COEFFICIENT	STANDARD ERROR	T-STATISTIC
ABU DHABI	3.397	0.821	4.135[a]
ALGERIA	-0.561	0.361	-1.554
ANGOLA	-2.077	0.800	-2.596
CAMEROON	0.190	0.895	0.212
ECUADOR	0.334	1.024	0.326
EGYPT	3.543	2.112	1.678
GABON	-0.164	1.026	-0.159
INDONESIA	-0.711	0.294	-2.416
LIBYA	-2.027	0.362	-5.594[a]
MALAYSIA	-3.158	1.171	-2.697
MEXICO	-1.311	0.468	-2.803[b]
NIGERIA	-0.846	0.249	-3.404[a]
NORWAY	-0.008	0.485	-0.016
OMAN	-0.102	1.547	-0.066
PERU	0.634	1.028	0.616
SAUDI ARABIA	1.307	0.229	5.715[a]
TRINIDAD	-3.401	0.463	-7.348[a]
UNITED KINGDOM	-0.252	0.396	-0.638
VENEZUELA	2.708	0.443	6.117[a]

Note: a and b indicate significance levels of 5% and 10%, respectively, according to the Bonferroni test, i.e. greater than 3.00 and 2.79, respectively, in absolute value.

explained above. Unfortunately no coherent inference can be made, as can be seen from the 1981 result. It was expected that the average purchase price increases with the number of credit days due to the implicit loan. Furthermore, affiliates may want to charge implicit interest rates different from market interest rates in order to realize money transfers. Unfortunately, the data reveal no definite pattern in this respect, although some coefficients of the variables for credit days are statistically significant.

The last group of explanatory variables is based on transaction type by country. It yields the annual average price differential associated with the type of transaction. Table 3 shows that with two exceptions, crude oil sold by the Venezuelan government was the cheapest crude oil imported into the US.[11] Using the estimated coefficients reported in Table 3 and the estimated variance-covariance matrix, the average price differential between third-party and affiliate transactions is calculated for each country along with the pertinent standard error and t-statistic. The results are reproduced at the bottom of Table 3. A positive value implies that prices for transactions through affiliates were lower than those for transactions through third parties. A negative value implies the converse. Recalling the discussion above, differentials motivated by tax considerations should be positive. Table 3 shows that the two prices were statistically different at the 5 percent significance level for Abu Dhabi, Libya, Nigeria, Saudi Arabia, Trinidad and Venezuela, and at the 10 percent level for Mexico, but that only three of the significant differentials have the sign predicted by the tax-motivation hypothesis.[11a]

Table 4 provides a summary of the results from the annual regressions. Only the average price differentials which are statistically significant at the 10 percent level are shown.[12] No price differential is statistically significant in 1983, so the null hypothesis of no difference is not rejected for that year according to the Bonferroni procedure. The null hypothesis is rejected for all other years. Countries are separated into two groups with the first including major exporting countries which contributed 5 percent or more of all US crude oil imports in a particular year and the second all other smaller oil exporting countries.

TABLE 4

Differences Between Third-party and Affiliate Purchase Prices

Note: A dash indicates that the difference between T and A is not significant at the 10 percent level (according to the Bonferroni test, except for Canada, to which the usual t-test is applied); a blank space indicates insufficient data to estimate coefficients for both T and A.

a indicates a difference significant at the 5 percent level.

b indicates a country that accounts for at least 5 percent of US imports in the given year.

YEAR	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973
MAJOR OIL-EXPORTING COUNTRIES												
ALGERIA	1.08[ab]	----	----	----	----	----	----	----	----	-0.37[a]	----	5.12[a]
CANADA	0.27[b]	----	4.09[a]	-1.02	----	0.98[a]		-1.38[a]	-1.04[a]	----	----	----
INDONESIA	-1.13[ab]	----	----	----	----	----	0.13[b]	-0.15[ab]	-0.35[ab]	-0.59[ab]	----	-1.60[ab]
IRAN	----	----	----		----	2.22[ab]	----	0.12[ab]	----	----	----	----
LIBYA			----	-2.03[ab]	----	----	----	----	0.29[ab]	----	----	----
MEXICO	----	----	----	-1.31[b]	----	----	----	----	----	----	----	
NIGERIA	----	----	----	-0.85[ab]	0.91[ab]	----	----	-0.10[ab]	0.22[ab]	----	-0.62[ab]	-1.42[ab]
SAUDI ARABIA	----	----	----	1.31[ab]		----	0.24[ab]	0.51[ab]	0.37[ab]	----	----	----
UNITED KINGDOM	----	----	----	----	----	----	----	----	----			
VENEZUELA	0.87[b]		1.69[a]	2.71[a]	----	2.23[a]	----	----	----	----	-1.13[ab]	-0.70[ab]
OTHER OIL-EXPORTING COUNTRIES												
ABU DHABI	----	----	----	3.40[a]	----	6.68[a]	----	----	0.23[ab]	----	----	----
ANGOLA	----	----	----	----	-4.04[a]	----	----	----	----	----	5.56[a]	
BOLIVIA							----	----	----	----	----	

TABLE 4: Differences Between Third-party and Affiliate Purchase Prices (continued)

YEAR	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973
OTHER OIL-EXPORTING COUNTRIES (continued)												
BRUNEI			----		----		----					
CAMEROON	----	----	----	----	----	----						
CHINA	----		----			----						
CONGO	----	----			----	----			-1.50[a]			
DUBAI			----		2.92	----			----	----		
ECUADOR	----	----	----	----	----	----	----	----	----	----	2.42[a]	2.46a
EGYPT	----	----	-2.03[a]	----	-3.51[a]	10.24[a]		1.62[a]				
GABON	0.90[a]	----	----	----		----	----	----	----	----	----	
IRAQ					----	9.33[a]	-0.63	0.36[a]	0.73[a]			
IVORY COAST	----											
KUWAIT										----		----
MALAYSIA				----	----	-8.47[a]	----	----	0.68[a]			
NEUTRAL ZONE	----	----	-7.39[a]		----				----		----	
NORWAY	-0.71	----	----	----	----	----	----	----	----	----		
OMAN		----		----	-6.62		----	----	0.59	----		
PERU	----		----	----	-3.35[a]	7.81[a]						
QATAR					----	----	----	----	----	----	----	
SHARJAH							----	----	----	----	----	
SYRIA						----						
TRINIDAD	-1.82[a]	----		-3.40[a]	----		-0.76[a]	----	----			
TUNISIA			----									
USSR									----			
ZAIRE	----	----	----									
R^2	0.85	0.85	0.88	0.79	0.80	0.74	0.81	0.85	0.83	0.73	0.47	0.71
number of obs.	1816	2<<<	2238	2942	3979	4480	4729	5039	4573	3412	3266	659

TABLE 5: Value of Differences Between Third-party and Affiliate Purchase Prices: (million $)

Note: (+) and (-) indicate the sum of all the positive and negative numbers that are significant at the 10% level

YEAR	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973
MAJOR OIL-EXPORTING COUNTRIES												
ALGERIA	11.8	---	---	---	---	---	---	---	---	-15.4	---	1.6
CANADA	10.0	---	182.7	-35.0	---	25.3	---	-41.7	-29.1	---	---	---
INDONESIA	-80.0	---	---	---	---	---	19.0	-21.1	-56.7	-52.1	---	-16.6
IRAN	---	---	---	---	---	119.1	---	16.4	---	---	---	---
LIBYA	---	---	---	-138.3	---	---	---	---	26.9	---	---	---
MEXICO	---	---	---	-115.6	---	---	---	---	---	---	---	---
NIGERIA	---	---	---	-106.2	170.7	---	---	-17.7	50.0	---	-99.8	-35.7
SAUDI ARABIA	---	---	---	526.8	---	---	87.1	209.1	131.2	---	---	---
UNITED KINGDOM	---	---	---	---	---	---	---	---	---	---	---	---
VENEZUELA	1.7	---	10.3	45.9	---	73.9	---	---	---	---	-121.2	-18.2
OTHER OIL-EXPORTING COUNTRIES												
ABU DHABI	---	---	---	119.8	---	479.1	---	---	16.5	---	---	---
ANGOLA	---	---	---	---	-51.7	---	---	---	---	---	154.8	---
CONGO	---	---	---	---	---	---	---	---	-1.5	---	---	---
DUBAI	---	---	---	---	12.6	---	---	---	---	---	---	---
ECUADOR	---	---	---	---	---	---	---	---	---	---	31.9	1.5
EGYPT	---	---	-18.4	---	-37.3	150.3	---	16.4	---	---	---	---
GABON	11.0	---	---	---	---	---	---	---	---	---	---	---
IRAQ	---	---	---	---	---	244.7	-12.0	5.8	4.4	---	---	---
MALAYSIA	---	---	---	---	---	-75.0	---	---	4.6	---	---	---
NEUTRAL ZONE	---	---	-25.7	---	---	---	---	---	---	---	---	---
NORWAY	-8.1	---	---	---	---	---	---	---	---	---	---	---
OMAN	---	---	---	---	-22.3	---	---	---	0.5	---	---	---
PERU	---	---	---	---	-27.8	55.2	---	---	---	---	---	---
TRINIDAD	-48.4	---	---	-120.2	---	---	-26.8	---	---	---	---	---
TOTAL	-102.0	---	149.0	177.2	44.3	1072.5	67.3	167.1	146.9	-67.5	-34.3	-67.5
Summation (+)	34.6	---	193.1	692.6	183.4	1147.5	106.1	247.7	234.2	---	186.7	3.1
% total type A	0.3	---	0.8	1.7	0.4	3.6	0.5	1.2	1.4	---	2.0	0.4
% total imports	0.1	---	0.5	1.2	0.3	2.4	0.3	0.7	0.9	---	1.2	0.2
Summation (-)	136.5	---	44.1	515.4	139.1	75.0	38.8	80.5	87.3	67.5	221.0	70.6
% total type A	1.2	---	0.2	1.3	0.3	0.2	0.2	0.4	0.5	0.6	2.3	8.1
% total imports	0.5	---	0.1	0.9	0.2	0.2	0.1	0.2	0.3	0.4	1.5	5.3
total type A	11073.4	14003.8	23769.3	41198.6	46180.9	31870.2	21214.3	20360.3	17142.5	11446.2	9490.6	869.1
total imports	29395.5	33758.6	38733.1	57126.7	62039.2	48806.9	32451.2	34769.9	26623.1	17302.7	14948.8	1343.6

TABLE 6

Differences Between Third-party and Affiliate Transportation Costs

Note: A dash indicates that the difference between T and A is not significant at the 10 percent level (according to the Bonferroni test, except for Canada, to which the usual t-test is applied); a blank space indicates insufficient data to estimate coefficients for both T and A.

a indicates a difference significant at the 5 percent level.

b indicates a country that accounts for at least 5 percent of US imports in the given year.

YEAR	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973
MAJOR OIL-EXPORTING COUNTRIES												
ALGERIA	----	----	----	-0.41[ab]	0.32[ab]	0.22[ab]	0.25[ab]	0.26[ab]	0.20[ab]	----	----	----
CANADA	-0.15[ab]	----	0.48[a]	0.13[a]	----	0.48[a]		-1.40	-0.94[a]	-3.04a	----	----
INDONESIA	-0.44[ab]	----	0.50[ab]	-0.45[ab]	0.27[ab]	----	-0.20[ab]	0.15[ab]	----	----	----	----
IRAN	-1.10[a]	-0.80[a]	-1.58[a]		----	-0.88[ab]	0.31[ab]	----	-0.15[b]	-0.33[ab]	----	----
LIBYA			----	----	0.64[ab]	0.38[ab]	0.23[ab]	0.19[ab]	----	0.37[ab]	----	----
MEXICO	----	0.41[ab]	----	0.44[ab]	0.84[ab]	----	----	----	----	1.11[a]	----	
NIGERIA	-0.29[b]	----	----	-0.23[ab]	----	0.26[ab]	0.35[ab]	0.25[ab]	----	0.29[ab]	----	----
SAUDI ARABIA	-0.37[ab]	-0.29[ab]	----	-0.88[ab]		----	----	-0.46[ab]	-0.34[ab]	-0.33[ab]	-0.48[ab]	----
UNITED KINGDOM	----	----	----	----	----	----	0.44[a]	0.45[a]	----			
VENEZUELA	----		----	0.39[a]	1.00[a]	----	----	-0.17[a]	-0.15[ab]	-0.73[ab]	-0.31[ab]	----
OTHER OIL-EXPORTING COUNTRIES												
ABU DHABI	----	----	-1.64[a]	-0.78[a]	----	----	0.45[ab]	----	0.23[ab]	-0.56[a]	----	----
ANGOLA	----	----	----	----	0.77[a]	0.46[a]	----	----	----	0.95[a]	----	
BOLIVIA							----	----	----		----	

TABLE 6: Differences Between Third-party and Affiliate Transportation Costs (continued)

YEAR	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973
OTHER OIL-EXPORTING COUNTRIES (continued)												
BRUNEI			----		-3.17[a]							
CAMEROON	----	----	----	----	----	----						
CHINA	----		----			----						
CONGO	----	----			----	----			----			
DUBAI			----		----	----			-1.34	----		
ECUADOR	0.40[a]	----	----	----	----	----	-0.82[a]	----	----	----	----	----
EGYPT	----	-1.12[a]	-1.41[a]	-2.61[a]	-1.53[a]	----		-1.93[a]				
GABON	----	----	----	----		----	----	----	----	----	----	----
IVORY COAST	----											
IRAQ					----	----	----	-0.50[a]	-1.08[a]			----
KUWAIT										----		----
MALAYSIA			----	----	----	----	----	----	-0.89[a]			
NEUTRAL ZONE	----	----	----		----				----		----	
NORWAY	----	----	----	----	----	----	0.34[a]	0.49[a]	0.53[a]	----		
OMAN		----		----	----		0.51[a]	----	----	----		
PERU	----		----	----	----	----						
QATAR					----	----	----	0.54[a]	----	----	----	
SHARJAH							----	----	----	----	----	
SYRIA						-1.43[a]						
TRINIDAD	----	----		----	----		----	----	----			
TUNISIA			----									
USSR									----			
ZAIRE	----	----	----									
R^2	0.51	0.46	0.49	0.47	0.49	0.44	0.50	0.42	0.47	0.29	0.54	0.49
number of obs.	1816	2228	2238	2942	3979	4480	4729	5039	4573	3412	3266	659

TABLE 7

Value of differences between third-party and affiliate transportation costs: (million $)

Note: (+) and (-) indicate the sum of all the positive and negative numbers that are significant at the 10% level

YEAR	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973
MAJOR OIL-EXPORTING COUNTRIES												
ALGERIA	---	---	---	-25.7	21.2	23.0	25.5	19.2	12.6	---	---	---
CANADA	-5.6	---	21.4	4.5	---	12.4	---	-42.3	-26.3	-76.5	---	---
INDONESIA	-31.1	---	41.7	-41.8	28.3	---	-29.3	21.1	---	---	---	---
IRAN	-7.8	-17.1	-6.5	---	---	-47.2	28.3	---	-13.5	-30.2	---	---
LIBYA	---	---	---	---	83.2	56.0	33.8	24.7	---	23.9	---	---
MEXICO	---	16.9	---	38.8	97.1	---	---	---	---	4.9	---	---
NIGERIA	-6.6	---	---	-28.7	---	54.9	69.5	44.4	---	41.4	---	---
SAUDI ARABIA	-10.3	-23.0	---	-353.9	---	---	---	-188.6	-120.5	-54.1	-74.9	---
UNITED KINGDOM	---	---	---	---	---	---	8.8	5.7	---	---	---	---
VENEZUELA	---	---	---	6.6	16.3	---	---	-11.8	-10.4	-87.2	-33.3	---
OTHER OIL-EXPORTING COUNTRIES												
ABU DHABI	---	---	-30.4	-27.5	---	---	43.5	---	16.5	-20.4	---	---
ANGOLA	---	---	---	---	9.9	4.0	---	---	---	28.5	---	---
BRUNEI	---	---	---	---	-0.5	---	---	---	---	---	---	---
DUBAI	---	---	---	---	---	---	---	---	-5.4	---	---	---
ECUADOR	3.6	---	---	---	---	---	-6.0	---	---	---	---	---
EGYPT	---	-1.6	-12.8	-8.8	-16.3	---	---	-19.6	---	---	---	---
IRAQ	---	---	---	---	---	---	---	-8.0	-6.5	---	---	---
MALAYSIA	---	---	---	---	---	---	---	---	-6.1	---	---	---
NORWAY	---	---	---	---	---	---	3.2	5.7	6.2	---	---	---
OMAN	---	---	---	---	---	---	7.9	---	---	---	---	---
QATAR	---	---	---	---	---	---	---	8.1	---	---	---	---
SYRIA	---	---	---	---	---	-1.0	---	---	---	---	---	---
TOTAL	-57.7	-24.8	13.6	-436.6	239.3	102.1	185.3	-141.4	-153.3	-169.6	-108.2	---
Summation (+)	3.6	16.9	63.19	49.9	256.0	150.3	220.5	128.8	35.4	98.7	---	---
% imports type A	0.0	0.1	0.3	0.1	0.6	0.5	1.0	0.6	0.2	0.9	---	---
% total imports	0.0	0.1	0.2	0.1	0.4	0.3	0.7	0.4	0.1	0.6	---	---
Summation (-)	61.4	41.7	49.6	486.5	16.7	48.2	35.2	270.2	188.7	268.3	108.2	---
% total type A	0.6	0.3	0.2	1.2	0.0	0.2	0.2	1.3	1.1	2.3	1.1	---
% total imports	0.2	0.1	0.1	0.9	0.0	0.1	0.1	0.8	0.7	1.6	0.7	---
total type A	11073.4	14003.8	23769.3	41198.6	46180.9	31870.2	21214.3	20360.3	17142.5	11446.2	9490.6	869.1
total imports	29395.5	33758.6	38733.1	57126.7	62039.2	48806.9	32451.2	34769.9	26623.1	17302.7	14948.8	1343.6

If attention is centered on the major oil exporting countries only, it is possible to observe specific patterns over time and for individual countries. From 1973 to 1975, when major oil exporting countries had yet to nationalize completely their oil production, all average price differentials were negative with one exception, Algeria in 1973. From 1982 to 1984, all price differentials are positive, with Indonesia in 1984 being the single exception. Between these two periods, the results are mixed. At the individual country level, Indonesia shows negative price differentials for all years, with 1978 being the only exception. Saudi Arabia has only positive price differentials, while Venezuela has negative price differentials before nationalization, in 1973 and 1974, and positive price differentials from 1979 to 1984 after nationalization. It should be pointed out that average price differentials were unusually large in favor of interaffiliate transactions in 1979.[13] This can be explained by the 1979 oil price surge, with interaffiliate prices being adjusted slowly.

When prices are higher for transactions through affiliates than prices through third parties (assumed to represent market prices), or in other words, when price differentials are negative, money is transferred from the United States to other countries. The converse occurs with positive price differentials. To get an idea of the relative importance of these money transfers within affiliated parties, the statistically significant differences in prices reported in Table 4 were multiplied by the number of barrels imported by affiliated parties. The results appear in Table 5, which also shows the total value of oil imported by affiliated parties and of all oil imports. With the exception of the first two years and the last one, more money was flowing into the US than out. The gross money transfer represents less than 2 percent of the value of crude oil imported into the US by affiliated parties, with 1979 being an exception, and an even smaller percentage of all crude oil imports.

The database includes information on both the purchase price and the price of oil at the port of

entry, the difference being transportation costs. There is no information on the ownership of tankers (or pipelines) carrying crude oil to the American port of entry, nor is there information about which countries ultimately received the money spent on transportation. Nevertheless, transportation fees form another channel which could be used to transfer money into or out of the US. In spite of the incomplete information, an analysis similar to that described above for crude oil prices was applied to transportation costs in order to test whether the latter differ between third-piate transactions.[14]

Table 6 displays the summary results with respect to differences between transportation costs of third-party and affiliate transactions. No systematic differences over the years seem evident, but some individual countries display definite patterns: Algeria (positive), Iran (negative), Libya (positive), Mexico (positive), Saudi Arabia (negative), Angola (positive), Egypt (negative), and Norway (positive). Table 7 shows the money transfers that result from affiliates paying significantly different transportation costs than third parties. These transfers represent less than one percent of the value of oil imported into the US by affiliated parties.[15]

Tax effects

As shown in Table 4 and Table 6, third-party and interaffiliate purchase price and transportation cost differentials display specific patterns for some countries. What are the relationships between these estimated patterns and the host country tax regimes? Oil taxation in each country of interest and its evolution over time are highly complex and cannot easily be summarized in a few general statements.[16] Furthermore it is quite difficult to put together a set of statistical information on this matter which displays consistency over time. Since our interest lies in transfer pricing between affiliated parties, our objective is to find an indicator of the fiscal treatment granted to an additional dollar of oil production income by host countries.

The higher is the marginal oil income tax rate, the greater is the incentive to reduce reported taxable income in a particular country, regardless of whether the marginal tax rate is higher than the home country (US) tax rate.[17] Since marginal tax rates are not readily available, we have to rely on average effective tax rates prevailing abroad. The average effective income tax rate is defined as the ratio of income tax paid or accrued to taxable income based on measures which would normally be acceptable to the Interval Revenue Service. The average effective income tax rate may be a poor indicator of the marginal rate when the latter is increasing (understatement) or decreasing (overstatement). It is possible to have a situation where the average tax rate is high and the marginal rate is nil, as was the case when the income tax paid was based on the posted prices.[18]

Average effective income tax rates are displayed in Table 8, but should be interpreted with great care. The main statistical sources are as follows. The tax and income data for even years up to 1982 are taken from various issues of Statistics of Income put out by IRS; the data for 1977 and 1982 come from the benchmark survey of the US Department of Commerce on US direct investment abroad. Smith (1987) presents a few figures for 1983, and finally, some judgment was applied to make interpolations or extrapolations. We are left with a number of missing observations. The salient feature of the average effective tax rates as shown in Table 8 is that they are high, both in absolute terms, and relative to US statutory income tax rates over the same period.[19] Furthermore, the effective income tax rate of US parents of foreign oil affiliates, computed in a similar fashion, was 0.30 in 1982;[20] only Mexico was characterized by a lower figure. No overall time trends are evident; some countries, such as Canada, Egypt, and Nigeria, display upward trends, while others countries, such as Ecuador, Indonesia and Kuwait, show downward trends.

TABLE 8

Average effective tax rates for the U.S. petroleum industry abroad

YEAR	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972
ALGERIA	--	--	--	--	--	--	--	--	0.000	--	--	--	0.561
ANGOLA	0.930[c]	0.930	--	--	--	--	--	--	--	--	--	--	--
BOLIVIA	--	--	--	--	--	--	--	--	0.000	--	--	--	--
BRUNEI	--	--	--	--	--	--	--	--	--	--	--	--	--
CANADA	0.562[b]	0.562[b]	0.562	0.475[a]	0.387	0.411[a]	0.434[a]	0.457	0.347	0.408[a]	0.469[a]	0.342[a]	0.214
CONGO	--	--	--	--	--	--	--	--	--	--	--	--	--
CHINA	0.810[c]	0.810	--	--	--	--	--	--	0.040	--	--	--	--
CAMEROON	--	--	--	--	--	--	--	--	--	--	--	--	--
ECUADOR	0.890[c]	0.890	0.973	1.011[a]	1.048[a]	1.086[a]	1.123[a]	1.161[a]	1.199	1.061[a]	0.924	--	0.000
EGYPT	0.870[c]	0.870	0.750	0.732[a]	0.714[a]	0.696[a]	0.677[a]	0.659[a]	0.641	0.613[a]	0.585[a]	0.556[a]	0.528
GABON	--	--	--	--	--	--	--	--	0.000	--	--	--	--
INDONESIA	0.567[b]	0.567[b]	0.567	0.565[a]	0.563	0.573[a]	0.583[a]	0.593[a]	0.603	0.591[a]	0.579	0.632[a]	0.684
IRAN	0.940[b]	0.940[b]	0.940	0.912[a]	0.884[a]	0.856[a]	0.829[a]	0.801	0.923	0.908[a]	0.893[a]	0.878[a]	0.863
IVORY COAST	0.770[c]	0.770	--	--	--	--	--	--	--	--	--	--	--
NEUTRAL ZONE	--	--	--	--	--	--	--	--	--	--	--	--	--
IRAQ	--	--	--	--	--	--	--	--	0.000	--	--	--	--
KUWAIT	0.697[b]	0.697[b]	0.697	0.714[a]	0.731[a]	0.749[a]	0.766[a]	0.783[a]	0.800	0.903[a]	1.006[a]	1.109[a]	1.212
LIBYA	0.810[c]	0.810	0.830[a]	0.850[a]	0.869[a]	0.889[a]	0.909[a]	0.929	0.903	0.901[a]	0.898[a]	0.896[a]	0.894
OMAN	--	--	--	--	--	--	--	--	--	--	--	--	--
MEXICO	--	--	0.290	--	--	--	--	0.667	0.756	0.577[a]	0.398	0.326[a]	0.254
MALAYSIA	0.470[b]	0.470[b]	0.470	0.476[a]	0.482[a]	0.488[a]	0.494[a]	0.500	0.000	--	--	--	--
NIGERIA	0.950[c]	0.950	0.859	0.856[a]	0.853[a]	0.849[a]	0.846[a]	0.843	0.795	0.785[a]	0.694[a]	0.644[a]	0.593
NORWAY	0.935[c]	0.935	0.706	0.684[a]	0.661[a]	0.639[a]	0.616[a]	0.593	0.860	--	--	--	--
PERU	0.770[c]	0.770	--	--	--	--	--	--	1.944	1.501[a]	1.058[a]	0.915[a]	0.797
QATAR	--	--	--	--	--	--	--	--	--	--	--	--	--
SAUDI ARABIA	0.650[b]	0.650[b]	0.650	--	--	--	--	--	0.960	0.931[a]	0.903[a]	0.875[a]	0.847
SYRIA	--	--	--	--	--	--	--	--	--	--	--	--	--
TRINIDAD	0.797[c]	0.797	--	--	--	--	--	--	1.175	1.164[a]	1.154[a]	1.144[a]	1.134
TUNISIA	--	--	--	--	--	--	--	--	--	--	--	--	--
ABU DHABI	0.697[b]	0.697[b]	0.697	0.714[a]	0.732[a]	0.749[a]	0.767[a]	0.784[a]	0.802	0.753[a]	0.704[a]	0.655[a]	0.607
DUBAI	0.697[b]	0.697[b]	0.697	0.714[a]	0.732[a]	0.749[a]	0.767[a]	0.784[a]	0.802	0.753[a]	0.704[a]	0.655[a]	0.607
SHARJAH	0.697[b]	0.697[b]	0.697	0.714[a]	0.732[a]	0.749[a]	0.767[a]	0.784[a]	0.802	0.753[a]	0.704[a]	0.655[a]	0.607
UNITED KINGDOM	0.420[c]	0.420	0.580	0.520[a]	0.459	0.538[a]	0.617[a]	0.696	0.000	--	0.375	0.416[a]	0.456
USSR	--	--	--	--	--	--	--	--	--	--	--	--	--
VENEZUELA	0.423[b]	0.423[b]	0.423	0.453[a]	0.483	0.471[a]	0.459[a]	0.446	1.598	1.495[a]	1.392	1.223[a]	1.054
ZAIRE	--	--	--	--	--	--	--	--	--	--	--	--	--

Note: -- missing data
a linear interpolation
b same as the 1982 figure
c same as the 1983 figure

TABLE 9

Empirical Results: Relationships between Third-Party/Affiliate Differentials and Tax Rates

1980 - 1984

DEPENDENT VARIABLE: PURCHASE-PRICE DIFFERENTIAL DIVIDED BY ITS STANDARD ERROR

Variable	Coefficient	Std Err	T-stat	Signf
CONSTANT	0.178966	0.386520	0.463019	0.645
TAX RATE	-0.294553	0.539478	-0.545996	0.587

No. of Observations = 66 R^2= 0.0054 (adj)= -0.0256

DEPENDENT VARIABLE: TRANSPORTATION-COST DIFFERENTIAL DIVIDED BY ITS STANDARD ERROR

Variable	Coefficient	Std Err	T-stat	Signf
CONSTANT	0.253021	0.172652	1.46550	0.148
TAX RATE	-0.401841	0.253265	-1.58664	0.118

No. of Observations = 66 R^2= 0.0385 (adj)= 0.0085

1973 - 1978

DEPENDENT VARIABLE: PURCHASE-PRICE DIFFERENTIAL DIVIDED BY ITS STANDARD ERROR

Variable	Coefficient	Std Err	T-stat	Signf
CONSTANT	0.573028E-01	0.677641E-01	0.845622	0.400
TAX RATE	-0.386491E-01	0.773865E-01	-0.499429	0.619

No. of Observations = 78 R^2= 0.0186 (adj)= -0.0073

DEPENDENT VARIABLE: TRANSPORTATION-COST DIFFERENTIAL DIVIDED BY ITS STANDARD ERROR

Variable	Coefficient	Std Err	T-stat	Signf
CONSTANT	0.241430	0.879156E-01	2.74615	0.008
TAX RATE	-0.267596	0.100285	-2.66835	0.009

No. of Observations = 78 R^2= 0.0909 (adj)= 0.0669

RANK CORRELATIONS FOR 1976 (22 observations)

Variables Correlated	Spearman Rank Correlation Coefficient
purchase-price-differential coefficient/standard error, tax rate/purchase-price-differential standard error	.339
transportation-cost-differential coefficient/standard error, tax rate/transportation-cost-differential standard error	-.145

What is the relationship between third-party and interaffiliate purchase price and transportation cost differentials, on the one hand, and the average effective income tax rates, on the other? For purchase price, the transfer-pricing hypothesis states that interaffiliates would like to set a lower price in high-tax host countries relative to third-party transactions, hence generating high positive price differentials. As for transportation cost, a high effective tax rate should induce integrated companies to take income out of the oil-producing host country, possibly into the home country, or more likely into a tax-haven country through a flag-of-convenience shipping affiliate. This would result in more of the oil acquisition cost being in the form of transportation cost, and hence increase transportation cost relative to third parties.

Along with these two transfer pricing hypotheses, our objective is to check whether significant structural breaks occurred between the early part of the sampling period and the latter part, when a number of oil-producing countries had taken over oil production, and when the IRS improved its ability to monitor US oil companies operating abroad.

To test for the influence of effective income tax rates on affiliate pricing behavior, and for possible structural changes, regressions were run with average effective tax rate as the explanatory variable, and differentials between third-party and affiliate prices (as shown, e.g., at the end of table 3) as the dependent variable, for two subperiods, 1975 to 1978 and 1980 to 1984.[21] Each observation is weighted by the inverse of the standard error of the estimated third party/affiliate differential to take into account the precision of the information. Only observations for which tax rates and estimated price differentials are both available are used.

Table 9 presents the summary regression results. The relationship between the two sets of variables is at best tenuous. There appears to be no significant relationship between third-party and affiliate estimated purchase price differentials and average effective income tax rates in

both subperiods. Estimated transportation cost differentials, on the other hand, show the predicted negative relationship with tax rates, significantly so in the first subperiod, and a weaker relationship in the second one. To probe this relationship further, attention was centered on the year 1976, which had the most extensive set of information on individual-country effective oil income-tax rates. Spearman rank correlations between third-party and affiliate estimated purchase price (transportation cost) differentials and effective income tax rates[22] were computed in an attempt to reduce the influence of measurement errors. The price differential/effective income tax rate rank correlation yields, as predicted, a positive value, 0.34, with a standard error of 0.23, while the transportation cost/effective income tax rate rank correlation is, also as predicted, negative, equal to -0.14 with the same standard error. The first estimated rank correlation coefficient is significantly different from zero at the 10 percent level, while the second is not.[23] Taken together, the regression and rank correlation results provide only very weak support for an influence of effective income tax rate on transfer prices between affiliated parties.

Conclusion

In general, multinational corporations can reduce their tax obligations by setting transfer prices that differ from arm's-length prices. Their ability to do so is constrained by tax regulations in their home and host countries. The effectiveness of these regulations, however, is not easily determined.

In this paper, we have conducted the first systematic empirical analysis of transfer prices. The industry we have studied, petroleum, has a long history of tax-motivated transfer pricing. Even after the changes in the tax treatment of the industry in the mid-1970s, there have been allegations of transfer-price abuse, but little in the way of hard evidence.

Our findings indicate that there are systematic differences between transfer and arm's-length prices for many exporting countries. Some of these countries exhibit consistent patterns over time, but others do not. Moreover, the relationship between transfer-price/arm's-length-price differentials and corporate tax rates appears to be weak. There are at least four possible hypotheses for this. First, the nature and enforcement of IRS regulations may be so effective that companies are precluded from reducing their tax obligations through transfer pricing. Second, it may be much easier to avoid taxes through the other channels discussed above. Third, transfer prices may serve a primarily managerial role within the firm, as described by Eccles (1985) and Robbins and Stobaugh (1973).[24] Finally, marginal and average effective tax rates may be sufficiently different as to prevent identification of any relationship between the former and transfer-pricing behavior. These hypotheses are not all mutually exclusive, and untangling them is unlikely to prove easy. While this study represents a step in the empirical analysis of transfer pricing, it is clear that much work remains to be done in this area.

NOTES

1. Briefly, this practice arose out of U.S. foreign policy goals in the Middle East following World War II. The practice began with the establishment of an income tax on petroleum-company profits by Saudi Arabia in 1950. The U.S. Internal Revenue Service issued a ruling accepting the deductibility of this tax against U.S. income tax in 1955. In the 1960s market prices for crude oil declined, but transfer prices, called "posted," or "tax-reference," prices (used in determining petroleum companies taxes paid to oil-producing countries) did not, effectively increasing transfers form the U.S. Treasury to foreign governments (for details see U.S. Congress 1977; for an economic analysis see Jenkins and Wright 1975).

In the mid-1970s foreign crude-oil reserves (except in Canada) were nationalized, limiting the ability of U.S. multinationals to claim payments to foreign governments as creditable against U.S. income tax. The rules on deductibility of foreign taxes were tightened by the U.S. Tax Reduction Act of 1975 and Tax Reform Act of 1976. McDaniel and Ault (1977) summarize these changes.

2. The primary use of the data in Anderson (1988) was to adjust crude oil import prices for quality. Weiner (1986) used the data to test hypotheses about contracting and spot trading.

3. Reporting of the data by firms that import crude oil into the United States is mandatory under the U.S. Federal Administration Act (1974) and the U.S. Energy Policy and Conservation Act (1975), which were part of the basis for U.S. domestic crude oil price regulation. We were unable to find out whether these data were the same as those reported to the IRS. However, these regulations did not provide an incentive for misreporting transfer prices of imported crude oil (see Kalt 1981 for a description and analysis of U.S petroleum regulation in the 1970s), and it appears unlikely that MNCs maintained separate accounting systems for the Department of Energy in addition to their tax and managerial systems.

Since the U.S. deregulation of crude oil prices in 1981, the data have been collected for statistical purposes only. The reporting form was not changed until late 1984, after which the information we use here was no longer requested.

4. Firms are not required to report in months in which they import less than 500 thousand barrels into the United States. In comparison, crude oil imports into the United States averaged roughly 200 million barrels per month during this period. The database covers approximately 90 percent of U.S. crude oil imports.

4a. The MNC's US tax credits and liabilities cannot be deferred when its foreign affiliates are organized as branches, rather than separately incorporated abroad as subsidiaries. Most US petroleum MNCs organize their foreign operations as branches, implying that the transfer-price incentive discussed in the text is relevant only when $t_f > t_{us}$. As indicated below, this is always the case in our data.

5. For a more detailed description, see Plasschaert (1979).

6. The database contains landed as well as f.o.b. prices. Shipments for which the two prices were equal were assumed to change hands on a c.i.f. basis, and were not used in the regressions.

7. Shipments that loaded in one year and landed in the next were counted in the loading year. An alternative to conducting annual regressions would have been to run one regression with interaction terms to allow for changes over time. The database contains so many observations (see Table 4) that there is little to be gained form pooling years for additional degrees of freedom.

8. Not every country exported through every transaction type every year. Dummy variables are omitted in cases where no transactions from a given country of a given type exist.

8a. If the transaction type itself is an endogenous choice based on tax considerations, the coefficient estimates may be biased. To test for endogeneity, we performed a logit analysis, using transaction type as the dependent variable, and effective tax rates (described below) as explanatory variables. The test revealed no significant relationships between transaction type and country-specific effective tax rates.

9. This result comes from applying the Bonferroni inequality $P(E_1, \ldots, E_m) \leq 1 - \Sigma^m P(E_i^c)$, where E_i stands for event i, and E_i^c for the complement of event i. As an example, suppose the events E_1, E_2 are that the t statistics associated with two regression coefficients are in the acceptance region for the null hypothesis. Then the $\leq .05$ level test of both being in the acceptance region is that each is in the .025 acceptance region. In comparison, if the two t statistics are independent, then the exact distribution of B can be calculated; a .025 level test on each coefficient is equivalent to a $1 - (1 - .025)^2 = .0494$ level test of the null hypothesis.

10. The null hypothesis that Canadian data fit the overall regression is rejected at conventional significance levels.

11. The exceptions are China (transaction type T) and Venezuela (transaction type A), but neither is statistically significant at conventional levels.

11a. It has been suggested that type A prices may follow type H prices closely, which would indicate that affiliates' prices merely follow those set by their host government. The Bonferroni test rejects at the five percent level the hypothesis of no price differential between transaction types A and H.

12. In addition, the differences that are significantly different from zero at the 5 percent level are so indicated.

13. Malaysia is the exception.

14. These regressions omit the explanatory variables API gravity, sulfur, and credit days.

15. The result that the United States has received relatively small net inflows differs markedly from that of Jenkins and Wright (1975) for the period before our data start.

16. See Kemp (1987).

17. See the discussion earlier in the paper. For a summary of U.S. taxation of income earned abroad, see Hines (1988a).

18. See U.S. Congress (1977).

19. Average effective tax rates greater than one reflect the fact that the tax base used by the IRS for foreign operations of U.S. companies differs from the tax base as defined by other governments.

20. U.S. Department of Commerce (1985) Table iii.M.1 .

21. As can be seen in Table 4, the price differentials for 1979 are very large. This is in part due to the disruption in the oil market, which resulted in rapid price changes. Since the differentials were almost certainly affected, we have dropped 1979 from the regressions.

22. Taking into account the standard error of the estimated differentials.

23. The approximate distribution for order statistics suggested by Kendall and Stuart (1960), section 31.19, is used to obtain the critical value.

24. This hypothesis requires the additional, questionable assumption that it is too costly for the MNC to maintain separate accounting systems for managerial and tax purposes.

REFERENCES

Anderson, J.M., "Empirical Analysis of World Oil Trade, 1967-1984," in G. Horwich and D.L. Weimer, eds., *Responding to International Oil Crises*, Washington: AEI, 1988.

Benvignati, A.M., "An Empirical Investigation of International Transfer Pricing by US Manufacturing Firms," in A.M. Rugman and L. Eden, eds., *Multinationals and Transfer Pricing*, New York: St. Martin's Press, 1985.

Bertrand, R.J., *The State of Competition in the Canadian Petroleum Industry, Volume III, International Linkages: Canada and the World Petroleum Market*, Ottawa: Minister of Supply and Services, 1981.

Eccles, R.G., *The Transfer Pricing Problem: A Theory for Practice*, Lexington: D.C. Heath, 1985.

Eden, L., "The Microeconomics of Transfer Pricing," in A.M. Rugman and L. Eden, eds., *Multinationals and Transfer Pricing*, New York: St. Martin's Press, 1985

Hines, J.R., "Taxation and U.S. Multinational Investment," *Tax Policy and the Economy* 2, 1988a.

_____, "Where the Profits Are: On the Taxation of Transfers by Multinational Firms," paper presented to the National Bureau of Economic Research Summer Institute, 1988b.

Hubbard, R.G., and R.J. Weiner, "Contracting and Price Adjustment in Commodity Markets: Evidence from Copper and Oil," *Review of Economics and Statistics*, February 1989.

Jenkins, G.P., and B.D. Wright, "Taxation of Income of Multinational Corporations: The Case of the United States Petroleum Industry," *Review of Economics and Statistics*, February 1975.

Kalt, J.P., *The Economics and Politics of Oil Price Regulation*, Cambridge: MIT Press, 1981.

Kemp, A., *Petroleum Rent Collection Around the World*, Halifax: Institute for Research on Public Policy, 1987.

Kendall, M.G., and A. Stuart, *The Advanced Theory of Statistics*, 2nd ed., Vol. 2, London: Griffin and Co., 1960.

Lall, S., "Transfer Pricing by Multinational Manufacturing Firms," *Oxford Bulletin of Economics and Statistics*, August 1973.

LaMont, H., "Multinational Enterprise, Transfer Pricing, and the 482 Mess," *Columbia Journal of Transnational Law* #3, 1975.

McDaniel, P.R., and H.J. Ault, *Introduction to United States International Taxation*, Deventer, Netherlands: Kluwer, 1977.

Plasschaert, S.R.F., *Transfer Pricing and Multinational Corporations*, New York: Praeger Publishers, 1979.

Robbins, S.M., and R.B. Stobaugh, *Money in the Multinational Enterprise*, New York: Basic Books, 1973.

Roumeliotis, P., "La Politique des Prix d'Importation et d'Exportation des Enterprises Multinationales en Grèce," *Revue Tiers Monde*, April-June 1977.

Rugman, A.M., "Transfer Pricing in the Canadian Petroleum Industry," in A.M. Rugman and L. Eden, eds., *Multinationals and Transfer Pricing*, New York: St. Martin's Press, 1985.

Savin, N.E., "The Bonferroni and the Scheffé Multiple Comparison Procedures," *Review of Economic Studies*, 1980.

Smith, J.L., "International Petroleum Taxation: Reasons for Instability," in J.G. Rowse, ed., *World Energy Markets: Coping with Instability*, Calgary: IAEE, 1987.

U.S. Congress, House Committee on Government Operations, *Foreign Tax Credits Claimed by U.S. Petroleum Companies*, Hearings before the Commerce, Consumer, and Monetary Affairs Subcommittee, Washington DC: Government Printing Office, 1977.

U.S. Department of Commerce, Bureau of Economic Analysis, *U.S. Direct Investment Abroad: 1982 Benchmark Survey Data*, Washington DC: Government Printing Office, 1985.

Vaitsos, C.V., *Intercountry Income Distribution and Transnational Enterprises*, Oxford: Clarendon Press, 1974.

Weiner, R.J., *Models of Contracting, Trading, and Spot Markets*, Unpublished Ph.D. dissertation, Harvard University, 1986.

Williamson, O.E. *Markets and Hierarchies*, New York: Free Press, 1975.