

The seemingly anomalous price behavior of Royal Dutch/Shell and Unilever N.V./PLC

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We examine two Anglo–Dutch groups the shares of whose parents trade on several international exchanges. Within each group, the parents' corporate charters mandate the division of cash flows available for distribution. This implies a specific ratio for the market prices of their securities. We document persistent deviations from these ratios on both the New York and London exchanges. The direction and magnitude of the mispricing are common to both pairs of stocks and both markets. Nevertheless, we find no evidence of profitable intra- or intermarket trading rules.

1. Introduction

In an efficient capital market, firms with identical risky cash-flow streams should sell for the same price. This principle is contradicted in the pricing of shares in the parent companies of two Anglo–Dutch combines: the Royal Dutch/Shell group (consisting of the Royal Dutch Petroleum Company and Shell Transport and Trading PLC) and the Unilever group (comprising Unilever N.V. and Unilever PLC). Both groups have structured corporate agreements that allocate claims on group assets, income, and dividends in specified ratios to the shareholders in the parent companies. Given these agreements, the companies' very large market capitalizations, and market efficiency, the relative prices of shares should reflect the division of claims implicit in the allocation agreements. In this paper we document significant and persistent deviations from these theoretical pricing relationships. Our analysis is in the spirit of Long (1978) and Poterba (1986).

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The shares of the British and Dutch parents of each group trade on the New York and the London Stock Exchanges, and the Dutch parents also trade on the Amsterdam Stock Exchange. The pricing of these securities in different markets has important implications for both intramarket efficiency and the integration of international capital markets. Our inferences about efficiency and integration are strengthened by our observation of deviations in the pricing of the stocks of both pairs of companies on both the New York and London exchanges. Moreover, the direction and magnitude of the mispricing are common to both pairs of stocks and both markets. Nevertheless, it does not appear that this mispricing is exploitable on either exchange after relevant costs are taken into account. We also tested an intermarket trading rule and found no evidence of profitability. Our analysis suggests that international capital markets are integrated in that, for individual securities, the law of one price prevails.

The paper is organized as follows. Section 2 provides background on the allocation agreements between the companies and on the markets in which their stocks trade. Section 3 discusses data sources, and section 4 presents evidence on intramarket efficiency for both the New York and London markets. The possibilities for profitable arbitrage are investigated in section 5, where both intramarket and intermarket trading rules are examined. Section 6 considers two possible explanatory factors, and section 7 presents concluding comments.

2. Background

2.1. Royal Dutch / Shell

The Royal Dutch Petroleum Company (henceforth Royal Dutch) and Shell Transport and Trading PLC (henceforth Shell) are independent companies incorporated in the Netherlands and the United Kingdom, respectively. As a result of a 1907 agreement, Royal Dutch and Shell:

share in the aggregate net assets and in the aggregate dividends and interest received from the Group companies in the proportion of 60:40...the burden of all taxes in the nature of or corresponding to an income tax leviable in respect of such dividends and interest shall fall in the same proportion. (Royal Dutch Petroleum, Form 20-F for 1986, filed with the Securities and Exchange Commission)

Thus their sole assets are, respectively, 60% and 40% of the shares in two group holding companies¹ (see fig. 1). The latter own service and operating companies, which in turn pay interest and dividends to the group holding

¹A third holding company, Shell Petroleum Inc., was added in 1987, after the period of our study.

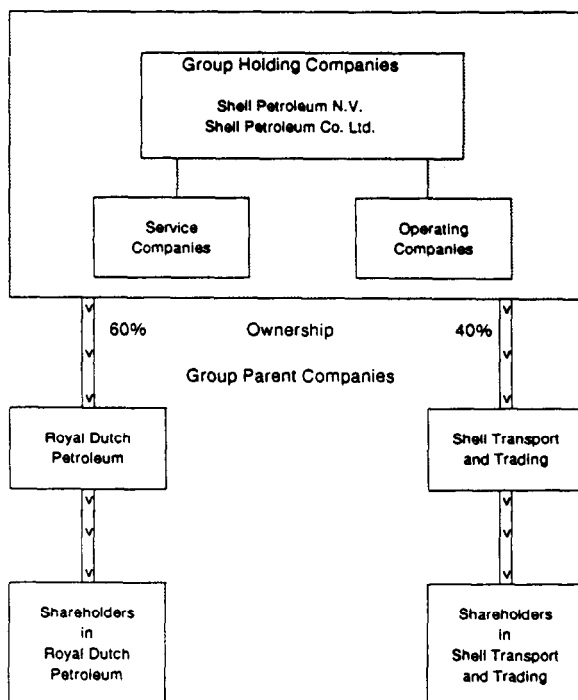


Fig. 1. Flows of income and claims on assets within the Royal Dutch/Shell group of companies. Royal Dutch and Shell share in the aggregate net assets and in the aggregate dividends and interest received from the group companies in the proportion 60:40.

companies. Consequently the shareholders of either parent hold proportional claims against a common pool of assets and receive dividend flows from the group holding companies in that proportion.

Besides the Amsterdam Exchange and the London Stock Exchange, Royal Dutch is actively traded on the New York Stock Exchange (panel A of table 1 provides a summary of exchanges on which each share trades together with distributions of shares by country). It is also traded on an unlisted basis on the Boston, Cincinnati, Midwest, Philadelphia, and Pacific Stock Exchanges. Those shares traded in the U.S. are registered in New York and referred to as 'New York' shares. The principal trading market for Shell Transport is the London Stock Exchange. However, American Depositary Receipts (each representing four shares of the underlying stock) trade on the New York Stock Exchange as well as various regional exchanges. In 1986, approximately 34% and 7% of Royal Dutch and Shell stock, respectively, was represented by the ADRs that trade in U.S. markets.

Table 1

Distribution of shareholdings by country for the parents of the Royal Dutch/Shell and Unilever groups of companies, together with information on the markets in which their shares trade.^a

Year	Panel A – Royal Dutch/Shell group					
	Royal Dutch			Shell		
	U.S.	U.K.	Neth.	U.S.	U.K.	Neth.
1979	17%	3%	36%	1%	97%	< 1%
1980	20	5	33	1	97	< 1
1981	24	7	31	< 1	98	0
1982	24	8	33	1	98	0
1983	28	6	32	1	98	< 1
1984	33	5	29	1	98	< 1
1985	39	4	27	8	91	< 1
1986	34	2	35	7	92	< 1

Royal Dutch is actively traded on the New York, Amsterdam, and London Stock Exchanges. It is also traded on an unlisted basis on the Boston, Cincinnati, Midwest, Philadelphia, and Pacific Stock Exchanges. The principal trading market for Shell is the London Stock Exchange. Shell ADRs^b trade on the New York Stock Exchange and on various regional exchanges.

Year	Panel B – Unilever group					
	Unilever N.V.			Unilever PLC		
	U.S.	U.K.	Neth.	U.S.	U.K.	Neth.
1979	5%	5%	53%	< 1%	> 99%	< 1%
1980	5	7	51	< 1	> 99	< 1
1981	6	15	46	< 1	> 99	< 1
1982	7	19	42	< 1	> 99	< 1
1983	18	13	41	< 1	> 99	< 1
1984	18	8	47	< 1	> 99	< 1
1985	21	7	45	< 1	> 99	< 1
1986	16	4	58	< 1	> 99	< 1

Shares of Unilever N.V. trade on the Amsterdam and London Stock Exchanges, while shares of Unilever PLC trade on the London Stock Exchanges. The 'New York' shares of Unilever N.V.^c and the ADRs of Unilever PLC^d trade on the New York Stock Exchange.

^aSource: Annual Reports and Forms 20-F filed with the SEC.

^bOne Shell ADR is equivalent to four shares of Shell common stock.

^cThese represent Fl. 20 of ordinary share capital.

^dOne Unilever PLC ADR is equivalent to four shares of Unilever PLC common stock.

2.2. *Unilever N.V. / PLC*

Unilever N.V. and Unilever PLC are also incorporated in the Netherlands and the United Kingdom, respectively. Since 1930, N.V. and PLC have operated as if they were the single parent of the Unilever group (see fig. 2). The firms have identical boards of directors and are linked by 'equalization' agreements designed to make the positions of the shareholders of both companies as nearly as possible the same as if they held shares in a single

ing surplus is then pooled and distributed among the holders of ordinary shares of both companies on the footing that each holder receives the same amount on £1 nominal of ordinary capital of PLC as on Fl. 12 nominal of ordinary capital of N.V. (Unilever PLC, Form 20-F for 1986, filed with the Securities and Exchange Commission)

Although the assets of the two companies are not pooled, the agreements insure that in all circumstances the cash flows to the shareholders of the parents will be as close to equal as possible.

As with Royal Dutch and Shell, shares of the Dutch partner trade in both Amsterdam and London and shares of the U.K. partner trade in London. The 'New York' shares of Unilever N.V. and the ADRs of Unilever PLC trade on the New York Stock Exchange. In 1986, approximately 16% and 1%, respectively, were owned by U.S. holders (see panel B of table 1). Unilever N.V. enjoys an active market in the U.S., whereas Unilever PLC does not. Each Unilever PLC ADR represents four British shares; the 'New York' and Dutch shares of Unilever N.V. represent identical claims.

3. Data

New York Stock Exchange prices and rates of return for each security are obtained from the daily Center for Research in Security Prices (CRSP) file. London Stock Exchange and Amsterdam Stock Exchange prices are obtained from the *Financial Times of London*. All prices are adjusted for capital distributions. Daily rates of return are compounded to create weekly rates of return. The test period, September 1979 through December 1986, starts after the removal of the Interest Equalization Tax in the U.S. (January 1974) and exchange controls in the U.K. (August 1979).

4. Intramarket pricing relationships

For each pair of securities we assume the following processes of price formation:

$$P_{ND,t} = V_{ND}(\tilde{\Psi}_t) + \tilde{\mu}_t, \quad (1a)$$

$$P_{UK,t} = V_{UK}(\tilde{\Psi}_t) + \tilde{\nu}_t, \quad (1b)$$

where $P_{ND,t}$ and $P_{UK,t}$ are the market prices of stock in the Dutch and U.K. parents, respectively, at time t , $\tilde{\Psi}_t$ is the 'true' aggregate market value of the group at time t , V_{ND} and V_{UK} are the multipliers used to derive the value of a share in the Dutch or U.K. parent from the market value of the group, and $\tilde{\mu}_t$ and $\tilde{\nu}_t$ represent deviations from the 'true' value of a share. If security

prices are unbiased estimates of 'true' values, then

$$E(\tilde{\mu}_t) = 0, \quad (2a)$$

$$E(\tilde{\nu}_t) = 0. \quad (2b)$$

Rearranging (1a) and (1b) to eliminate Ψ_t , we obtain

$$P_{ND,t}(V_{UK}/V_{ND}) - P_{UK,t} = \tilde{\varepsilon}_t, \quad (3)$$

where $\tilde{\varepsilon}_t$ provides a measure of the mispricing of the U.K. share in relation to the Dutch. More precisely, it is the deviation of the observed price of a U.K. share from the price that could be predicted using the price of a Dutch share and the ratio of the multipliers V_{UK} and V_{ND} . When the relative prices of the U.K. and Dutch shares are as predicted by the relative values of the multipliers, $E(\tilde{\varepsilon}_t) = 0$. By observing the ε_t we are able to identify departures from this pricing relationship.

For each pair of shares we test the hypothesis that the price of a U.K. share is the price that could be predicted using the price of a Dutch share and the ratio of the multipliers, V_{UK} and V_{ND} . The hypotheses are rejected where the ε_t are observed to differ significantly from zero.² Where a hypothesis is rejected, we are also indirectly rejecting the joint hypotheses that (2a) and (2b) hold.

H1. For Royal Dutch (*RD*) and Shell (*ST*):

$$P_{RD} \times (V_{ST}/V_{RD}) = P_{ST}.$$

The ratio of the multipliers (V_{ST}/V_{RD}) is derived as follows: there are 268 million Royal Dutch shares and 1,104.8 million Shell shares issued. Given the 60-40 split in assets, cash flow, and dividend allocation,

$$V_{RD} = \frac{0.6}{268 \text{ million}}, \quad V_{ST} = \frac{0.4}{1104.8 \text{ million}}.$$

Thus, in the London market,

$$V_{RD}/V_{ST} = 6.184.$$

²From (1a), (1b), and (3), ε_t may also be written as

$$\varepsilon_t = \mu_t(V_{UK}/V_{ND}) - \nu_t.$$

Since ε_t is a linear combination of two variables, μ_t and ν_t , that we assume to be normally distributed, a simple *t*-test is used to test for a significant difference from zero.

In the New York market, since one Shell ADR is equivalent to four ordinary shares,

$$V_{RD}/V_{ST} = 1.546.$$

H2. For Unilever N.V. (*UN*) and Unilever PLC (*UL*):

$$P_{UN} \times (V_{UL}/V_{UN}) = P_{UL}.$$

The ratio of the multipliers (V_{UL}/V_{UN}) follows from the equalization agreements that equate £1 of PLC ordinary to Fl. 12 of N.V. ordinary. While the PLC ADRs actually represent £1 of ordinary, the N.V. shares represent Fl. 20 of ordinary. Thus, in the New York market,

$$V_{UN}/V_{UL} = 5/3.$$

In the London market, PLC trades as 25 pence ordinary shares, while N.V. is listed as Fl. 12 subshares. In this case,

$$V_{UN}/V_{UL} = 4.$$

Since stockholders in each parent share in the group cash flows and assets, the shares of Royal Dutch and Shell are close substitutes (adjusted for scalar differences). Similarly, the shares of Unilever N.V. and Unilever PLC are close substitutes. Consequently,

- H3. The realized rates of return to holdings of Royal Dutch and Shell should be similarly distributed.
- H4. The realized rates of return to holdings of Unilever N.V. and Unilever PLC should be similarly distributed.

This should apply for either pair of securities in any market in which both trade.

4.1. New York Stock Exchange

We test our first two hypotheses by calculating deviations of U.K. parent-company share prices from predicted values (ϵ_t) for the Royal Dutch/Shell and Unilever groups of companies. The second column of table 2 shows annual means of weekly calculated values of ϵ_t for Royal Dutch/Shell. From

Table 2

Deviations of U.K. parent-company share prices from theoretically predicted values for the parents of the Royal Dutch/Shell and Unilever groups of companies, using weekly New York Stock Exchange prices from September 1979 through December 1986 (*t*-values in parentheses).

Year	Deviation of U.K. share price from predicted value ^a		Valuation ratios ^b	
	Royal Dutch/ Shell	Unilever N.V./PLC	Royal Dutch/ Shell	Unilever N.V./PLC
	Mean	Mean	Mean	Mean
1979	-5.1803 (-21.351)	-5.9485 (-20.717)	0.8281	0.8669
1980	-9.4343 (-26.611)	-7.4599 (-21.481)	0.7546	0.8315
1981	-7.9867 (-36.959)	-10.3659 (-38.999)	0.7479	0.7698
1982	-6.3379 (-45.382)	-8.9618 (-34.194)	0.7702	0.8024
1983	-4.3657 (-19.882)	-3.1380 (-15.749)	0.8682	0.9324
1984	-2.2315 (-8.856)	-0.4500 (-1.481)	0.9368	0.9917
1985	1.2690 (16.484)	3.5370 (8.983)	1.0340	1.0565
1986	3.2469 (19.586)	11.9620 (13.232)	1.0647	1.1140

^aDifferences in relative values for the parents of each group are derived as $P_{ND}(V_{UK}/V_{ND}) - P_{UK}$, where P_{ND} and P_{UK} are the market prices of shares in the Dutch and U.K. parents, and (V_{UK}/V_{ND}) is the 'theoretical' value ratio for the shares of the two parents.

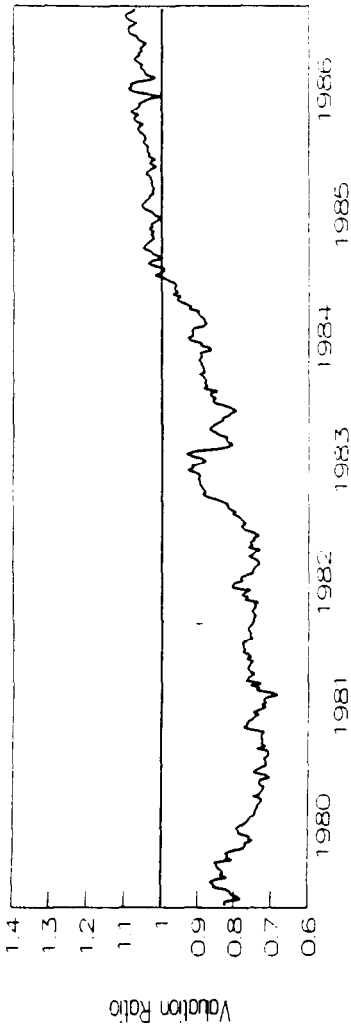
^bValuation ratios are defined as $(P_{ND}/P_{UK})/(V_{ND}/V_{UK})$.

1979 through 1984 the mean ϵ 's are negative, indicating relative overvaluation of Shell shares. In 1985 and 1986 the mean ϵ 's are positive. Hypothesis H1 is tested by performing *t*-tests for difference from zero on these mean values. In all cases the means are significantly different from zero. This evidence of the deviation of the relative prices of Royal Dutch and Shell from their predicted ratio enables us to reject hypothesis H1.

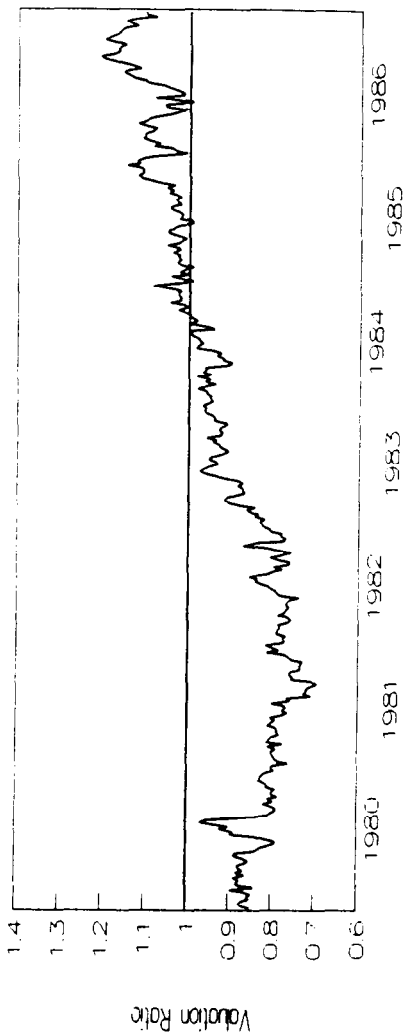
Results for the Unilevers are shown in column 3 of table 2. They closely resemble those for Royal Dutch/Shell, with decreasingly negative means from 1981 to 1984 becoming positive in 1985 and 1986. In all years except 1984 we are able to reject hypothesis H2.

The valuation ratios in table 2 normalize the differences in relative value by dividing the observed price ratio by its theoretical value. Thus, the valuation ratios represent the ratio of observed (market) prices relative to the

Royal Dutch / Shell



Unilever N.V. / PLC



Differences Between Unilever N.V./PLC and Royal Dutch/Shell Valuation Ratios

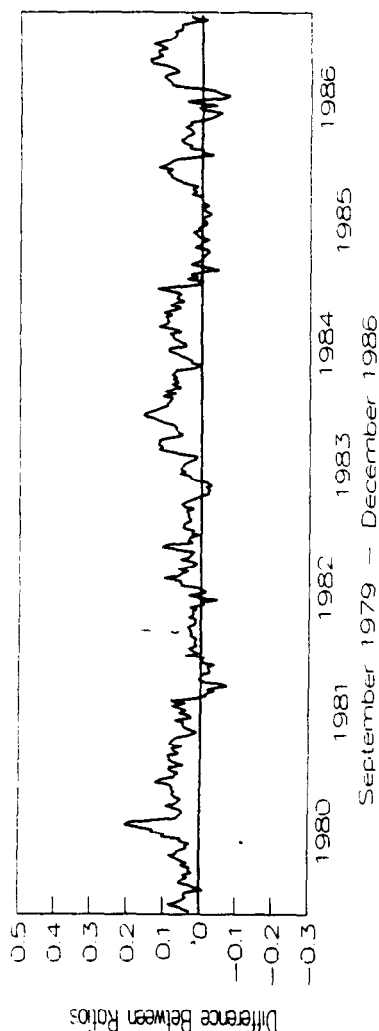


Fig. 3. Weekly valuation ratios for the Royal Dutch/Shell and Unilever N.V./PLC groups of companies calculated from New York Stock Exchange prices over the period September 1979 to December 1986. Valuation ratios are defined as $(P_{ND}/P_{UK})/(V_{ND}/V_{UK})$, where P_{ND} and P_{UK} are the market prices of shares in the Dutch and U.K. parents and (V_{ND}/V_{UK}) is the 'theoretical' value ratio for the shares of the two parents. Theoretical value ratios take into account the agreed division of claims between the two parents and the number of shares outstanding for each parent. The final graph shows the weekly difference between the valuation ratios of the two groups.

ratio of the multipliers, V_{UK} and V_{ND} . At time t ,

$$\text{Valuation ratio} = \frac{P_{ND,t}/P_{UK,t}}{V_{ND}/V_{UK}}.$$

If the relative prices of the securities reflect the predicted ratios, the valuation ratio would equal 1.0.

The upper two panels of fig. 3 display weekly valuation ratios for the two pairs of companies. Persistent differences between the observed and predicted price ratios existed throughout the period, being most pronounced from September 1979 to December 1983. Columns 4 and 5 of table 2 show yearly averages of weekly valuation ratios for each pair of companies.

The valuation ratios for the two pairs of companies are very similar and follow closely related time paths. The bottom panel of fig. 3 shows the difference between the valuation ratio for the two Unilevers and that for Royal Dutch/Shell. The differences are generally small, with the ratio for the Unilevers being the larger.³

Hypothesis H3 is concerned with differences in the distribution of rates of return between Royal Dutch and Shell. It is tested by comparing the respective weekly rates of return using a t -test for difference between means and by comparing the variance of those returns using an F -test. These tests are run using total rate of return.

The results of tests for Royal Dutch/Shell are shown in panel A of table 3. In no case are the returns significantly different from one another. The variances are significantly different only for 1979 and 1985. In general, these results indicate that the variances of this pair are not different.

The results of the tests of H4 for difference between mean returns for the two Unilevers are presented in panel B of table 3. As with Royal Dutch/Shell, there is no significant difference between the mean weekly rates of return. For all the years except 1982, 1983, and 1984, the F -ratios are statistically significant, indicating that the variances are not equal. The higher variance is reasonable given that the proportion of the U.K. shares held in the U.S. is small relative to U.S. holdings in the Dutch shares (see table 1). This implies much thinner trading and therefore considerably different variance properties from the more widely held Dutch shares. If this explanation is valid, we

³This implies that Unilever PLC is less overvalued in relation to Unilever N.V. than Shell is to Royal Dutch. This may be explicable by reference to the uncertainty surrounding the Leverhulme Trust holdings in Unilever PLC. Before January 27, 1984, these included 18% of the ordinary share capital, the dividends on which were waived but which still represented a considerable claim against the assets of the firm. After January 27, 1984, they comprised 5% of the ordinary share capital plus securities that could convert to a further 6% of the ordinary share capital in the year 2038. (Unilever PLC, Form 20-F for 1986, filed with the Securities and Exchange Commission, p. 26)

Table 3

A comparison of weekly NYSE rates of return (in percent) for the parents of the Royal Dutch/Shell and Unilever groups of companies^a (*t*-values in parentheses).

Panel A – Royal Dutch/Shell						
Year	Mean weekly returns			Weekly return variances ($\times 10^{-2}$)		
	Royal Dutch	Shell	Difference	Royal Dutch	Shell	<i>F</i> -ratio ^b
1979	0.523%	0.413%	0.110% (0.14)	0.078	0.229	2.960 ^c
1980	0.705	0.953	-0.247 (-0.76)	0.120	0.136	1.113
1981	-0.405	-0.480	0.074 (0.08)	0.163	0.202	1.241
1982	0.213	0.005	0.208 (0.59)	0.132	0.191	1.456
1983	0.691	0.590	0.100 (0.33)	0.128	0.142	1.104
1984	0.348	0.089	0.258 (0.81)	0.151	0.200	1.324
1985	0.593	0.576	0.017 (0.09)	0.048	0.082	1.707 ^c
1986	0.990	0.953	0.037 (0.16)	0.087	0.086	1.012
Panel B – Unilever N.V./PLC						
Year	Mean weekly returns			Weekly return variances ($\times 10^{-2}$)		
	Unilever N.V.	Unilever PLC	Difference	Unilever N.V.	Unilever PLC	<i>F</i> -ratio ^b
1979	-0.159%	-0.377%	0.219% (0.25)	0.046	0.178	3.870 ^d
1980	0.154	0.277	-0.122 (-0.26)	0.092	0.164	1.787 ^c
1981	0.241	0.323	-0.081 (-0.17)	0.079	0.168	2.126 ^c
1982	0.601	0.194	0.407 (0.77)	0.132	0.124	1.063
1983	0.364	0.262	0.102 (0.36)	0.072	0.068	1.057
1984	0.245	0.050	0.195 (0.42)	0.060	0.046	1.313
1985	1.030	1.058	0.028 (0.07)	0.064	0.120	1.874 ^c
1986	1.013	1.031	0.018 (0.04)	0.104	0.173	1.654 ^c

^aAll tests are based on weekly New York Stock Exchange prices from September 1979 through December 31, 1986.

^b*F*-tests are on variances of weekly rates of return.

^cSignificant at the 0.05 level.

^dSignificant at the 0.01 level.

should not expect variance differences on the London Stock Exchange, where all the shares are relatively actively traded.

4.2. London Stock Exchange

Tests similar to those for the New York Stock Exchange were performed using London weekly closing prices. For hypotheses H1 and H2 the results (not shown) are similar to those for New York shown in fig. 3 and table 2. The hypotheses are rejected identically. For hypotheses H3 and H4 the similarities to the New York results are less clear-cut. Tests for differences in the means of weekly rates of return for each pair of companies are analogous to those for New York in producing no significant *t*-statistics. However, *F*-ratios from tests for differences in variances between returns of each pair produce different results. In no case are the variances different at the 5% level.

The broad similarities between the New York and London results eliminate the possibility that the relationships observed in the New York data derive primarily from the thinness of the market for the U.K. half of each pair. The absence of significant variance differences in the London returns does, however, indicate that the differences found in the New York return variances may be explained by that thinness.

5. Opportunities for profitable trading

We examine trading rules designed to take advantage of profitable intra- or intermarket arbitrage opportunities. These occur wherever the prices of a pair of securities deviate from their expected relationship in one market or an individual security trades at different prices in different markets.

5.1. Intramarket trading rules

We consider two methods by which an investor might have profited from the deviations of observed prices from their expected relationships. The methods involve establishing a short position in the overpriced security and a long position in the underpriced one. Generally the proceeds from the short sale are held as collateral and hence cannot be used to finance the long position. Overall such a strategy requires an investment equal to the cost of the long position.

We establish the long and short positions in September 1979 and hold them until the mispricing is corrected. Note that such a 'spread' position has little market risk. The realized holding period returns would have been approximately 22% for the Royal Dutch/Shell position and 16% for the Unilever position. In each case commissions and the cost of trading across

the spread would reduce the total return by 6–8%. Given an investment period of more than five years, the annual rate of return (2–3%) would not cover the costs of financing the long position.

We also tested a short-term trading rule. Starting with the end of the first week in the sample period, buy the relatively underpriced stock and short the other stock. The English shares are always bought or sold as a multiple of the Dutch shares. The positions are covered at the end of the following week, and then a new position is established, based on the observed price ratio at that time. Rates of return are calculated taking dividends into account, but not transactions costs (round trip commissions and the bid–ask spread) and interest costs. In this sense, the trading strategy is a test of maximum possible returns assuming no frictions in the market and the ability to use the proceeds of short sales to finance the long position. Annual rates of return range from a minimum of –12.28% (for Royal Dutch/Shell in 1980) to a maximum of 23.52% (for Unilever in 1982). Overall means are 4.12% per year for Royal Dutch/Shell and 4.88% for Unilever. Nevertheless, it was not possible to earn a rate of return significantly different from zero in any year.

5.2. *Intermarket trading rules*

We examine the relative pricing of each security across pairs of markets for profit opportunities. In the absence of friction, for intermarket pricing to be efficient, the ratio of prices for the same security in markets in two countries should be equal to the exchange rate between the currencies. Thus,

$$X_{j,k,t} = P_{i,j,t}/P_{i,k,t}, \quad (4)$$

where $P_{i,j,t}$ is the price of security i on market j at time t , $P_{i,k,t}$ is the price of security i on market k at time t , and $X_{j,k,t}$ is the j per unit of k exchange rate at time t .

We test for pricing efficiency by examining the distribution of deviations from this relationship. The deviations are defined as

$$W_{i,j,k,t} = X_{j,k,t} - (P_{i,j,t}/P_{i,k,t}). \quad (5)$$

Table 4 presents summary statistics on the deviations between pairs of markets for each security. For comparability and to provide a measure of the potential trading profits,⁴ deviations are normalized by the exchange rate and reported as percentages. In all cases they are small and, on the whole, provide little evidence that it might be possible to formulate profitable trading rules. The exception is the New York and London pricing of the shares of the U.K. companies. Here the actual £/\$ exchange rate is consis-

⁴Note that

$$W_{i,j,k,t}/X_{j,k,t} = (P_{i,k,t}X_{j,k,t} - P_{i,j,t})/(P_{i,k,t}X_{j,k,t}).$$

Table 4

Average differences between weekly actual and implied exchange rates^a (expressed as a percentage of the actual exchange rate) for Unilever N.V. and Royal Dutch in the Amsterdam/London and Amsterdam/New York markets, and for all four companies in the London/New York markets (*t*-statistics in parentheses).

Year	Panel A - Fl./£ Amsterdam/London		Panel B - Fl./\$ Amsterdam/New York	
	Unilever N.V.	Royal Dutch	Unilever N.V.	Royal Dutch
1979-86	-0.03% (-0.38)	0.01% (0.24)	0.11% (1.58)	0.04% (0.48)
1979	0.30 (0.75)	0.32 (0.55)	-0.23 (-0.60)	0.09 (0.27)
1980	0.61 (4.31) ^c	0.23 (1.77)	-0.12 (-0.75)	-0.32 (-1.24)
1981	0.10 (0.43)	-0.13 (-0.81)	0.14 (0.58)	-0.26 (-0.87)
1982	-0.26 (-1.56)	-0.07 (-0.48)	0.25 (1.17)	-0.20 (-0.75)
1983	-0.17 (-1.12)	0.11 (0.66)	0.05 (0.35)	0.32 (1.57)
1984	-0.04 (-0.27)	0.09 (0.65)	0.14 (0.66)	0.28 (1.24)
1985	-0.24 (-1.38)	-0.02 (-0.16)	0.11 (0.70)	0.17 (1.27)
1986	-0.43 (-1.32)	-0.24 (-1.83)	0.27 (1.34)	0.09 (0.40)

Year	Panel C - £/\$ London/New York			
	Unilever PLC	Unilever N.V.	Royal Dutch	Shell
1979-86	0.52% (3.79) ^c	0.19% (1.78)	0.05% (0.54)	0.44% (4.68) ^c
1979	1.81 (2.89) ^c	-0.52 (-1.41)	-0.26 (-0.54)	1.31 (1.86)
1980	-0.14 (-0.25)	-0.74 (-3.29) ^c	-0.54 (-1.91)	-0.11 (-0.38)
1981	1.32 (2.84) ^c	0.05 (0.17)	-0.10 (-0.32)	0.49 (1.36)
1982	0.70 (1.84)	0.51 (1.82)	-0.13 (-0.46)	-0.48 (-2.31) ^b
1983	-0.30 (-1.29)	0.20 (0.97)	0.21 (0.88)	0.06 (0.25)
1984	-0.13 (-0.32)	0.19 (0.68)	0.17 (0.74)	0.88 (4.33) ^c
1985	0.84 (2.86) ^c	0.33 (1.30)	0.18 (1.04)	0.96 (4.96) ^c
1986	1.05 (3.93) ^c	0.59 (1.62)	0.32 (1.42)	0.63 (3.32) ^c

^aImplied exchange rates are defined as $(P_{i,j,t}/P_{i,k,t})$, where $P_{i,j,t}$ and $P_{i,k,t}$ are the prices of stock i at time t in markets j and k , respectively.

^bSignificant at the 0.05 level.

^cSignificant at the 0.01 level.

Table 5

U.K. transfer tax rates and average pretax profits from arbitrage between the London and New York markets for the corresponding time periods.

Period	Transfer tax rate	Pretax arbitrage profits			
		Unilever PLC	Unilever N.V.	Royal Dutch	Shell Transport
Sept. 1979 – March 1984	2%	0.42%	0.01%	-0.06%	0.10%
April 1984 – March 1985	1	0.24	0.28	0.12	1.06
April 1985 – March 1986	0.5	0.85	0.37	0.19	0.67
April 1986 – Dec. 1986	1.5	1.01	0.66	0.28	0.82

tently greater than the implied rate, suggesting relative underpricing of the shares in the London market. The differences are sufficiently persistent that they might provide profit opportunities in the absence of costs. Such trading would involve the purchase of shares in the London market, their conversion to ADRs, and their subsequent sale in New York. Unfortunately for would-be arbitrageurs, U.K. taxes impose an additional cost on this type of trading strategy.

The U.K. imposes a transfer tax called the stamp tax when securities are purchased. The tax has varied since 1979, ranging from 2% from 1979 to April 1984 to 1% from April 1984 until April 1985, and $\frac{1}{2}\%$ since then. Thus, any investor buying the shares in London of any of the four firms being discussed would have to factor in the tax. This includes ADR investors whose shares were bought on the London Exchange and then converted to ADRs. In April 1986, the British Treasury considered imposing a 5% tax whenever U.K. shares were converted into ADRs, but this was reduced to 1.5% as a result of complaints from the securities industry. This would be in lieu of the transfer tax for shares purchased for non-ADR use. Table 5 lists chronologically the effective rates of transfer tax in the U.K. and shows the average potential (pretax) gains from arbitrage over the same periods. Only in the period April 1985 to March 1986 was there profit potential (in Unilever PLC and Shell Transport) after allowing for these taxes. Even here, the posttax profits were too small compared with other transaction costs and with the cost implicit in trading across the bid-ask spread to represent a profitable arbitrage opportunity.

6. Possible explanations

6.1. British institutional investors

A number of analysts⁵ argue that at least part of the early period 'mispricing' may be explained by the relative attractiveness of Shell and Unilever

⁵For example, at a Royal Dutch/Shell presentation to New York analysts on June 26, 1985.

Table 6

Supplementary dividends received by Shell stockholders, dates of payment, and the Shell stock price on each date of payment.

Date	Supplementary dividend	Present value of dividend stream ^a	Shell stock price
10-01-79	\$0.1142	\$1.2038	\$32.87
04-03-80	0.1695	1.1441	29.75
10-03-80	0.1301	1.0233	40.25
04-07-81	0.1613	0.9379	32.75
10-02-81	0.1219	0.8154	24.50
04-06-82	0.1599	0.7282	27.25
09-24-82	0.1341	0.5967	27.37
04-06-83	0.1473	0.4857	29.25
09-30-83	0.0968	0.3554	35.62
04-06-84	0.1643	0.2715	36.62
09-28-84	0.1125	0.1125	34.75

^aThe present value at 10% of the stream of supplementary dividends to be received on or after each payment date.

PLC over their Dutch counterparts to certain types of British institutional investors. In particular, tax-exempt (or 'gross') funds, usually pension funds, are able to obtain the full, pretax, dividend from the British company, but are penalized by the 15% Dutch withholding tax that they are unable to offset against taxes payable. Thus, for these investors, the shares of the Dutch company are only 85% as valuable as the theoretical valuation would suggest. This would imply a valuation for Royal Dutch/Shell of 1.314:1, and for Unilever N.V./PLC of 1.417:1.

It is further argued that increased integration of capital markets, and particularly increased trading activity in the U.S., led to the British institutions losing the price-setting role after 1984. The weakness of this argument can be seen by observing from table 1 that holdings in the U.K. companies (particularly Unilever PLC) remain concentrated in the U.K. market post-1984. Finally, at no time were the holdings of the British tax-exempt funds in either company sufficiently large to be consistent with their taking the price-setting role suggested.

6.2. *Shell supplementary dividend*

From 1977 to 1984, Shell Transport and Trading paid a 15% supplementary dividend each year. This arose from the need to distribute monies previously withheld because of statutory dividend restrictions in the U.K. In the early 1980s, some analysts argued that this was a major factor in Shell's relative overpricing. We contend that it played a very minor role. This contention is supported by two observations. First, the effect on the Shell price should have been limited to the present value of the expected 'bonus'

dividends. Using a 10% discount rate (which probably overstates the present value, given financial market conditions during this period), this amounts to at most \$1.20 relative to a stock price of \$32.87 in 1979 (see table 6) and declines as the termination of the supplementary dividends (1984) approaches. Second, essentially the same pattern of relative pricing is observed for the two Unilevers as for the Royal Dutch/Shell combine, but Unilever PLC paid no supplementary dividend.

7. Conclusions

We document what appears to be persistent mispricing in the stocks of two Anglo-Dutch combines on both the New York and London exchanges. The direction and magnitude of the mispricing are common to both pairs of stocks and both markets, indicating systematic rather than specific origins. Despite the pricing differences, we find no evidence of profitable intramarket trading rules or arbitrage opportunities.

Finally, the evidence we present on intermarket trading rules implies that the securities of each parent are consistently priced across the markets in which they are traded. That is, for an individual security, the law of one price prevails.

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