The Impact of Exchange Rate Fluctuations on the Shipping Industry

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Abstract

The international shipping industry has certain characteristics, which make it particularly vulnerable to exchange rate risk. While the commercial world recognises such risk, neither the shipping industry nor academia have yet tried to quantify or evaluate the extent of the problem. This thesis attempts to fill this intellectual void.

These characteristics specific to the shipping industry are: first, its unique freight rate structure which, being fixed in US Dollars, necessitates subsequent conversions into a variety of other currencies, and second, its low profit margins, both at operating and net levels, which serve to exacerbate the impact of exchange rate volatility. Susceptibility is relative to the economic and commercial environment of the different shipping nations and, accordingly, this analysis takes account of this by examining two particular nations, namely Norway and Japan, which have been subject to different experiences. It sets out to examine their shipping industries and their differing response to exchange rate management in the light of these varying experiences, and to assess their companies, both from a corporate and market perspective, using the performance indicators of operating profit and share price returns. Principal instruments of evaluation are mainly quantitative, in the form of statistical analysis of unpublished data, but also qualitative, in terms of discussion with industry experts *in situ*.

Abbreviations

ADF	Augmented Dickey Fuller Unit Root Test
AR	Abnormal Return
BERG	Bergesen d.y.
'Big 3'	The biggest 3 shipping companies in Japan
'Big 5'	The biggest 5 shipping companies in Japan
CAFs	Currency Adjustment Factors
χ^2	Chi Squared Distribution
LEIF	Leif Hoegh
$\Delta ER_{t,t-j}$	Change in Log Nominal Exchange Rate between time t and t-j
$\Delta RER_{t,t-j}$	Change in Log Real Exchange Rate between time t and t-j
ER	Log Nominal Exchange Rate
F	F distribution
K Line	Kawasaki Kisen Kaisha
MOL	Mitsui OSK Lines
NYK	Nippon Yusen Kabushiki Kaisha
PPP	Purchasing Power Parity
Q test	Box Pierce test for white noise errors
R^2	Coefficient of Determination
RER	Log Real Exchange Rate
Krone/US$	The number of Krone to the US Dollar
Yen/US$	The number of Yen to the US Dollar
VAR	Value at Risk
WILH	Wilhelmsen

PART A: Introduction

Chapter 1: Introduction

Chapter 2: Source Material and Literature

Chapter 3: Methodology

Chapter 1

Introduction

This research argues that exchange rate fluctuations have a significant impact on the performance of the shipping industry. Exposure to fluctuations in the rate of exchange creates problems for any international business. The shipping industry with its particular currency structure and low profit margins is especially prone to exchange rate risk. The aim here is to analyse the nature of the risk and to measure its impact on performance in terms of operating profits and share price returns.

The research uses two countries, two measures of performance, two methodologies. Each of these is defined and justified in what follows.

The two countries chosen are Japan and Norway. Both are major maritime nations accounting for 13% and 10% of the world fleet (measured in dead weight tons) respectively. For the purposes of this study, however, the reason for selecting these particular countries is the different patterns of exchange rate fluctuations that have occurred over recent years. The Yen has been subject to long periods of appreciation against the Dollar, whilst the Krone has exhibited volatility, but no apparent trend.

The two methodologies use different performance measures. The first is operating profit, which includes all revenues and expenses associated with the carriage of freight,

and ignores other income and expenses, such as those associated with the sale and purchase of vessels and the financing of them. It should be noted that, although depreciation on the vessels does represent an operating expense, it is excluded from the analysis, since it only a notional transaction[1].

The use of operating profit allows the isolation of the results from day to day activities which are in turn free from the distortions of 'asset plays'[2]. This allows an analysis of how the operating results are affected by exchange rate movements. The available data for this analysis are country aggregates, which means that performance of the industry as a whole can be studied.

The other measure of performance is returns on shares. This is a measure which encompasses all activities of a business, trading, sale and purchase, and investor perception. The approach on returns data is, of necessity, company specific, since no meaningful index exists for shipping company shares. However, since the bulk of the industry in the two countries is represented by a few major companies, analysis of these companies will give a good approximation for the industry as a whole.

The use of these two measures gives greater depth to the analysis. Consistencies should exist between the two, but differences may emerge as a result of performance in non trading activities and market perception, reflected in share prices but not in operating profit.

The results are a reflection of the volatility of the particular currency against the US Dollar and the level of exposure to that volatility.

Whilst the main hypothesis is an analysis of the impact of exchange rate risk on performance of the shipping industry, the thesis is essentially a comparative analysis which allows further hypotheses to be explored. It measures significant differences in the results of the two countries chosen, and, within those countries, significant differences between the companies themselves. Differences between countries may be the result of economic factors and national responses to the exchange rate risk. Variations between the companies may the consequence of differences in corporate policy, management, and type of trade, for example, liner, dry bulk, tank. This sector diversity is a well documented as in The Rochdale Report[3]:

> 'Shipping is a complex industry and the conditions which govern its operations in one sector do not necessarily apply in another; it might even, for some purposes, be better regarded as a group of related industries.' (p.1 paragraph 2)

The companies selected for this analysis are large companies with a diverse operational base covering a range of the shipping sectors[4]. However, where the company does have a bias towards a particular trade, this factor may provide an explanation of differences between the results. An analysis of this diversity is presented in Appendix 5.

The following discussion examines the problem and its causes, by considering the types of exposure, the volatility of the exchange rate, the cost and revenues structure, methods of measurement, and strategic implications for the industry.

The Problem

Foreign exchange risk in the shipping industry arises from a unique freight market structure exposed to a volatile foreign exchange market. The exposure arises from revenues in US Dollars which are not matched by US Dollar expenses. The net Dollar revenues i.e. US Dollar revenues less US Dollar costs must, therefore, be converted into other currencies to meet those costs not denominated in US Dollars, the majority of which will be in the domestic currency. In a system of volatile exchange rates, fluctuations in the rate of exchange between these currencies and the US Dollar can, therefore, have a serious impact on the performance of the shipping industry in terms of operating results and returns on shares.

The problem thus consists of two essential elements. Firstly, the exposure in terms of net US Dollar revenues, and, secondly, the volatility of the exchange rate. This study uses a number of primary sources, detailed discussions with shipowners, shipbrokers, and financiers, and official statistics to identify the exposure for the Japanese and Norwegian industries. These levels are then used in conjunction with measures of volatility of the domestic exchange rate against the US Dollar to calculate sensitivity of the industries to foreign exchange fluctuations and finally the effect on share price returns.

A number of terms used in the analysis require definition. The following sections, therefore, discuss exposure, exchange rate volatility, net Dollar revenues and costs structures, share price returns and tools of measurement.

Types of Currency Exposure

Generally foreign exchange risk refers to the volatility of exchange rates between countries and its consequences for the cash flows and the value of the firm. Three types of exposure can be identified: translation or accounting exposure, transaction exposure, and economic exposure.

Translation exposure arises from the fact that the book value of shareholders' funds may change as a result of movements in the exchange rate. Foreign currency assets, liabilities, income and expenses must be translated into the domestic currency to be included in the company's financial statements. The exchange rates used in this translation process are governed by both International and a variety of National Accounting Standards. Such exposure has no affect on the value of the business, since it merely has a cosmetic effect and no impact on cash flow.

Transaction exposure arises from the change in the value of outstanding financial obligations incurred prior to a change in the exchange rate, but settled after the change. All businesses engaged in international trade are subject to this short term exposure, and the majority manage it by the use of short term hedging instruments, such as forward rate agreements, futures and options.

Economic exposure is the most significant, since it examines the impact on the present value of a firm resulting from change in the future operating flows caused by exchange rate fluctuations. Transactions exposure can be thought of as a subset of economic exposure, since it can alter the cash flows. It is not necessary to operate internationally to be subject to economic exposure. For example, a UK firm, selling in the UK in a

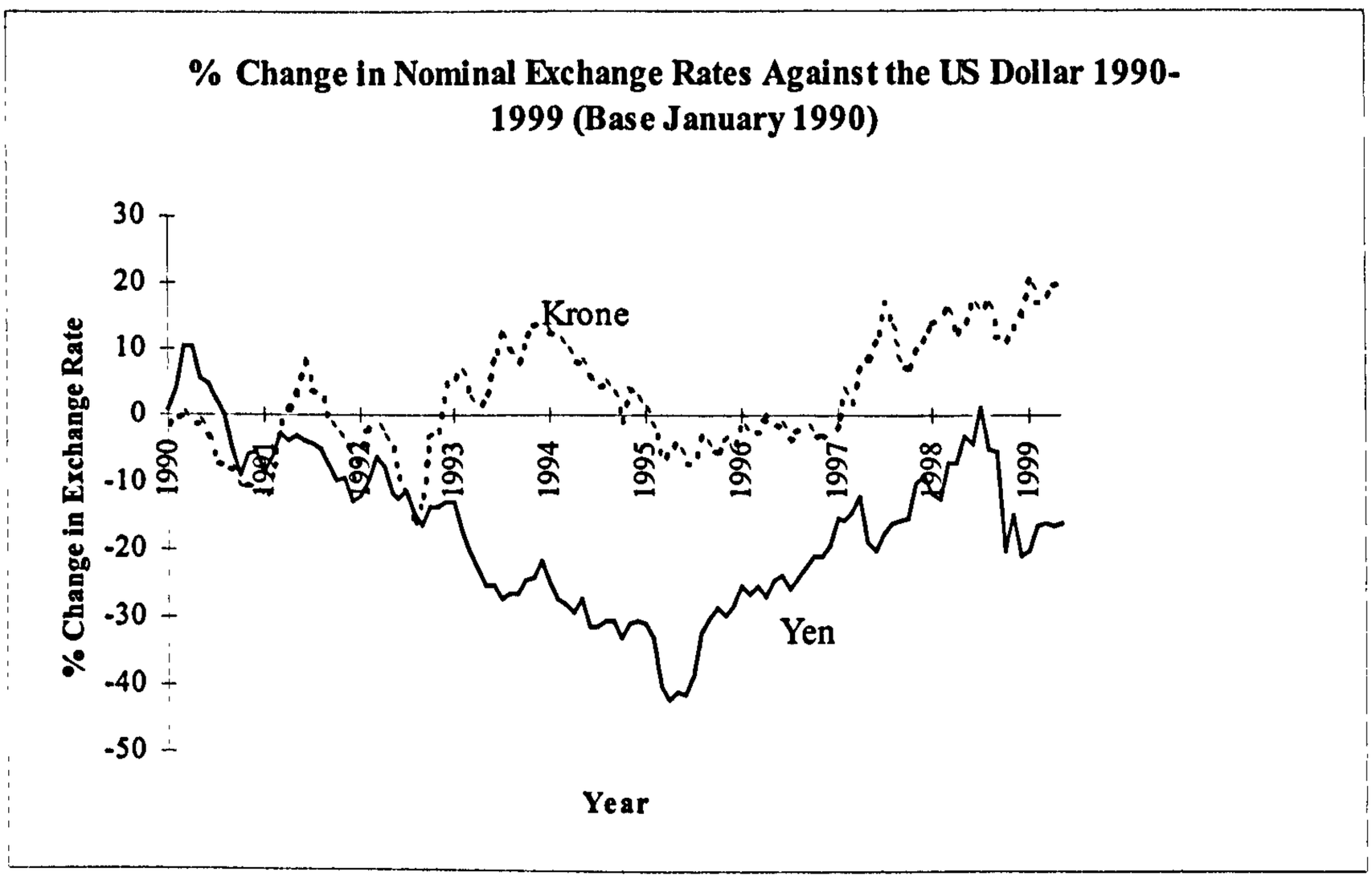
market which is also supplied by a French competitor, is subject to economic exposure. This stems from the fact that movements in the £/Franc exchange rate may alter the competitive position of the rival firm and give it either an advantage or disadvantage over the UK firm.

This thesis is concerned with economic exposure, the effect of a volatile exchange rates on operating results, and the value of the business as encapsulated by the returns on shares.

Exchange rate volatility

The collapse of the fixed exchange rate regime in the 1970s led to instability of currencies on the international market. This study focuses on the events and trends of the last decade, in order to determine the more recent effects of this volatility on the shipping industry.

Figure 1.1



Source: Datastream

Figure 1.1 illustrates the volatility of the nominal Yen/US$ and Krone/US$ exchange rate since 1990. The diagram shows the percentage change in the nominal exchange rates against the Dollar since 1990, with January 1990 as the base year. It can be seen that both the Yen and Krone exhibit volatility against the US Dollar during that period. The Yen, however, shows a marked long term appreciation up to mid 1995, being particularly strong between 1993 and 1995. During 1996 there is a recovery back to 1992 levels. The appreciation of 1997 leads up to the Asian Crisis, in which all the

Asian currencies depreciated dramatically on the international markets in the wake of a major banking collapse in the Far East. The recovery from this has been relatively strong, with the Yen in 1999 reaching its highest levels against the US Dollar. The underlying strength of the Yen is clearly apparent during the period under investigation. The experience of the Krone is less clear, with no apparent trend emerging. In the early part of the decade from 1990 to 1993 the fluctuations both upward and downward are around a relatively consistent average rate for the period. 1993 proved to be a year of depreciation against the US Dollar which was reversed in 1994. 1995 and 1996 are characterised by low levels of volatility.

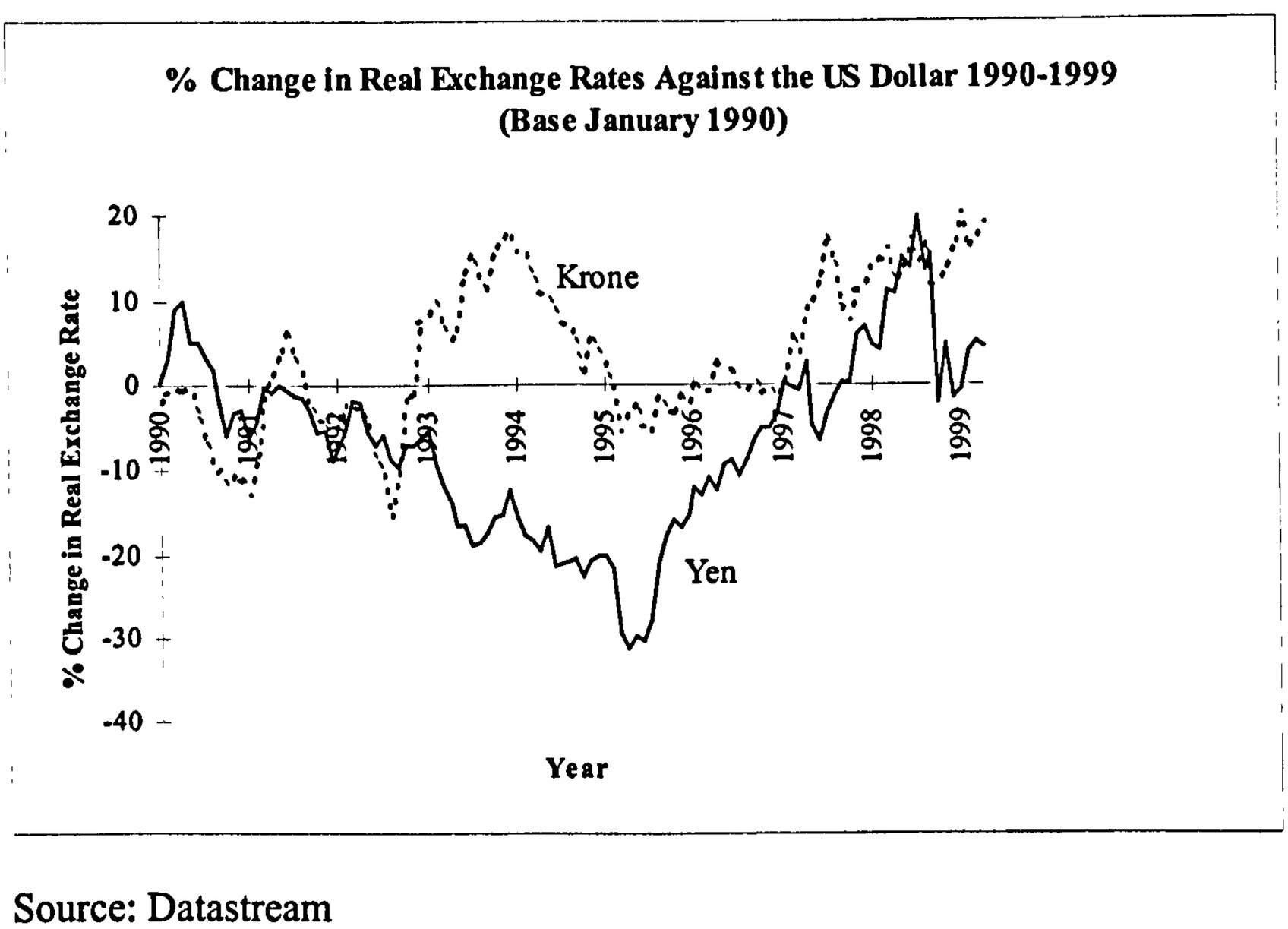
It is not, however, the nominal rate, but the real rate which requires investigation. If the exchange rate moved according to cost differentials in the various countries, volatility would not be such an issue, since real rates would be maintained. This theoretical argument relies on the existence of constant purchasing power parity in the various countries.

Shipowners receiving Dollars will use some of these Dollars to pay their Dollar costs, and the rest will be exchanged in order to pay for non Dollar denominated costs. If purchasing power parity holds, then the movement in the exchange rate will reflect relative movements in the price levels of the two countries, such that the purchasing power remain the same. Thus, if the Dollar is depreciating against the Krone, this must be because the price level in the US is higher than that of Norway[5].

Empirical work suggests that exchange rates do deviate from purchasing power parity, which is demonstrated by examining the movement in real exchange rates[6]. These are

rates adjusted for inflation and should therefore be constant if purchasing power parity holds.

Figure 1.2



Source: Datastream

Figure 1.2 shows the volatility of **real** Krone/US$ and Yen/US$ between 1990 and 1999. The real rates have been obtained by adjusting the nominal rates by the appropriate country producer price index. The diagram shows volatility of real rates over the period, which follow similar trends to those of the nominal rates. Such volatility in the real rate indicates deviations from purchasing power parity. The major difference between the nominal and real rates is the more marked depreciation of the real Yen/US$ rate in 1997 and 1998. This is caused by an increasing US producer price index and decreasing Japanese producer price index.

It should be noted that the use of a price index in such an analysis is far from perfect. The basket of goods used to represent the price index differs from country to country and may not be indicative of the movements in costs and freight rates in the shipping industry. The fact remains that in a Dollar dominated industry, the volatility of the exchange rate can have a major impact on the operating profit where a large proportion of costs is denominated in other currencies.

Industry Costs and Revenues

The proportion of exposed flows is determined by the cost and revenue structure of the industry. Freight rates are the revenue of the shipowner. These rates depend on freight market conditions. On these market determinants, various indices have been developed to encapsulate the movement in freight rates and provide an indicator of revenues. The volatility of these rates has been addressed by the use of derivative products, such as the Baltic International Financial Futures Exchange (BIFFEX) which handles freight futures. These enable the parties to effectively buy certainty by fixing a rate now for a future point in time. Given that freight rates are denominated in US Dollars, fluctuations in the rate of exchange between the US Dollar and the domestic currency will, therefore, affect the domestic currency denomination of revenues and eventual receipts. For shipowners, whose currencies are depreciating against the US Dollar, revenues may show positive growth based purely on the exchange rate movement. However, for an appreciating currency the growth is either zero or negative.

A large proportion of the receipts are used to pay costs. These costs are not denominated in Dollars, but in a variety of currencies, some dependent on the nationality of the shipping company, on the flag of registration, others on the currency

of the port country. The Dollar revenues thus have to be converted into these currencies in order to meet the payments. These costs can be can be considered under different categories but, for the purpose of this paper, must be analysed according to their currency denomination. Table 1.1 summarises these costs.

Table 1.1: Summary of Costs and Currency Denominations

Cost	Currency
Repairs and maintenance	Currency of country where work carried out
Insurance	Currency of insurance company
Management	Currency of Head Office country
Port and canal dues	Currency of port country
Cargo handling	Currency of port country
Fuel	Primarily US Dollars
Capital	Various
Crew	Various

The Table highlights the fact that some costs are fixed in terms of their currency denomination, being related to the country in which the work is performed, whereas others are more flexible and can play an important role in the management of exchange rate exposure. The exposure is dependent on the level of net Dollar revenues. These are determined by the amount of Dollar costs. The currency denomination of costs is thus crucial to the analysis. These cost denominations are considered in more detail in Chapter 3.

Measuring the Risk

Foreign exchange risk or exposure is very difficult to quantify. Attempts to measure it have yielded a variety of responses in terms of statistical regressions and standard deviation techniques. This thesis uses two different techniques for the measurement. The first focuses on operating profit, using a variation on the 'Value at Risk' approach adopted by many corporate treasury managers, and the second concentrates on share prices, using statistical regression of exchange rate movements on share price returns.

Operating Profit

The operating profit measure analyses the sensitivity of operating results to fluctuations in the exchange rate. Such a measure focuses on the day to day trading activity of the business and thus ignores investment incomes and financing costs[7]. The Value at Risk (VAR) methodology uses a statistical analysis of past volatility of rates to assess, with a certain level of confidence, the potential loss over a future particular holding period.[8] Clearly there are problems with the use of historical data in predicting the future, particularly with exchange rates which are subject to violent shocks. However, in the analysis the VAR approach is used to assess the historical impact on the profitability of the industry. In other words the standard deviation of the exchange rates is applied *ex post* to the exposed net revenues in that year to highlight the effect on the business.

Strictly the VAR is a calculation of the maximum loss over a given period of time at a given confidence level.[9] Furthermore, exchange rate risk lends itself particularly well to such an approach and, despite the fact that exchange rates deviations are not normally distributed, a normal approximation can nevertheless be used.[10]

As previously stated, the exposure for shipping companies arises out of the fact that revenues (freight rates) are predominantly denominated in US Dollars, but costs must be met in a variety of other currencies. Measurement of the impact of this exposure involves calculating the exchange rate volatility of these other currencies vis-à-vis the US Dollar. Since the majority of costs are in the domestic currency, the concentration will be on the domestic currency against the US Dollar.

In this context, value at risk is a statistical analysis of past exchange rates, using standard deviation as the measure of volatility. It is done by obtaining a value of volatility for the Krone/US$ and Yen/US$ exchange rates. These measures can then be applied to the exposed net revenues to determine the variation in any one year. The exposed net revenues are calculated by subtracting the Dollar denominated costs from the Dollar denominated revenues. These cost denominations are derived from official statistics and from discussion with the companies in the industry. This study uses aggregate operating results in order to obtain an overview of foreign exchange risk for the Japanese and Norwegian industries as a whole. The analysis estimates the maximum loss or gain at a 95% confidence level, by calculating the impact on the exposed net revenues of 1.96 standard deviation movement in the exchange rate either side of the average annual rate.

Returns on Shares

The regression technique examines the relationship between exchange rate changes and the returns on shares.

Recent studies[11] by Jorion (1990), Amihud (1993), Bodnar and Gentry (1993) have examined empirically the exchange rate exposure of US firms, in other words, the relationship between changes in the value of the US Dollar and contemporaneous changes in the value of the firm as measured by share prices. Their studies achieved limited success. Bartov and Bodnar (1994)[12] suggest two possible explanations for this. Firstly, it was attributable to sample selection in that there were a high proportion of companies with few international links, some which had opposite exposures, and others which can react to international conditions at very low costs. Secondly, there is more likely to be a lagged relationship between the changes in value of the Dollar and the value of the firm, rather than a contemporaneous one.

Bartov and Bodnar (1994)[13] address these problems by sampling companies likely to have similar exchange rate exposures, and by examining the relationship between lagged as well as contemporaneous changes in the value of the US Dollar and the value of the firm.

Their sample of US firms between 1978 and 1989 shows no correlation with the contemporaneous change in the value of the Dollar; but the lagged variable was significant in explaining the abnormal returns. Tests employing a simple trading strategy based on this information show that the changes in the value of the Dollar one quarter before produced statistically significant abnormal returns. This suggests that investors do not use all freely available information to predict the value of the firm.

The period over which abnormal earnings accrue can be explained by the past change in the value of the Dollar.

The model used is a simple regression of abnormal returns against a constant, and a set of current and lagged changes in the foreign currency value of the US Dollar.

$$\Delta SP_{i,t} = \alpha_0 + \sum_{j=0}^{n} c_j \Delta CUR_{i,t-j} + \varepsilon_{i,t} \qquad (1.1)$$

where:

$\Delta SP_{i,t}$	abnormal stock performance for security i in the period t (in percentage terms)
$\Delta CUR_{i,t-j}$	the percentage change in the trade weighted US Dollar exchange rate index for the period t to j
α_0, c_j	parameters to be estimated
$\varepsilon_{i,t}$	error term for firm i in period t

Abnormal returns are calculated using the market model.

$$AR_{i,t} = r_{i,t} - \hat{\alpha}_i - \hat{\beta}_i r_{m,t} \qquad (1.2)$$

where:

$AR_{i,t}$	is the abnormal return for security I from day t-1 to day t (in percentage form)
$r_{i,t}$	is the return on investment at time t
$r_{m,t}$	is the market return at time t
$\hat{\alpha}_i, \hat{\beta}_i$	are the estimated parameters

The abnormal returns are calculated over a 60 day period, using at least 30 observations. The testing failed to discover a relationship between contemporaneous changes in the Dollar value and the value of the firm. However, the lagged change in Dollar value

does have explanatory power with respect to errors in analysts' forecasts of quarterly earnings.

The analysis of shipping companies in both Japan and Norway regresses changes in the domestic exchange rates against the Dollar on both total returns and abnormal returns, as measured using a market model for the stock markets of both countries for contemporaneous and lagged data. In so doing it is possible to assess the likely impact of exchange rate movements on the value of the business and the extent to which the market prices these movements.

Managing operating exposure

The management of operating exposure involves strategic planning in the short and long term. Many organisations have attempted to address the problem through contractual agreements, in which the buyer and seller agree to share the impact of currency movements. Such agreements in alleviating currency pressures also help preserve a business relationship[14]. Typical guidelines for such a contractual clause between a shipowner and charterer is illustrated in Appendix 1. In practice, however, it is very difficult to reach agreement on these matters.

A better solution is provided by international diversification of operations and finance, whereby the company is able to change the currency denomination of the costs so that revenues and costs are matched. In the shipping industry this means shifting as much cost as possible into Dollars.[15]

An examination of the costs detailed in Table 1.1 shows some potential for currency matching. The denomination of crew costs depends on the nationality of the flag. These costs can, therefore, be manipulated by 'flagging out'. In flags of convenience ships, such as those of Liberia and Panama, the wage bill is often paid in Dollars. 'Flagging out' has been an option for Japanese shipowners to reduce their Yen denominated costs in favour of the Dollar. The use of a second register (NIS) in Norway has produced similar results.

Repairs and renewals costs can potentially be 'switched' into Dollars even if the ship yard is not US based. This could arise if the yard needed Dollars for its own transactions. This idea of currency- switching is becoming more widespread in various industries around the world.

Management and other head office expenses can be changed by simply shifting the head office. Again, this particular option has been put into practice by the Japanese to reduce their Yen denominated expenditure.

Capital costs could be denominated in Dollars through a eurocurrency loan or from capital emanating from the US. There is currently discussion about financing and about moves by certain banks to introduce shipowners to other capital markets and alternative sources of finance in order to lower their costs. One such option is through non-investment grade bonds, the so-called junk bonds, which have been popularised in the US[16]. These more exotic forms mainly from the US will inevitably lead to more US Dollar denominated financing costs.

Currency swaps can also provide relief from the exposure, particularly in situations in which the company cannot easily make foreign borrowings. In a typical currency swap, two companies borrow their domestic currency from their domestic banks and simply swap their loans. Thus a Japanese shipowner with no easy access to a Dollar loan could borrow Yen from a Japanese bank and swap its Yen denominated interest and capital payments with a US company which wanted to borrow Yen. Such transactions are performed through a swap dealer, and the other party is not known. Since their introduction on a global scale in the early 1980s currency swaps have grown to be one of the largest financial derivative markets in the world.

Even in the shipping industry conventional lending by banks is gradually being superseded by other financial products. In fact, the shipping division of one of the leading banks has at most only one third of its business in lending activities and the majority in derivatives, foreign exchange, cash management, capital market activities. Only five to six years ago 80% was conventional lending.[17]

Thus, by currency switching, swapping, and careful choice of financing, operating exposure due to currency risk can be reduced.

Summary

The problem presented in this analysis is concerned with the impact of the volatile market for foreign exchange on an industry which is particularly vulnerable to it. The aim here is to measure and compare the impact of these foreign exchange movements on the performance of two major maritime nations and the major companies operating in them. The results reflect both the exchange rate volatility and the levels of exposure. Such exposure is a function of the strategic management of the risk in the two countries which has developed in response to recent history of exchange rate volatility. During the 1980s and 1990s the long term appreciation of the Yen against the US Dollar was particularly harmful to the Japanese industry. No such trend materialised for the Krone, and so the need for this natural hedging in the form of matching revenues and costs in the same currency was not so imperative to their operating strategy. Consequently, the Japanese have actively pursued a policy of shifting as many costs as possible into Dollars in an attempt to minimise their exposure, whereas the Norwegian companies elect to maintain an exposure, thus allowing them to speculate on favourable movements in the rate of exchange.

This discussion highlights the fundamental importance for world shipping of foreign exchange risk, as exemplified by the experience of these two nations. Foreign exchange volatility can have dramatic consequences on performance. What also emerges from this analysis is that exposure can be seen in a positive or negative light, depending on the direction of movement in the exchange rate. Given that shipowners are vulnerable to these movements and cannot totally avoid exposure, an effective strategy is essential to insure against negative affects of the risk.

The thesis is structured as follows: Chapter 2 examines the source material and literature in the area of shipping and finance in order to define the problem and measure its impact; the methodology in Chapter 3 is developed from some of the techniques found in the finance literature, namely VAR and statistical regression; Chapters 4 and 5 then analyse the Japanese experience in terms of impact on operating results and returns on shares. The position for the Norwegian industry follows in Chapters 6 and 7, with comparisons and conclusions presented in Chapter 8 and 9.

Endnotes

[1] Statement of Standard Accounting Practice 12 produced by the UK Accounting Standards Board defines depreciation as 'the measure of wearing out, consumption, or other reduction in the useful economic life of a fixed asset, whether arising from the use, effluxion of time or obsolescence through technological or market changes. Depreciation should be allocated so as to charge a fair proportion of cost or valuation of the asset to each accounting period expected to benefit from its use'.

[2] The term for the buying and selling of assets, in this case ships, in order to make a profit.

[3] Committee of Inquiry into Shipping Report, Chairman The Rt. Hon. The Viscount Rochdale, OBE, TD, DL, HMSO, May 1970.

[4] These are discussed in detail in the relevant country chapters. Japan in chapter 4 and Norway in Chapter 6.

[5] Purchasing Power Parity (PPP) theory states that the general level of prices when converted to a common currency will be the same in every country, assuming no transactions costs. This may be expressed as:
$P^h = SP^f$, where P^h is the price level in the home country, P^f is the price level in the foreign country, and S is the exchange rate or the price of a unit of foreign currency measured in a unit of domestic currency. If the general level of prices is a reasonable estimate of cost of production in one country, then the ratio of price levels for any 2 countries will be a reasonable estimate of competitiveness. If PPP holds, then competitiveness as measured in this way would be constant and equalised across countries, and no country would have a price advantage. In practice international competitiveness has been far from constant, and deviations from PPP are often measured using real exchange rates. The real exchange rate is the price of foreign relative to domestic goods and services. In other words, it is the nominal exchange rate corrected for relative prices, P^f/P^h. One of the problems with this absolute PPP is that prices are measured using an index. If different base dates are used for the different countries, the results will be distorted. In this analysis the base rates used are the same and therefore this is not an issue.

[6] Adler, M. and Lehmann, B. (1983) Deviations from purchasing power parity in the long run. *Journal of Finance*, 38 (5), 1471-87 and Frenkel J.A. (1980) The collapse of purchasing power parities during the 1970s, *European Economic Review*, 7, 145-65, Coakley, J. and Fuertes, A.M. (1997) Reevaluating Relative PPP in an OECD Panel 1973-96, *Discussion Paper No. 97-04, Centre for International Capital Markets, London Guildhall University.*

[7] Note that the measure of returns on shares will include all elements of the business including financing.

[8] Bennett, D. (1997), *Managing Foreign Exchange Risk*, FT Pitman Publishing, London.

[4]Jorion, P. (1996) Risk^2 : Measuring the Risk in Value at Risk, *Financial Analysts' Journal*, November/December, 52 (6), 47-56.

[10] Froot, K. A., Scharfstein, D. S., and Stein, J. C. (1996) A Framework for Risk Management, *Journal of Applied Corporate Finance*, 7 (3), 23-32.

[11] Jorion, P. (1990) The exchange rate exposures of US Multinationals, *Journal of Business*, 63, pp 353-376, Amihud, Y. (1993) Evidence on exchange rates and valuation of equity shares, in Amihud, Y., and Levich, R., eds, *Exchange Rates and Corporate Performance*, Business One Irwin, Homewood, Illinois, USA., and Bodnar, G. M., and Gentry, W. M. (1993) Exchange Rate Exposure and Industry Characteristics: Evidence form Canada, Japan, and U.S., *Journal of International Money and Finance*, 12, 29-45.

[12] Bartov, E., and Bodnar, G. M. (1994) Firm Valuation, Earnings, Expectations, and Exchange Rate Exposure Effect, *Journal of Finance*, 44 (5), 1755-85.

[13] Ibid.

[14] For typical guidelines for such a contractual clause between a shipowner and a charterer see Appendix 1.

[15] Source: information provided by the Japanese Shipowners' Association.

[16] Lloyd's List 27 June 1997.

[17] Ibid.

Chapter 2

Source Material and Literature

Introduction

Following the move from a fixed rate to a floating rate system in the 1970s, currency exposure was recognised as a real problem by the shipping industry, as is illustrated by the numerous references in company annual reports and industrial journals. It is surprising, therefore, that it has attracted so little interest in the area of academic maritime research. Consequently, the literature sources are, of necessity, taken from the area of international finance which examines the experience of multinational businesses. These secondary sources are used to define currency exposure, discuss the reasons for it, consider techniques of quantification, and highlight strategic responses. The data relating to exchange rate risk in the Shipping Industry have been obtained from a number of primary sources: government, maritime and financial institutions, and corporations. Much of the information came out of discussion with senior officials[1] and is not in the public domain. Strategic sensitivity prevents the disclosure of the company names. This Chapter examines these primary and secondary sources in turn as the basis for further analysis of the impact of foreign currency fluctuations on the shipping industry.

Primary Sources: The Data

The data are derived from a number of different sources, both at an aggregate and corporate level. The macro data has been obtained from government and other official sources in both countries. For Japan, the operating results and currency denominations of revenues and costs of the five major companies ('Big 5')[2] were provided by the Ministry of Transport in Japan. Other information on financing and debt structures came from the banking sector, in particular from the Japanese Development Bank. Numerous reports from JAMRI formed the basis of international trade statistics. The Japanese Shipowners Association produced statistics on the operating results of the sector. Annual Reports for the 'Big 5' companies were examined, and interviews with the directors of those companies provided more detailed information on currency denomination and company policy in this area. For reasons of confidentiality and particular sensitivity of the information, names of the companies remain anonymous.

In the case of Norway, similar sources were used. Aggregate data was obtained from Official Statistics of Norway, the Norwegian Shipowners Association, and Intertanko. Again the shipping banks were consulted for information on exposure levels and hedging techniques. Annual reports were examined and interviews conducted at a senior corporate level.

The resulting data allowed a detailed analysis of operating earnings and costs, and their currency denominations, enabling a measurement of the net revenues exposed to

fluctuations in the rate of exchange. Exchange rate movements against the US Dollar since 1990 were obtained from Datastream, as were the share prices for the regression analysis.

Secondary Sources: The Literature

Due to the general paucity of maritime literature, the secondary sources are derived from the area of general finance, which is not specific to any particular industry. In the maritime literature that exists, discussion is limited to a recognition of the problems that currency fluctuations may cause and of the source of the problem. This first section explores this area.

Maritime

Hans Ludwig Beth (1979)[3] recognised the problem for shipowners as the US Dollar denomination of freight rates, and the fact that other currency did not move in line with the Dollar. The necessity of non-US shipowners having to meet costs in a variety of other currencies can affect them adversely if their domestic currency is strengthening against the US Dollar. Furthermore, Beth highlighted the role played by inflation rates in the different countries, that foreign exchange volatility does not conform to inflation differentials.

> 'The real issue for the shipping industry is not short term currency fluctuations containing ups and downs likewise, but the fixation to a given freight rate, printed in the US $, being also subject to market fluctuations indeed, but the commensurate value of home currency which is exposed to a medium fluctuation trend. As a matter of fact, this is not true for the US shipping industry - revenue and cost currencies are the same - and for those countries, the national currency of which are pegged to the US Dollar. What makes things complex is that each country is in a different position with regard to the dynamic value of its currency expressed in Dollars as well as to its home rate of inflation. It is beyond question that just in a situation of overall market weakness shipping in high-cost nations with strong currencies may suffer most.' (p. 2)

According to Mendoza (1979)[4], there are three aspects to the problem: the currency denomination of the operating costs; the currency of related financing to investment; the sensitivity of the revenue stream to parity changes. The market situation is also important in determining the extent of the problem. Where the market favours the shipowners, they are in a position to pass on the currency risk to the shipper. The general advice is to 'try to match the maturities and the currencies between inflows and outflows'[5] (Angelicoussis p. 27).

There was general agreement about the principle of compensation for loss of revenues resulting from movements in parity conditions.

For liners a solution was sought in the form of adjustment factors[6]. This was because changes in the exchange rate could cause serious losses to some and gains for others operating within the same liner conference[7]. The Currency Adjustment Factors (CAFs) compensate shipowners where exchange rate movements cause a fall in the value of the freight rate and or an increase in the operating costs. The system of CAFs is self-regulating, and follows the rules contained in the UNCTAD Code of Conduct for Liner Conferences. The CAFs are calculated using a formula based on the weighted currency movements against the tariff currency (the US Dollar) from a set of base exchange rates. The weightings are derived from costs and revenues. The CAF is expressed as a percentage to be applied to the tariff base freight rate and is computed for each loading area, taking into account the various currencies in which the lines incur their costs. These are calculated with reference to proportions of cargo carried by respective conference members, to their

nationality, and to the origin and destination of the cargo. The CAF formula is reviewed on a quarterly basis, taking the average exchange rate to the US Dollar in operation during a set period of 10 banking days in the last month of the quarter. If the resulting CAF shows a swing of 1.5% or more, then it is revised and is effective from the first day of the month following a quarterly review period. Should a swing of 4% be observed over a 3 day banking period, the CAF is revised with effect from the 10th day after commencement of this significant movement. Since the 1 January 1990, there have been only 3 CAFs in operation, from Europe, from Japan, and from areas other than Japan (Evans and Marlow 1990)[8].

Problems with the CAFs system arose from high volatility in the exchange rates which led to continuous adjustments. There was also a lack of transparency in calculation, which came under much criticism. High CAF differentials in the different trade areas were capable of both attracting and diverting trade. Since the early 1990s, there has been greater stability of exchange rates around the world which has lead to the effective abandonment of the system. For this reason it will receive no more attention in relation to this study.

Thus academics recognised the problem back in 1979, but made no attempt to quantify its effects or address it, except in the liner trade.

Defining Currency Exposure

In the finance literature, there are a number of definitions of currency exposure: at a basic level they are translation, transaction and economic exposure (see Chapter 1). However, within these categories are many nuances. The focus of this study is on economic exposure which was defined by Kent and Shapiro (1988)[9] as follows:

> 'Economic exposure is concerned with the impact of an exchange rate change on future cash flow. Stated more precisely, real foreign exchange exposure is the extent to which the present value of a firm is expected to change as a result of a given currency appreciation or depreciation. Exchange *risk* is defined as the variability of a firm's value that is due to *unexpected* exchange rate changes.'
>
> 'Accordingly, economic exposure and its companion, exchange risk, are determined by the difference between inflows and outflows of both domestic and foreign currencies over a specified time period, and by the sensitivity of those projected net flows to exchange rate changes.' (p. 6)

Economic exposure can be further subdivided into operating and strategic exposure. Antl (1989)[10] states that with operating exposure the emphasis is on anticipating the long-term exposure which is inherent in a business, the revenues or costs of which are denominated in a currency other than the reporting currency.

Hekman (1989)[11] distinguishes between operating and strategic exposure. She maintains that these different types of exposure represent different perspectives, each focusing on the impact of exchange rate fluctuations on different measures of corporate performance. Operating exposure measures the sensitivities of operating profit to foreign exchange changes. Strategic exposure measures sensitivity of strategic opportunities to foreign exchange changes.

With operating exposure, the focus is on operational flexibility and the ability to adjust prices or costs which are largely determined by the structure of the product and input markets. Strategic exposure takes this one step further by looking at the long term earnings and preservation of market position.

This analysis uses the wider definition of both economic and operating exposure in examining the effects of currency fluctuations on the value of the business and on operating profits of currency movements. The fundamental problem of the shipping industry is its inability to adjust revenues, since freight rates are fixed by the market. Its only recourse, therefore, is to adjust the cost structure.

Sources of the problem

The main source of the problem for any international business is the fact that nominal exchange rate changes are not offset by inflation differentials, with the results that the competitive position can change. The impact can be felt whether or not the company operates internationally. Lessard and Lightstone (1989)[12] illustrated these effects using corporate examples. Consider a US and a Japanese company operating in the same market in the US. An appreciation of the Yen relative to the Dollar in line with inflation differentials (higher in US and lower in Japan) will cause Dollar costs to rise and Dollar revenues to rise. The Japanese have costs in Yen and revenues in Dollars. The Yen denominated costs will rise by a smaller amount, but the Dollar revenues will rise by a greater amount. However, when the revenues are converted to Yen, the appreciation means that the competitive position remains unchanged. If the appreciation is greater than that indicated by Purchasing Power Parity (PPP), then the competitive position of the US firm strengthens. Both the US firm and the Japanese firm are exposed to movements in the Yen/US Dollar exchange rate, even though the US firm only operates in the US market.

The key points to note about operating exposure are thus: it is determined by the structure of the markets and the competition in those markets; it is not necessarily associated with the country in which the goods are sold or inputs sourced; it is a function of the movement in real exchange rates.

Movements in the real exchange rate are a particular issue. Herring (1983)[13] stresses that the relationship between inflation differentials and exchange rate movements does not

always hold, due to real disturbances that change the internal price structures, such as productivity gains, or the availability of natural resources. Tariffs and transportation costs also create distortion. As Herring point out:

> 'But if purchasing power parity does not anchor the exchange rate movements to the path determined by relative price movements at home and abroad, then exchange movements introduce a new dimension of risk in international transactions. Decision makers must contend not only with movements in domestic and foreign prices, but also with movements in the exchange rate that may alter the relationship of domestic and foreign prices.' (pp.5- 6)

Measurement

It is generally agreed that exchange rate risk is difficult to measure. Attempts to quantify the extent of the exposure have yielded a variety of different methods, both qualitative and quantitative. This section explores the literature in this area, beginning with quantitative evaluation, before considering statistical regressions and the more recent 'Value at Risk' (VAR) approach. Finally, there is an consideration of the strategic responses adopted by many international businesses.

Early work in this area was based on an understanding of the market structures of the industry in terms of competition and flexibility. Cornell and Shapiro (1983)[14] suggest either a bottom up or top down approach. Bottom-up estimates require an understanding of the structure of market competitors, and of the method they use to source inputs and sell products, and of the degree of flexibility in changing markets, product mix, sourcing and technology. These point to a strategic approach for the business.

Top-down estimates require an analytical comparison of the historical profitability of the company with the changes in profitability expected on the basis of changes in the real exchange rate. These estimates presuppose that the company maintains the same competitive position during the period of comparison, has undergone no major structural changes at the level of aggregation under review. The effects of real exchange rate movements are then applied to the fraction of exposed revenues.

This idea is supported by Helmut Hagemann (1989)[15] in his analysis of long term foreign exchange management.

Investment and production commitments are such that currency risks may arise years before they are reflected in a company's accounting system. It is therefore in a company's interests to minimise or eliminate such exposures before they become critical and costly to cover. Basing his findings on several large companies, Hagemann advocates a systematic approach, whereby net exposures are estimated as the difference between expected inflows and outflows of foreign currency together with estimates of the range of exchange rate movements.

Regression techniques

Kent and Shapiro (1984)[16] use a case study to put forward a regression analysis of the measurement of risk. The case study uses a US company, Vulcan Materials, a company which operates in three basic sectors: construction, industrial chemicals and secondary aluminium manufacture, and domestic oil and gas exploration and production.

Cash flow is seen to be the primary determinant of corporate value. If, at any given time, the present value of a cash flow varies with exchange rate movements, the value of the business changes. Such cash flows will be unaffected by exchange rate movements, if these are in line with relative inflation rates.

In the regression below the cash flow, stated in terms of the home currency, is the dependent variable, and the nominal exchange rate movement is the independent variable.

$$CF_t = \alpha + \beta Exch_t + u_t \; : \; u_t \sim N(0,\sigma_t^2) \qquad (2.1)$$

In this way, the extent to which exchange rate movements explain the changes in the cash flows can be measured using the usual statistical techniques: coefficient of determination etc. The analysis can be further extended to include any number of periods. It is possible that the exchange rate in the last period has an impact on the current cash flow. Thus the regression equation becomes:

$$CF_t = \alpha + \beta_1 Exch_t + \beta_2 Exch_{t-1} + \ldots\ldots + \beta_{n+1} Exch_{t-n} + u_t : u_t \sim N(0,\sigma_t^2) \qquad (2.2)$$

Cash flows are assumed to encompass operating profit plus depreciation, plus or minus changes in the domestic currency value of working capital, before deducting interest expense from capital expenditures, and taxes. Other definitions were considered, but this was thought to be the most pertinent on the assumption that the domestic value of replacement capital spending was independent of the exchange rate.

The effect of different currency denominations on financing costs could be further analysed using the above definition, less interest expense. A comparison between the operating profit, with the actual interest, and the potential expense, using another source of finance, can then be performed using the same regression techniques.

The limitations of the analysis are that the historical sensitivity of cash flow to the movements in the exchange rate is a reasonable predictor of the future sensitivity. Furthermore, the variables need to be tested for stationarity, before attempting to model the data. If one or more variables are found to be non stationary, there may still be a long term relationship which can be found using cointegration techniques.[17]

Bartov and Bodnar (1994)[18] take this a step further in examining the relationship between share prices and exchange rate movements. Changes in the exchange rate have a significant effect on the performance of firms involved in international activities. The economic analysis suggests that the relationship between real firm value and unexpected changes in the real exchange rate should be examined, since it is changes in the exchange rate which are not the result of movements in relative price levels that affect the results of a business.

There is, however, considerable evidence that, over short periods, the changes in the nominal rates of exchange are highly correlated with changes in the real rates of exchange among highly industrialised countries.

Recent studies, notably Jorion (1990), Amihud (1993), Bodnar and Gentry (1993)[19], have empirically examined US firms' exchange rate exposure, in other words, the relationship between changes in the value of the US Dollar and contemporaneous changes in the value of the firm as measured by share prices. Working on the assumption that capital markets react fully and instantaneously to changes in the value of the Dollar, they examined the simultaneous correlation between stock returns and Dollar fluctuations. Their studies achieved limited success. Bartov and Bodnar (1994)[20] suggest two possible explanations for this. First is the fact that previous studies have contained firms with few international links, firms with opposite exposures, and those which can react to international conditions at very low costs. These factors can distort the results. Secondly, there is more likely to be a lagged relationship between the changes in value of the Dollar and the value of the firm, rather than a contemporaneous one.

Bartov and Bodnar (1994)[21] address these problems by sampling companies likely to have similar exchange rate exposures, and by examining the relationship between lagged as well as contemporaneous changes in the value of the US Dollar and the value of the firm.

Their sample of US firms between 1978 and 1989 shows no correlation with the contemporaneous change in the value of the Dollar, but the lagged variable was significant in explaining the abnormal returns. Tests employing a simple trading strategy based on

this information show that the lagged changes in the value of the Dollar produced statistically significant abnormal returns. This suggests that investors do not use all freely available information to predict the value of the firm. The period over which abnormal earnings accrue can be explained by the past change in the value of the Dollar.

The model used is a simple regression of abnormal returns against a constant and a set of current and lagged changes in the foreign currency value of the US Dollar. This is represented by the formula:

$$\Delta SP_{i,t} = \alpha_0 + \sum_{j=0}^{n} c_j \Delta CUR_{i,t-j} + \varepsilon_{i,t} \qquad (2.3)$$

where:

$\Delta SP_{i,t}$ is abnormal stock performance for security I in the period t (in percentage terms)

$\Delta CUR_{i,t-j}$ is the percentage change in the trade weighted US Dollar exchange rate index for the period t to j

α_0, c_j are parameters to be estimated

$\varepsilon_{i,t}$ is error term for firm i in period t

Abnormal returns are calculated using the market model.

$$AR_{i,t} = r_{i,t} - \hat{\alpha}_i - \hat{\beta}_i r_{m,t} \quad (2.4)$$

where:

$AR_{i,t}$ is the abnormal return for security I from day t-1 to day t (in percentage form)

$r_{i,t}$ is the return on the investment at time t

$r_{m,t}$ is the return on the market at time t

$\hat{a}_i, \hat{\beta}_i$ are the estimated parameters

The abnormal returns were calculated over a 60 day period, using at least 30 observations. The testing failed to discover a relationship between contemporaneous changes in the Dollar value and the value of the firm. However, the lagged change in Dollar value does have explanatory power with respect to errors in analysts' forecasts of quarterly earnings.

Value at Risk

Value at Risk (VAR) has grown in popularity as a practical approach for treasury managers to risk assessment. It is appealing, in that it gives a single value which is relatively easy to calculate. Jorion (1996)[22] defines Value at Risk (VAR) as a uniform measure of risk which calculates the maximum or worst loss over a given time period at a given confidence level. It is an approach which is used increasingly in both the private corporate and banking sectors as a basis to establish capital adequacy requirements for commercial banks. The Securities and Exchange Commission in December 1995 proposed its use in the disclosure of information on derivatives.

The VAR summarises in a single number the global exposure to market risks and the probability of adverse moves in financial variables. Given this figure, managers and shareholders can assess whether this level of risk is acceptable. It can also be used to measure the effect of hedging on total risk.

The period of analysis and the confidence level is set on an arbitrary basis. The choice reflects the degree of risk aversion and the purpose of the analysis. The higher the risk aversion, the higher the confidence level.

VAR can be derived from the probability distribution for the future value of a business or portfolio. At a given confidence level, the worst case has to be found, W^*, such that the probability of exceeding this value is c, where:

$$c = \int_{W^*}^{\infty} f(w)dw \tag{2.5}$$

or such that the probability of a value lower than W^* is 1-c, where:

$$1-c = \int_{-\infty}^{W^*} f(w)dw \tag{2.6}$$

This means that the area from $-\infty$ to W^* must sum to 1-c which may be, say, 5%. If, for example, the average revenue of a company is $5 million, and the number of observations is 254, we need to find W^*, such that the number of observations to its left is 254 x 0.05 =13. If W^* turns out to be -$10 million, the VAR is $5million- - $10 million = $15 million.

According to Jorion[23] the normal distribution can be used as a good approximation for VAR calculation. The coefficients corresponding to the appropriate confidence level can be found from the standard normal tables. For example, a one-tailed test at 5% would be 1.645 standard deviations. The VAR is therefore the standard deviation x 1.645.

VAR is not, however, without its problems. Beder (1995)[24] argues that the simplicity of VAR can be 'seductive', but warns in the paper that some radically different approaches to VAR can yield very different results. The study uses eight common VAR methodologies applied to three hypothetical portfolios. The results vary by more than fourteen times for the same portfolio. These variations occur because of different assumptions, parameters, data and methodology. Analysts may use historical or simulated data, different time horizons, and different databases.

Furthermore, VAR does not take account of all types of risk, notably those which are difficult to quantify, such as political risk. VAR must therefore be supplemented by stress testing and other qualitative forms of analysis. Some organisations are already realising the necessity of this: Moody's volatility ratings for funds, for example, are only 25% based on VAR, the remaining 75% being based on qualitative factors.

Jorion (1996)[25] points out that all the VAR measures are merely estimates, since the underlying distribution is measured, using a limited number of observations. These are further subject to variation due to differing time periods. He questions whether or not sampling variation leads to material differences in VAR. Any VAR measure carries some estimation risk. Interpretation of VAR would, therefore, be made easier by the reporting of a confidence band around the one estimate.

Nevertheless, this type of analysis gives a useful indication to companies of their vulnerability to movements in prices, whether they be product prices, share prices or exchange rates[26], and enables the formulation of an appropriate response.

Strategic Responses

Given that foreign exchange risk exists and does pose a problem to companies operating in global markets, it is necessary to find effective methods of risk management.

Since the types of exposure may conflict, yet must be addressed, it is necessary to develop a whole system of exposure management. This view is supported by Renoff[27], who suggests that foreign exchange management should be part of the overall corporate planning and strategy, and not a stand alone function.

Lessard and Lightstone (1989)[28] stress the need for a strategic response. In the short term various operating tactics may be employed, such as marketing, product pricing and mix, outsourcing and hedging. In the long run (4-10 years), however, a more strategic response is necessary: long term hedges (currency swaps), and changing the currency denomination of the core financial structure of the business.

He identifies different types of response: business alternatives, financial alternatives and organisational challenges. Business alternatives include a focus on sites selection, a portfolio of offsetting exposures, the configuring of the businesses in order to have the flexibility to increase production, or source in countries whose currencies are undervalued in real terms.

Financial alternatives can be more easily modified at little cost. The business can borrow long term in foreign currency, or engage in long dated fixed rate currency swaps in the

amounts of estimated foreign currency reserves. Organisational challenges faced by the business include: rehearsing the effects of different exchange rate changes, organisation of the foreign exchange function, and developing a effective system of information.

Clements (1989)[29] stresses that the strategies and policies adopted reflect the corporate culture, with respect to risk and return. Policies are invariably set according to net exposure, after matching receipts and payments in the same currency.

Hekman (1986)[30] highlights the need for companies to distinguish between losses, which are due to temporary currency misalignments, and those which mask a more fundamental and permanent effect on competitive position. Failure to make this assessment may lead to an inappropriate management response. Many difficulties which are blamed on disadvantageous currency fluctuations, in fact disguise a more dramatic shift in competitive advantage. It is therefore crucial to manage the foreign exchange problem in order to uncover any other problems which may be present.

The obvious benefits of managing the exposure appear in the form of higher operating cash flows and greater stability. In its attempts to acquire such benefits the shipping industry is constrained by the fixed denomination of its revenues. The basic strategic response long term has been one of shifting costs into US Dollars, and for the short term transactions the use of forward exchange contracts. The level of exposure varies from country to country and business to business, since it is largely a function of perception of the problem, of the costs of hedging, and of the history of volatility of exchange rates.

Conclusion

The thesis uses both primary and secondary sources. The primary ones provide the data, whereas the secondary or literary sources indicate the methodology developed in Chapter 3. The data have been obtained on a macro and micro level. Much is aggregate data supplied by government departments and other official sources, notably the shipowners' associations. On a micro level the information has been derived by an analysis of corporate information and numerous interviews with business managers. This analysis provides the basis for the VAR, and regression techniques for the measurement of currency exposure. The finance literature defines the problem, considers methods of quantification, and discusses the strategic implications for businesses. It is from this source that the methodology for VAR and the regression analysis for the shipping industries of the two countries will be developed in the following analysis.

Endnotes

[1] A full list of meetings is contained in Appendix 2.

[2] The 'Big 5' companies are Nippon Yusen Kabushiki Kaisha (NYK) , Kawasaki Kisen Kaisha (K Line), Mitsui OSK Line (MOL), Navix Lines, and Showa Lines. Since the date of this analysis, MOL merged with Navix on 1 April 1999 and NYK with Showa on 1 October 1999, thus creating a 'Big 3' of MOL K Line and NYK.

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Chapter 3

Methodology

Introduction

The aim of this Chapter is to present the two methodologies to be used in order to test the impact that exchange rate fluctuations have on the performance of shipping companies. The two methodologies use different measures of performance. The first, the Value at Risk (VAR), uses operating profits as a performance indicator and investigates the impact of real exchange rate fluctuations on the operating results of the industry. The operating results are those which concern the day to day operation of the business, namely, the income from the movement of freight, and the costs associated with it. It excludes the profits from the sale and purchase of vessels and the financing of the vessels. In restricting this analysis to operating profit, there is a basis for comparison of the two nations, Japan and Norway. For many companies 'asset plays' can have a dramatic influence on profits and could distort the overall picture of the true trading activity. The broader measure of performance, namely that of share price returns used in the regression analysis are the result of market perception and expectation. As such they will reflect all aspects of the business, not just the operating activities. Consistencies should exist between the two measures, since operating results are a major factor in the determination of share prices. Discrepancies between the results using the two methodologies for the two different countries may be due to the contribution of non-operational activities, or other factors which affect share prices.

The Value at Risk techniques use aggregate industry data, supported by company specific information. The regression techniques are based on models for the major companies operating in each industry. These companies represent a large proportion of the industry in each country. In Japan they account for almost all of the operating revenue of 96.1% (based on 1995 figures). In the case of Norway, they accounted for 32.1% of the total in 1995. In both cases they can provide a good indicator for the industries as a whole.

Value at Risk (Applied to Operating Profit)

Value at risk (VAR) measures the exposure of a portfolio to changes in market prices under a specific set of assumptions. These assumptions concern the time interval under scrutiny, the probability level, and the statistical properties of the underlying distribution. The choice of time period, which could be one day, one week, one month, or one year, depends on the cash flow position of the business and the maximum loss that can be sustained over a given period. A business may be interested in the maximum loss which it might suffer on a daily, weekly, monthly, or annual basis. A one day time horizon would give a very early warning signal that difficulties were being experienced. The probability level expresses the degree to which the company is risk averse. The higher the probability level, the more risk averse the company. A choice of 99% confidence would indicate that losses greater than the Value at Risk could only be tolerated infrequently, 1% of the time. Assumptions about the properties of the underlying distribution, for example, a normal, a log normal, a non normal distribution, will affect the final Value at Risk (VAR) calculation.

As with any model, there are limitations to this type of analysis. These arise from extreme observations, non-stationarity of data, lack of liquidity, and a linear relationship between the variables. Extreme observations, unusually high or low values, may lead to under- or overstatement of losses if employing a standard theoretical distribution. Non-stationary data, with changing mean and variance, is difficult to model and has to be made stationary. The markets need to be liquid to ensure reliable prices. A linear relationship means a linear relationship between changing prices and the resultant gains or losses.

In this study the prices under examination are exchange rates, more precisely, the price of the US Dollar in terms of the Norwegian Krone and the Japanese Yen. The Values at Risk are the operating flows which are exposed to fluctuations in these foreign exchange prices. Calculation of the VAR will be based on the distribution of these exchange rates, be they normal, log normal, or some other historically-based distribution. The time horizon will be one year, since the objective here is not to calculate the loss as a management tool, but to measure the affect of the loss on the performance of the company. The confidence level will be 95%. These assumptions are considered in turn in the following sections.

Exchange rate distribution

The exchange rates under consideration for each of the two industries are of the domestic currency against the US Dollar, viz. Krone/US$, and Yen/US$. The period under investigation is 1990 to 1997. This is because the latest aggregate data is available only for 1995 in the case of Norway and 1997 in the case of Japan. For each year the average rate and the standard deviation around this average is calculated. The

exercise is repeated, using real exchange rates. These are adjusted, using the producer price index for the respective countries.

As explained in Chapter 2, real rates are more pertinent to the analysis, since it is the fact that nominal exchange rates do not reflect inflation differentials which changes the competitive position of a company. The limitation of the use of real rates is that the producer price index may not be an accurate reflection of the inflation rates of goods relating to the shipping industry. Since no better index exists, this will be used as an approximation.

For the purposes of the VAR analysis, a normal distribution will be assumed[1]. Thus the ± 1.96 standard deviations will cover 95% of the exchange rates. These measures can then be applied to the exposed flows derived, as explained in the following section.

Exposed flows

The exposed flows in the cases of both Japan and Norway refer to the US Dollar denominated operating revenue which is not used to cover US Dollar denominated costs. As far as possible, the industry will engage in a process of natural hedging by using its Dollar receipts to meet Dollar payments. The remaining net Dollar receipts will be converted into other currencies. These are the exposed flows. Clearly, a number of currencies are involved, not just the domestic currency. The percentages for these other currencies are difficult to quantify, and it is assumed, therefore, that all are converted to the domestic currency. This may result in an over- or underestimate, depending on the volatility of these other currencies compared to the domestic currency.

The amounts involved are not expected to be significant since most of the sums involved are converted to the domestic currency.

The exposed portion of revenues may be determined either by the use of existing aggregate data, or by inference based on detailed discussion with companies and industry specialists. This involves an examination of all the operating costs and their potential currency denomination. These can be classified as nationally denominated and internationally denominated costs. Those costs that are related to country of performance and can only be varied by changing the country in which the activity takes place will be termed nationally denominated costs.

Nationally denominated costs

Repairs and Maintenance

Repairs and maintenance work must be regularly carried out on a ship to ensure its seaworthiness and classification. The costs of such work vary according to the type and size of ship, and will tend to be paid in the currency of the country in which the work is completed.

Insurance

Hull and machinery insurance and protection and indemnity cover are provided by a number of insurance companies. The premiums vary according to the value of the vessel, the condition of the ship and the insurer's evaluation of the shipping company. Premiums are generally payable in the currency of the insurance company.

Management costs

Managerial costs and general overheads, such as administration, advertising, and marketing, will be paid in the domestic currency or the currency of the country in which the head office is based.

Port and canal dues

Port charges include the port agency fees, harbour dues, costs of pilotage, of tugboats, and mooring crew. These are generally met in the currency of the country in which the port is located. Canal dues have to be paid as a toll. The Panama Canal charges are in US Dollars and the Suez Canal in Special Drawing Rights (SDRs) which represent a basket of currencies.

Cargo handling costs

Cargo handling costs are determined by the type of commodity, the type of ship and the characteristics of the port itself. Again these costs will be payable in the currency of the port country.

Fuel costs

These are determined by a number of variables, including type of ship, size of ship, type of fuel, quality of fuel, speed of the vessel, etc. The price of fuel depends on the world oil price, but also varies between ports around the world. Those ports located near to major refineries have the lower costs. The currency for fuel costs depends on the place where fuel is bought, and can therefore be subject to a number of denominations.

The currency denomination of the next group of costs is to some extent in the control of the shipowner. Varying the chosen denomination is therefore an important tool in management of exchange rate risk. Such costs will be termed internationally denominated costs.

Internationally denominated costs

Capital costs

Capital costs arise from the financing of the ships themselves. Such financing may be in the form of a loan on which interest must be paid. The annual cost will, therefore, be the interest and the principal. Alternatively, the finance may be equity, in which case the equity holder will require a return in the form of a dividend. The currency for such costs will be the currency of the country in which the loan has been taken out. A UK company may raise a US Dollar loan with a US bank.

The flexibility of foreign currency loans has increased dramatically over the last twenty years with the emergence of the Euromarkets. The Euromarket refers to transactions between banks, depositors and borrowers of eurocurrency. Eurocurrency is currency held on deposit in banks outside its country of origin. If a depositor of US Dollars in an American bank transfers these to a UK bank in London, then Eurodollars are created. The eurocurrency deposits may then be used for Eurocurrency loans. A eurocurrency loan is defined as a loan in a particular currency extended by a bank outside the country of the currency's denomination. For example, a London bank lending US Dollars is creating a Eurodollar loan. Since such options are available to companies, the denomination of capital costs could be almost anything.

The main form of financing for shipowners is debt through bank lending. This is due to a reluctance on the part of shipowners to relinquish control through the issue of share capital on the world-wide exchanges. Traditionally, the industry attracts few investors because of its risky nature and the relatively small market capitalisation. However, opportunities are becoming more available for equity and corporate debt issues in the US.[2]

Crew costs

The crew costs are determined by such factors as: the type of vessel, the level of technology, the flag of registration and the nationality of the crew. Minimum requirements are laid down by the International Maritime Organisation, but individual flag states make their own recommendations. Flag registration is an important factor for the currency denomination of crew costs. Wages are often paid according to the flag, except in the case of flags of convenience where the currency is the Dollar.

Clearly the proportion of non Dollar costs will vary according to the type of trade. Given that the receipts are in Dollars, the exposure arises because of the non Dollar costs. The reduction of these costs is therefore instrumental in the management of exchange rate exposure.

Regression techniques (Applied to Share Price Returns)

Introduction

There are a basically four stages to the analysis. The first involves ensuring the stationarity of the variables in order to develop a regression model. The second is the development of an expected return, using the market model. This expectation can then be subtracted from actual returns to obtain abnormal returns. The third is the regression of changes in the rate of exchange against the total returns. The fourth is a regression of changes in the rate of exchange against the abnormal returns. The rationale for these stages is presented below.

Jorion (1990), Amihud (1993), Bodnar and Gentry (1993)[3] have empirically tested the exposure of US firms, by examining the relationship between changes in the value of the US Dollar and contemporaneous changes in the value of the firm as measured by share prices. They have further examined the issue of whether or not the exchange rate risk is priced by the market. On the assumption that capital markets react fully and instantaneously to changes on the value of the Dollar, they analysed the correlation between simultaneous stock returns and Dollar fluctuations. They found significant cross sectional differences in exposure to movements in the Dollar, and evidence that exchange rate risk is not priced by the market. The relationship is, therefore, between the *unexpected* changes in the exchange rate, and the performance of firms involved in international activities.

Bartov and Bodnar (1994)[4] argue that greater success can be achieved by examining a lagged relationship as well as a contemporaneous one. Their sample of US firms

between 1978 and 1989 shows no correlation of returns with the contemporaneous change in the value of the Dollar, but demonstrates that the lagged variable was significant in explaining the abnormal returns. Tests employing a simple trading strategy, based on this information, show that the lagged changes in the value of the Dollar produced statistically significant abnormal returns. This suggests that investors do not use all freely available information to predict the value of the firm. The period over which abnormal earnings accrue can be explained by the past change in the value of the Dollar.

The testing failed, however, to discover a relationship between contemporaneous changes in the Dollar value and the value of the firm. Nevertheless, the lagged change in Dollar value does have explanatory power with respect to errors in analysts' forecasts of quarterly earnings.

The methodology adopted by all of these studies can be applied to the case of the shipping industry. This study, therefore, examines both the contemporaneous and lagged relationship between returns and the change in the exchange rate. It considers both nominal and real rates to see if one is more significant than the other. It analyses the link between changes in the exchange rate and both total and abnormal returns in order to address the pricing issues outlined above.

The regression model based on lags of the changes in the exchange rate is developed both at an individual company level, and at an industry level. The latter involves the use of cross sectional analysis to determine any significant differences between the two industries and the companies within each industry.

The following sections consider the process in greater detail, examining data stationarity, the development of a market model and the final regressions.

Stationarity

Time series data used in regression analysis may indicate the existence of a relationship between two variables which is spurious. In other words, where no relationship really exists. The concept of spurious relationships was first cited by Granger and Newbold (1974)[5], who found that it was due to the fact that the data is non- stationary.

A stochastic process $y_1,.....,y_T$ is stationary, if its mean and variance remain constant over time and its covariances depend only on the distance between two observation points, and not on the time at which the covariance is calculated. These conditions can be expressed mathematically as follows:

$$E(y_t) = \mu_y, \forall t \tag{3.1}$$

$$E\left[(y_t - \mu_t)^2\right] = \sigma_y{}^2, \forall t \tag{3.2}$$

$$E\left[(y_t - \mu_t)(y_{t+k} - \mu_y)\right] = Cov(y, y_{t+k}) = \gamma_k, \forall t \tag{3.3}$$

where k is the distance between observations

Much economic and financial data is non-stationary. However, such data in some cases can be rendered stationary by a process of 'differencing'. Data processed in this way is called homogeneous data. The number of times that the 'differencing' process takes place, in order to achieve stationarity, determines the order of homogeneity. Thus if y_t is a first order homogeneous non-stationary series, $y_t - y_{t-1} = \Delta y_t$ is stationary. Similarly, if y_t is second order homogeneous, $\Delta y_t - \Delta y_{t-1} = \Delta^2 y_t$ would be stationary.

A non-stationary series can be identified by determining whether it has a unit root. Examining the following series:

$$y_t = \rho y_{t-1} + u_t; u_t \sim N(0, \sigma^2) \qquad (3.4)$$

where u_t are normally distributed error terms with a zero mean and variance σ^2

The time series y_t will be stationary if $|\rho| < 1$. (If $|\rho| \geq 1$, the series will be explosive and tend to $\pm\infty$. Consider the situation where $\rho = 1$, namely a simple random walk process.

$$y_t = y_{t-1} + u_t; u_t \sim N(0, \sigma^2) \qquad (3.5)$$

The variance of this process will be as follows:

$$\gamma_0 = E(y_t^2) = E\left[(y_{t-1} + u_t)^2\right] = E(y_{t-1}^2) + \sigma_u^2 \quad .$$

$$= E(y_{t-2}^2) + 2\sigma_u^2$$

$$= E(y_{t-n}^n) + n\sigma_u^2 \qquad (3.6)$$

This recursive process demonstrates that the variance is infinite. The same is true for the covariances.

The existence of a unit root is important for econometric modelling, both of univariate and multivariate time series. In this analysis the focus is on the multivariate, where the standard ordinary least squares regression techniques may, as previously stated, result in spurious relationships. The ordinary least squares estimates are inconsistent, and the t and F statistics do not follow the standard distributions generated by a stationary series.

For this analysis, it is, therefore, necessary to test for stationarity of the data, and, where necessary, the order of homogeneity of integration, before proceeding with the regression techniques. The tests, known as a unit root test, are detailed in the next section.

Testing for Unit Roots

The formal test for a non-stationary series which follows a random walk is the unit root test, introduced by Dickey and Fuller (1981)[6].

The test starts from the basic equation:

$$y_t = \alpha + \beta t + \rho y_{t-1} + u_t \qquad (3.7)$$

Non-stationarity may arise because there is a positive trend i.e. $\beta > 0$, but can be rendered stationary by removal of the trend (note that this assumes that $|\rho| < 1$). Another possibility is that the growth in y_t occurs because it follows a random walk with a positive drift, i.e. $\alpha. > 0, \beta = 0, \rho = 1$. This would require differencing to effect stationarity. In other words, $y_t - y_{t-1} = \Delta y_t$. Unfortunately, this equation can not be estimated by an examination of the t statistic on ρ, using ordinary least squares. This is because, if the true value of ρ is 1, then this estimator will be biased towards zero, and there may be an incorrect rejection of the random walk hypothesis.

In their analysis Dickey and Fuller derived a distribution for the estimator $\hat{\rho}$ that holds when $\rho = 1$, and calculated statistics for a basic F test of the random walk hypothesis i.e. $\beta = 0, \rho = 1$. The mechanics of the test may be described as follows: estimate the equation 3.7, and then test the residuals to ensure that they are 'white noise'. This can be done using a Q test.

Q test

If the model has been correctly specified, the residuals, $\hat{u}_t$, should resemble a white noise process. They would be expected to be nearly uncorrelated with each other, so that the sample autocorrelation function of the residuals would be close to 0 for displacement $k \geq 1$.

The sample autocorrelation function $\hat{r}_k$ for displacement k of the residuals is calculated by:

$$\hat{r}_k = \frac{\sum_t \hat{u}_t \hat{u}_{t-k}}{\sum_t \hat{u}_t^2} \qquad (3.8)$$

A test, based on statistical results obtained by Box and Pierce (1970)[7], can be applied to the above function. If the model is correctly specified, then for large displacements k (k>5 for low order models), the residual autocorrelations, $\hat{r}_k$ are uncorrelated, normally distributed random variables with mean 0 and variance 1/T, where T is the number of observations in the time series. The statistic Q comprises the first K residuals autocorrelations $\hat{r}_1$.....$\hat{r}_k$

$$Q = T\sum_{k=1}^{K} \hat{r}_k^2 \qquad (3.9)$$

Box and Pierce (1970) demonstrate that the Q statistic will be distributed as $\chi^2(K-p-q)$, i.e. chi-squared with *K-p-q* degrees of freedom, where p is the number of autoregressive lags and q the number of moving average lags. The null hypothesis is that the residuals are white. This is rejected if the calculated Q is greater than the critical value in the χ^2 tables at the chosen level of confidence. Note that this study uses no moving average lags, and, therefore, q is equal to zero.

If there is autocorrelation, then extra lags of variable must be added as follows:

$$y_t = \alpha + \beta t + \rho y_{t-1} + \lambda_1 \Delta y_{t-1} + u_t \qquad (3.10)$$

where $\Delta y_{t-1} = y_{t-1} - y_{t-2}$. Additional lags of Δy_t may be included if necessary, to make the error white noise.

Using ordinary least squares, the unrestricted regression is first run:

$$y_t - y_{t-1} = \alpha + \beta t + (\rho - 1)y_{t-1} + \lambda_1 \Delta y_{t-1} + u_t \qquad (3.11)$$

and then the restricted regression:

$$y_t - y_{t-1} = \alpha + \lambda_1 \Delta y_{t-1} + u_t \qquad (3.12)$$

Using a standard F test to determine whether or not the restrictions hold, the calculated value is compared to the distribution generated by Dickey and Fuller, rather than the standard F tables. The critical values are much larger than those described in the standard F tables (see Appendix 3). The null hypothesis is that the series follows a random walk. This is rejected if the calculated value is greater than the critical value. Note that, although the test is commonly used, it only allows the rejection of a random walk. Failure to reject provides only weak evidence of the existence of a random walk.

Variables to be tested for stationarity

For the purposes of this analysis, the variables to be tested for evidence of a random walk are the nominal and real exchange rates, share prices, share price returns, and market indices.

Series showing a random walk will be made stationary by differencing, as described above.

The Development of the Market Model

The market model is essentially a statistical regression which indicates a relationship between returns on a particular investment and the returns on a market index, as follows:

$$r_{i,t} = \alpha_i - \beta_i r_{m,t} \qquad (3.13)$$

where $r_{i,t}$ are the returns on an investment at time t

$r_{m,t}$ are the returns on the market at time t

a_i, β_i are the parameters to be estimated.

The model was initially mentioned by Markowitz[8] ,but was developed by Sharpe[9]. This single factor model is used in this context to formulate an expectation of normal or expected returns.

The returns on an investment are taken to be the return from capital gain. Dividends are excluded because the shipping industry is characterised by very low dividends. Appendix 7 illustrates these low dividend levels for the companies under investigation over the period 1987 to 1999. In some years companies pay no dividend at all because of their low margins. The returns from capital gain may be expressed:

$$r_{i,t} = \frac{p_{i,t} - p_{i,t-1}}{p_{i,t-1}} \qquad (3.14)$$

where $p_{i,t}$ is the price of the investment at time t

$p_{i,t-1}$ is the price of the investment at time t-1

Similarly:

$$r_{m,t} = \frac{p_{m,t} - p_{m,t-1}}{p_{m,t-1}} \tag{3.15}$$

where $p_{m,t}$ is the price of the investment at time t

$p_{m,t-1}$ is the price of the investment at time t-1

For each company the share price data and the relevant market indices are used to generate returns, as above. The returns data is then used in the market model regression to generate a model for the expected returns of the investment. The number of observations used to generate the market model varies for each investment according to the availability of data. In each case there are at least 60 observations. The model for expected returns is then used to generate expectations for the period from 1990 to 1999.

Abnormal returns are then calculated be taking the difference between actual and expected returns for this period:

$$AR_{i,t} = r_{i,t} - \alpha_i - \beta_i r_{m,t} \tag{3.16}$$

where:

$AR_{i,t}$ is the abnormal return for investment in during period t.

These abnormal returns are those which are not anticipated and may be explained by a number of factors. One such factor for an international business is the change in the rate of exchange.

The Regression Model

Having established the abnormal returns for the period from January 1990 using the market model, these may then be regressed against the change in the real rate of exchange, to investigate evidence of a relationship. The regression equation is as follows:

$$AR_{i,t} = \alpha_0 + \sum_{j=0}^{n} c_j \Delta ER_{i,t-j} + \varepsilon_{i,t} \qquad (3.17)$$

where:

$AR_{i,t}$ is the abnormal return for investment in during period t

$\Delta ER_{i,t-j}$ represents the change in the real US Dollar exchange rate index for the period t to j

α_0, β are the parameters to be estimated

$\varepsilon_{i,t}$ is the error term for investment i in period t

The statistics used to measure the relationship are the R^2, the coefficient of determination, and the t statistic. The R^2 assesses how much of the abnormal return can

be explained by changes in the real rate of exchange. In statistical terms this may be expressed as:

$$R^2 = \frac{\sum(\hat{Y}_i - \bar{Y})^2}{\sum(Y_i - \bar{Y})^2} = \frac{RSS}{TSS} \qquad (3.18)$$

where $\sum(\hat{Y} - \bar{Y})^2$ is the explained variation of Y or regression sum of squares (RSS)

and $\sum(Y - \bar{Y})^2$ is the total variation in Y or total sum of squares (TSS)

The 't' statistic for the coefficient β_j indicates whether or not the change in the real rate of exchange is a significant variable in the regression. The null hypothesis is that the coefficient β_j equals zero. The t distribution is relevant for statistical testing because it is necessary to use a sample estimate of the error variance, rather than its true value. The t statistic is calculated as follows:

$$t_{N-2} = \frac{\hat{\beta}}{s_{\hat{\beta}}} \qquad (3.19)$$

where $\hat{\beta}$ is the estimated regression parameter

$s_{\hat{\beta}}$ is the estimate of the standard error of $\hat{\beta}$

t_{N-2} is the calculated t statistic which follows a t distribution with N-2 degrees of freedom

The calculated value is compared to the critical values in the t tables at the required level of confidence and appropriate number of degrees of freedom. If the absolute

calculated value is greater than the critical value, the null hypothesis, that $\hat{\beta}$ is 0, is rejected.

This study will examine the relationship between the contemporaneous and lagged change in the value of the US Dollar in terms of Krone and in terms of Yen and the share price returns of the major Norwegian and Japanese shipping companies, quoted on the relevant stock exchanges. This allows the use of the all share index of those exchanges to be used as the market index. The companies analysed are as follows:

Norway:

Bergesen d.y., Leif Hoegh, Wilhelmsen, Bona Shipholding

Japan:

NYK, K Line, Mitsui OSK, Navix, Showa

The final regression of abnormal returns against share prices is run using the data from 1990 to 1999.

Cross Sectional Analysis

Cross sectional analysis is also used to compare the results of the two industries and the companies within them. These regressions incorporate both cross sectional and time series data. The industry-specific model may be expressed:

$$R_{it} = \alpha_i + \beta ER_{it} + \varepsilon_{it} \qquad (3.20)$$

for i = industry, Japan or Norway and t = 1,2,.....T time periods

The company specific is:

$$R_{ct} = \alpha_c + \beta ER_{ct} + \varepsilon_{ct} \qquad (3.21)$$

for c = company 1,2, and 3 and t = 1,2,.....T time periods

Wald tests are used to determine differences between the coefficients of the models.

Conclusion

The research uses two different methodologies, and two measures of performance, to test the hypothesis. The VAR technique considers how operating profits for the whole industry are affected by fluctuations in the exchange rate. The regression analysis examines the relationship between exchange rate movements and share price returns, both expected and unexpected. These two different approaches allow an detailed examination of the effect of exchange rate volatility on operating and non-operating activities. The VAR approach highlights the two factors of exposure and the degree of exchange rate volatility faced by the two industries, and the way in which this impacts on the operating activities. The regression analysis uses a more global measure of performance, which encompasses all activities and includes market perception of the industry. Thus, it examines the way in which exchange rate risk affects the investors' measure of performance. The results of this work are presented in Chapters 4 and 5 for Japanese data, Chapters 6 and 7 for the Norwegian data, with comparative analysis in Chapter 8.

Endnotes

[1] It could be argued that exchange rates are more likely to conform to a 't' distribution due to the presence of extreme values. In this case a 't' distribution on the basis of monthly data for one year would mean a coefficient would be 2.179, and give a result 11% greater. However, an examination of the research on exchange rate risk indicates that the normal distribution is frequently used, notably, Jorion, P. (1991). The Pricing of Exchange Rate Risk in the Stock Market, *Journal of Financial and Quantitative Analysis*, 26(3), pp. 363-376, and Cheung, Y. (1993) Long Memory in Foreign Exchange Rates, *Journal of Business and Economic Statistics*, 11(1), pp. 93-102.

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PART B: The Japanese Experience

Chapter 4: Operating Profits

Chapter 5: Returns on Shares

Chapter 4

Operating Profit

Introduction

This Chapter examines and measures the sensitivity of the operating results of the Japanese shipping industry to fluctuations in the Yen/US$ exchange rate. It highlights the importance of an effective strategy, given the low margins achieved in the sector. The approach, as detailed in Chapter 3, calculates the standard deviation of exchange rates over a seven year period and applies this measure of volatility to the exposed net revenues of the industry. The major exposure originates from the Dollar revenues which must be converted, to pay the non-Dollar costs. The emphasis here is on the Yen-based costs, but clearly, companies use a variety of currencies. The analysis is based on aggregate data for the industry from the Japanese Ministry of Transport. The percentages obtained are also compared to information received for individual companies. The discrepancies suggest that the exposure is perhaps greater than indicated by the aggregate figures. In the interests of consistency the calculations are all based on this aggregate information. The effect on operating profit becomes less significant over the seven year period, which is the result of both strategic response to reduce exposure and the lesser volatility of exchange rate movements.

The Japanese Industry: Size, Profitability, Strategic Implications

Japan controls approximately 13% of the world fleet in terms of dead weight tonnage. Over the last few years between 1.6 billion and 2 billion Yen have been earned annually in freight revenues. The Japanese industry is dominated by 12 companies, all of which are listed on the first section of the Tokyo Stock Exchange. Of these, the five major companies (the 'Big 5')[1] accounted for between 80% and 98% of the total revenue in the period 1990 to 1996. These large companies are Nippon Yusen Kabushiki Kaisha (NYK), Kawasaki Kisen Kaisha (K Line) , Mitsui OSK Lines (MOL), Navix Line, and Showa Line.

Table 4.1 : The Size of the Japanese Industry

Year	No. of Vessels	DWT Millions	% of World Fleet	Freight Income Billions Yen	
				Industry	'Big 5'
1990	1992	91.2	13.7	2037	1631.7
1991	2060	95.47	14.0	2111	1698.4
1992	2013	93.06	13.4	1980	1664.6
1993	2048	97.51	14.0	1748	1525.0
1994	1990	93.90	13.3	1622	1501.8
1995	1999	98.74	13.8	1605	1542.6
1996	2007	98.52	13.3	1713	1679.0

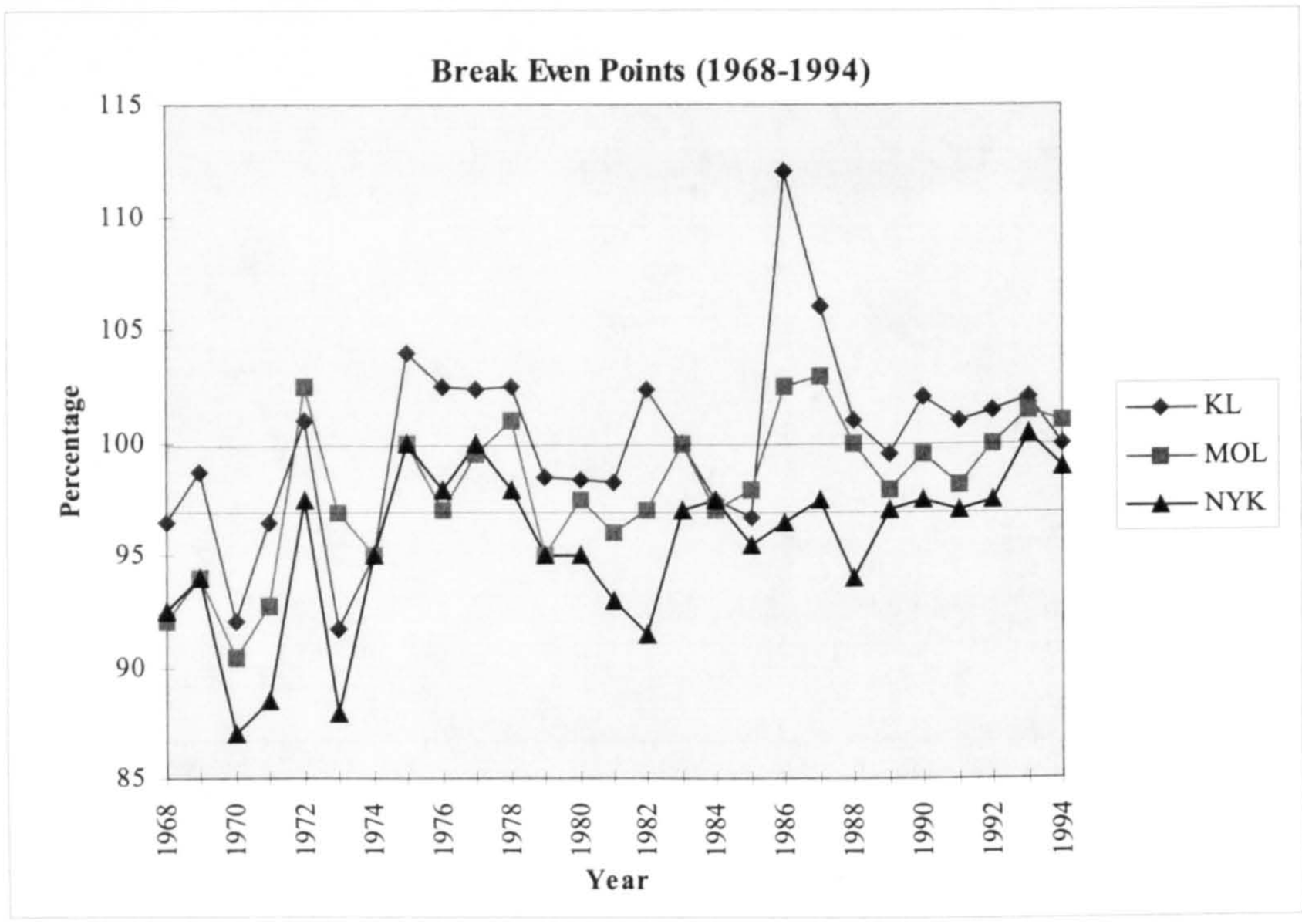
Source: Japanese Shipowners' Association

Table 4.1 shows the size of the Japanese fleet since 1990. The total number of vessels has been consistently oscillating around 2,000, with dead weight tonnage moving towards 100 million. Freight income has fluctuated considerably, reflecting the volatility of both freight rates and the Yen/US$ exchange rate. In fact, revenues expressed in US Dollars have been increasing since the beginning of the decade, but the

strength of the Yen in the mid 1990s caused the Yen denominated revenues to fall. The final column illustrates the significance of the 'Big 5' companies to the Japanese industry as a whole in terms of revenue. The percentage of the total revenue represented by these few companies increased from 79.2% in 1990 to 98.0% in 1996.

The shipping industry is characterised by low profits, which means that exchange rate movements can mean the difference between a profit or loss situation. The low margins for the Japanese industry may be seen by examining 'break even' points. These were introduced into financial statements by many large companies in 1972. They reflect, in terms of the percentage of sales, the sales of each firm at the end of the fiscal year at which all its operating expenses are covered. The break even points for the three major shipping firms, NYK, K Line, and Mitsui OSK are shown in figure 4.1.

Figure 4.1: Break even points (1968-1994)



Source: JAMRI Report No.55 March 1998[2]

This analysis considers operating revenues and total expenses. The 100% line is the point where operating revenues cover total operating expenses. The 97% line is, however, the true break even line, since the companies require 2% to cover taxes and a further 1.1% to cover dividends. If the calculated break even point, based on actual operating revenues and expenses, is above this line, then the companies must meet the expenses from other sources of revenue, such as investment income or profits from disposal of assets.

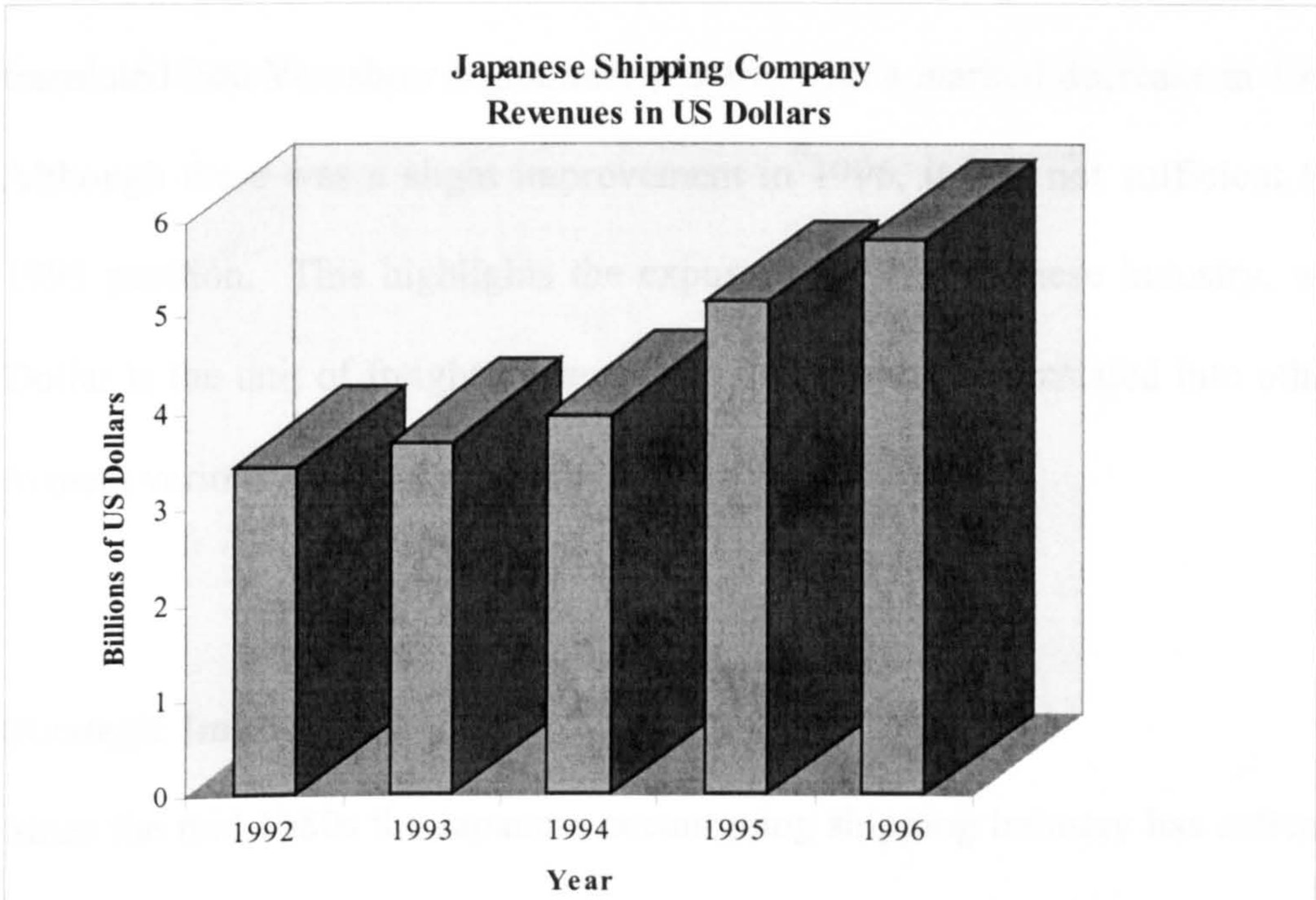
The results show that, for the period 1968-1974, all three firms could cover their costs with break even points below the 97% line. Between 1975 and 1985 all firms experienced difficulties in staying below the 100% line, with K Line exceeding it on numerous occasions. In fact, it suspended dividend payments for 1975-1979 and 1983-

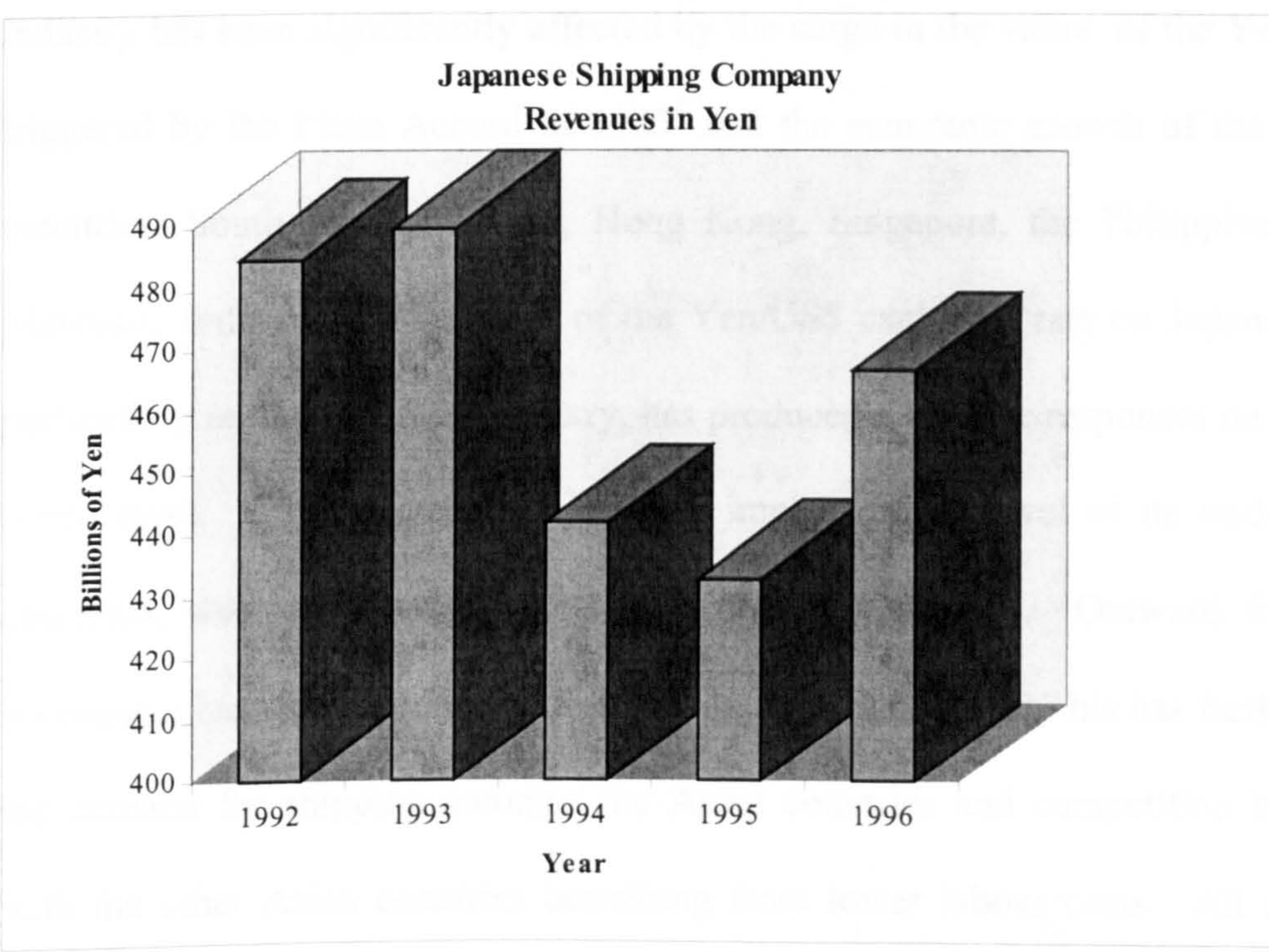
1994. The poor performance in this era was largely due to the second oil crisis, which led to expensive energy-saving measures such as the conversion of engines to more economical fuel consumption. In the business slump of the first half of the period companies were forced to sell off vessels and cancel charter contracts. This position then changed for the liner and bulk sectors in the latter years of this period.

The situation worsened in 1986, particularly for K Line and Mitsui. Mitsui responded with a suspension of its dividend for 1986-1988 and 1993-1994, since revenues during this period were in decline. In 1986 the reductions in revenue were 27.6% (NYK), 29.1% (MOL), 25.4% (KL). At the same time cost reductions were only 27.0% (NYK), 25.2% (MOL), 13.3% (KL). It was the strong Yen that was primarily responsible for the fall in revenues. A further rise between 1992 and 1994 created a further fall in the break even point. To counteract this, companies attempted to shift expenses into Dollars but achieved this only to a limited degree.

During the same period, revenues were volatile in themselves, due to fluctuations in freight rates and changing volumes. The appreciation of the Yen added to the problem. Even when Dollar revenues were increasing, the Yen denominated revenues were falling. It became clear that revenues could not be stabilised and that the focus would have to be on costs.

Figure 4.2: Revenues in US Dollars and Japanese Yen for Mitsui OSK





Source: Japanese Shipowners' Association[3]

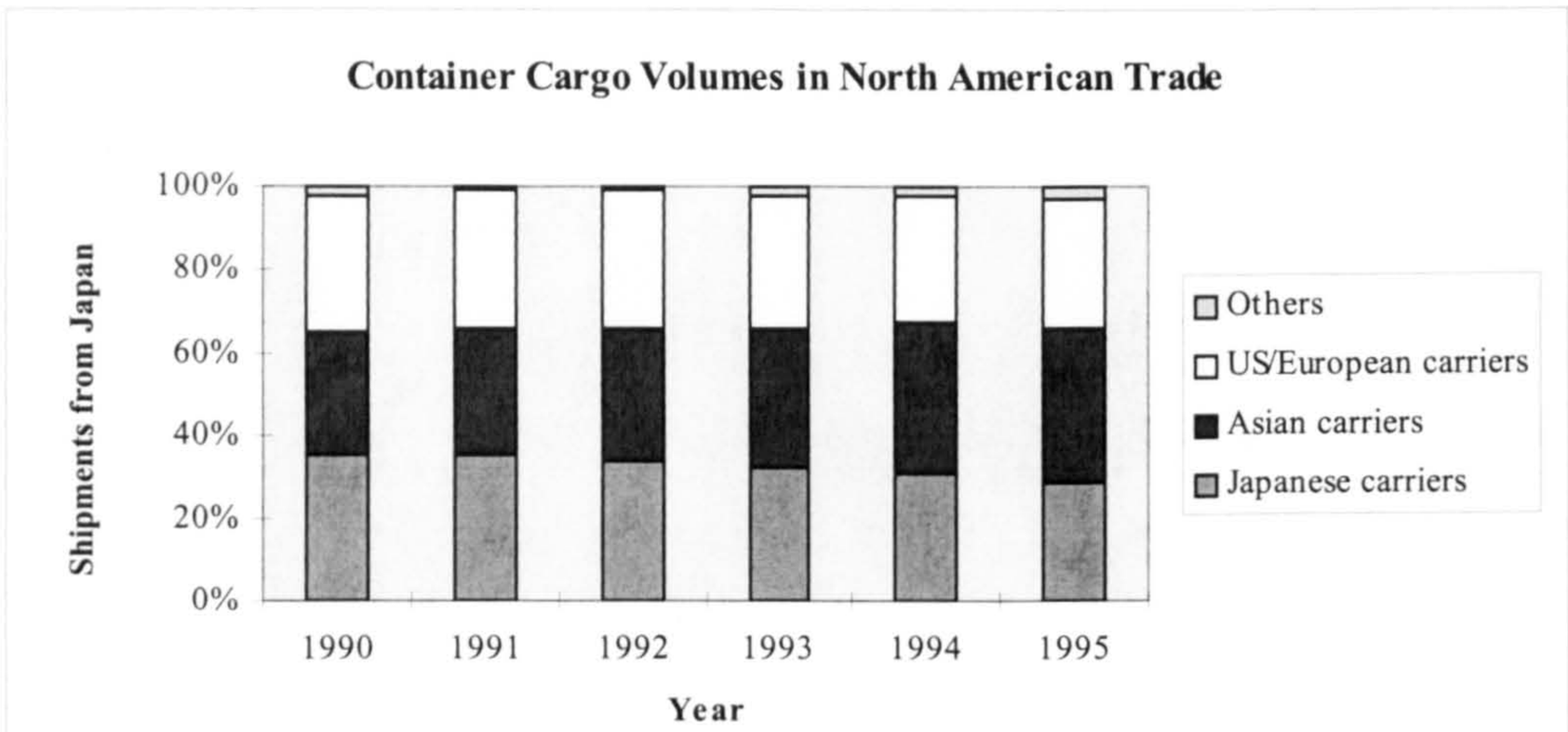
Figure 4.2 shows the revenues for Mitsui OSK 1992-1996 in terms of US Dollars and in terms of Yen. Although in Dollar terms there is an obvious upward trend, the revenues translated into Yen show a gloomier picture, with a marked decrease in 1994 and 1995. Although there was a slight improvement in 1996, it was not sufficient to restore the 1993 position. This highlights the exposure for the Japanese industry, where the US Dollar is the unit of freight revenues and these must be translated into other currencies to meet various forms of expenditure.

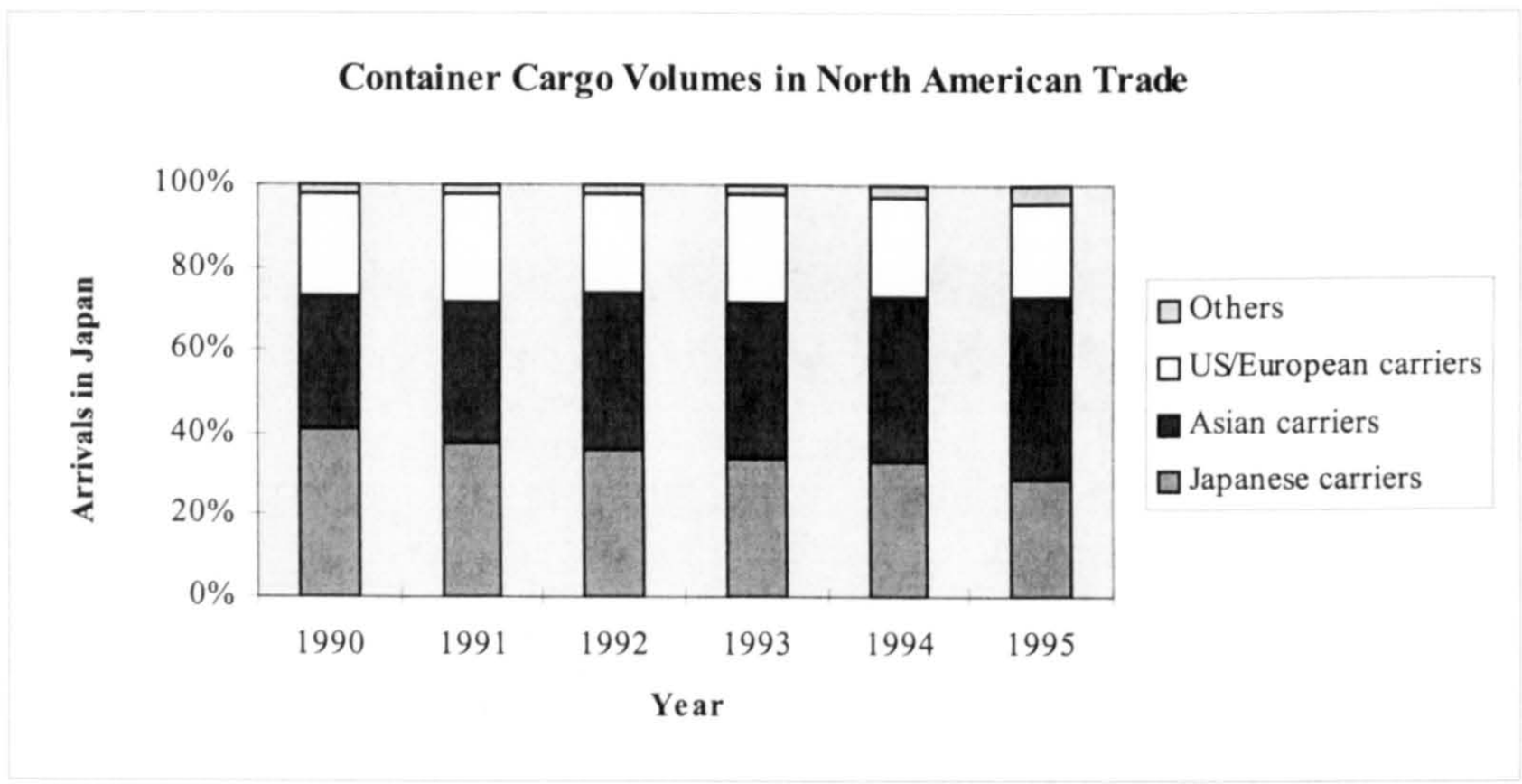
Strategic Implications

Since the mid 1980s the Japanese ocean-going shipping industry has actively pursued a structural transformation, in an attempt to adapt to the economic environment. The industry has been significantly affected by the surge in the value of the Yen, originally triggered by the Plaza Accord of 1985[4] and the economic growth of the other Asian countries: South Korea, Taiwan, Hong Kong, Singapore, the Philippines, Thailand, Malaysia, Indonesia. The effect of the Yen/US$ exchange rate on Japanese industry, particularly on the maritime industry, has produced a number responses on a macro and micro level. Clearly, there has been an impact on the level of its trade with other countries, with decreasing exports and increasing imports. Outward foreign direct investment has also risen in response to an appreciating Yen. This has further increased the demand for shipping amongst the Asian countries and competition in the sector, with the other Asian countries benefiting from lower labour costs. All these factors have a direct impact on all these sectors of the maritime industry which are involved in the movement of goods.

Figure 4.3 shows the effects of the increasing competition from other Asian companies, by analysing the container cargo volumes in North American trade since 1990. It shows that the Japanese companies have been losing trade to the other Asian countries for both the inward and outward voyages.

Figure 4.3: Competition in Container Shipping: Container Cargo Volumes in North American Trade carried by Japanese, other Asian, and US/European carriers (to and from Japan)





Source: Based on data in 'Research into Cargo Movements in Liner Shipping between the World's Major Regions', prepared by the Japan Maritime Research Institute (JAMRI)[5]

It can be seen that the increased competitiveness of the other Asian carriers, caused by the appreciation of the Yen and depreciation of other Asian currencies against the US Dollar, has led to an increasing volume of trade for these carriers, both into and out of

Japan (see also Table 4.2). The proportion of business conducted by US and European carriers, however, has remained fairly constant over the period 1990-1995. The shipping companies have been directly involved with foreign direct investment, but more in an attempt to achieve the major objective of moving as many costs as possible into Dollars. Such a step has led to change of flag registration, the use of more foreign crew, the locating of the administrative functions outside Japan, the setting up subsidiary companies in the US for the chartering of vessels, and to the use of Dollar loans for the financing of working capital.

The following sections consider the levels of exposure to which the Japanese industry are subject, and the volatility of the Yen/US$ exchange rate, in order to measure the extent of the problem.

Exchange Rate Volatility

The first stage of the measurement process involves the analysis of the Yen/US$ exchange rate movements over the decade and a calculation of the volatility of these rates.

The Yen experienced long term appreciation against the US Dollar from 1985 to 1996, before a relatively short-lived depreciation in the wake of the Asian crisis. Table 4.2 shows how the other major currencies have been depreciating against the US Dollar since 1980. Clearly, this has been an important factor for the Japanese shipping industry, dramatically affecting its competitiveness.

Table 4.2 Currency Indices against the US Dollar for Major Shipping Nations

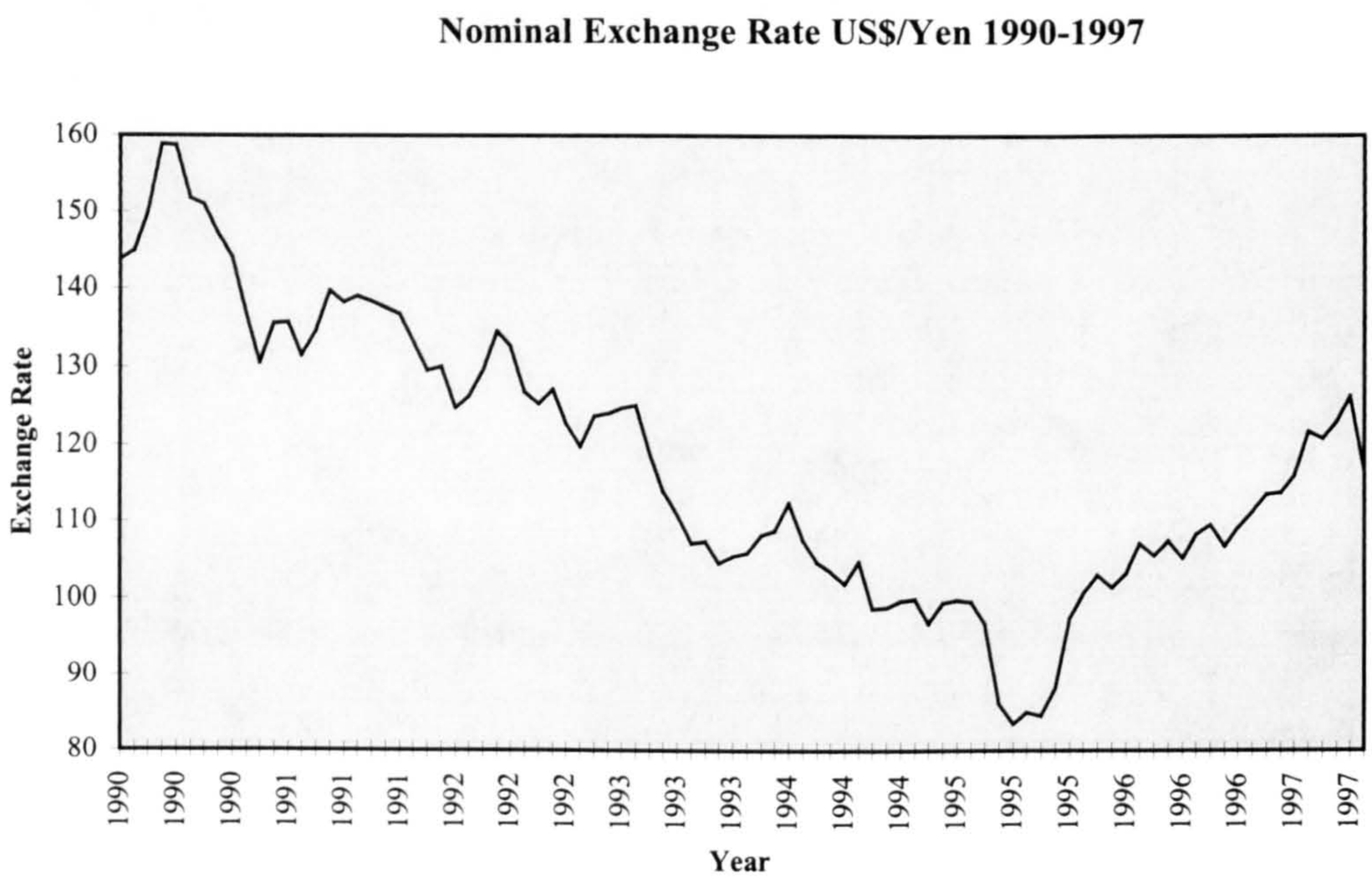
Country	Currency	1980		1996	
		Forex/ US$	Index	Forex/ US$	Index
Japan	Yen	226.74	100.0	108.76	48.0
UK	Sterling	0.43	100.0	0.64	148.9
Germany	DM	1.82	100.0	1.60	87.9
Norway	Krone	4.94	100.0	6.45	130.6
Korea	Won	607.43	100.0	810.79	133.5
Taiwan	Taiwan $	36.02	100.0	27.48	76.3

Source: Japanese Shipowners' Association[6]

By indexing the exchange rates against the Dollar at 100.0 for 1980, it can be seen that the value of the Yen had more than doubled against the Dollar from 226.74 to 108.76 over this sixteen year period. Sterling, Krone, and Won have all experienced volatility but have generally been depreciating against the US Dollar, as shown by the increasing index figures. The Deutschmark and the Taiwan Dollar have experienced appreciation, but not to the same extent as the Japanese Yen.

Figure 4.4 illustrates the volatility of the nominal Yen/US$ exchange rate since 1990. The analysis concentrates on the last decade in measuring the impact on the more recent results. It can be seen that there is a marked long term appreciation of the Yen against the US Dollar up to mid 1995. This had begun in the 1980s, as a result of policies to bring down the value of the US Dollar. The trend was partly reversed towards the end of the decade as a result of the turmoil in the Asian markets, but this trend proved to be relatively short-lived, since appreciation resumed by 1998.

Figure 4.4



The volatility shown above can be quantified by calculating the standard deviation around an average annual rate, as in Table 4.3. These calculations confirm what is shown in Figure 4.4.

Table 4.3: Nominal Exchange Rate Volatility Yen/US$ 1990-1996

	Average annual rate	Standard Deviation (SD)	Coefficient of variation	1.96 SD	1.96 SD as % of average annual rate
1990	136.756	6.97	5.1%	13.66	10.0%
1991	146.082	8.74	6.0%	17.13	11.7%
1992	135.413	3.55	2.6%	6.96	5.1%
1993	126.486	4.15	3.2%	8.13	6.4%
1994	102.305	4.48	4.4%	8.78	8.6%
1995	93.843	7.57	8.1%	14.84	15.8%
1996	108.401	3.28	3.0%	6.43	5.9%

Source: Datastream

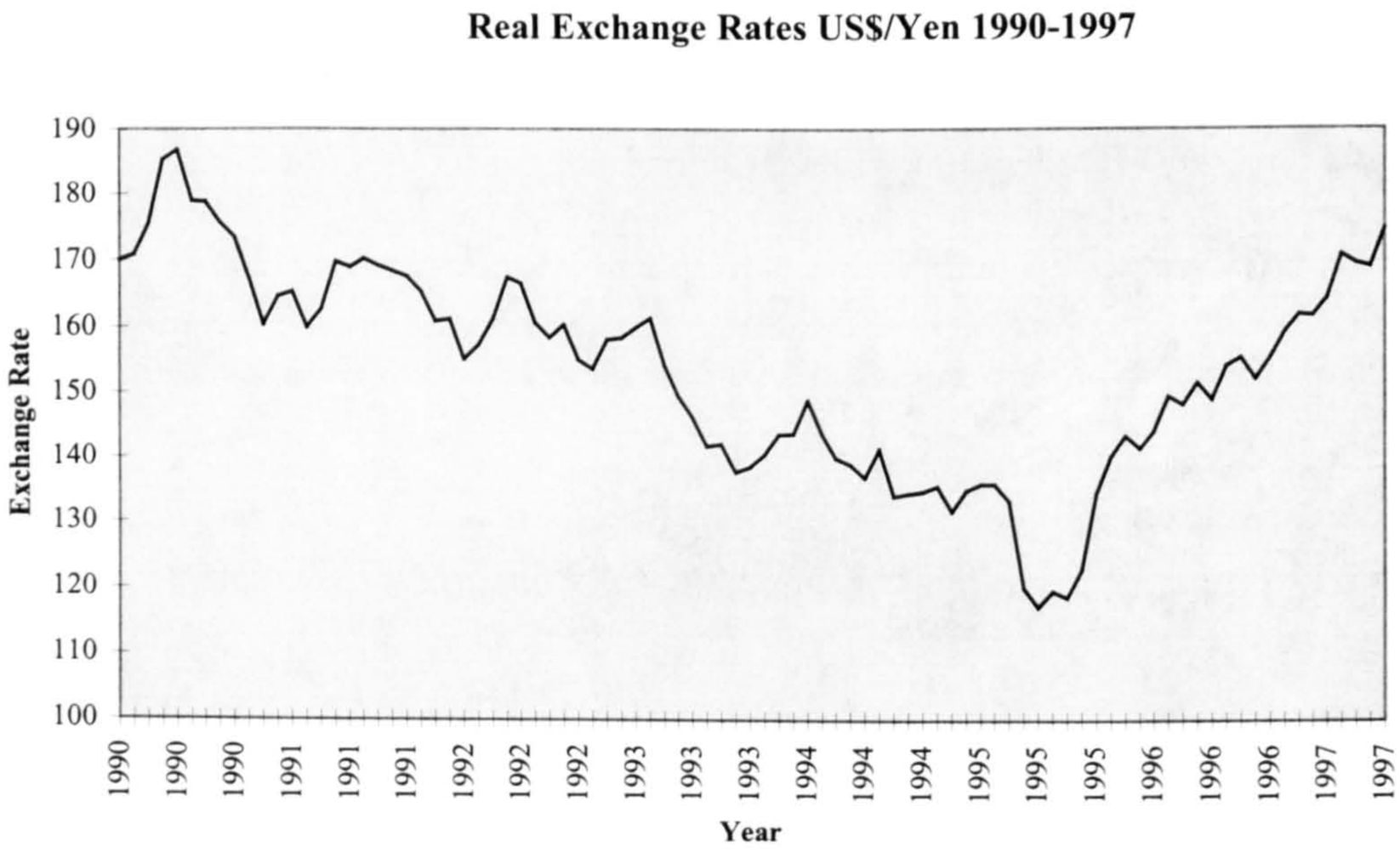
The Table shows high levels of volatility in 1990, 1991, and 1995, accompanying the appreciating Yen. This is confirmed by the coefficients of variation. The 1.96 standard deviation figures show the spread around the average annual rate at a 95% level of confidence. In other words, 95% of the time the exchange rate falls within this range, assuming a normal distribution of exchange rates[7].

It is not, however, the nominal rate, but the real rate which requires investigation. If the exchange rate moved according to cost differentials in the various countries, volatility would not be such an issue, since real rates would be maintained. This theoretical argument relies on the existence of constant purchasing power parity in the various countries.

Shipowners receiving Dollars will use some of these Dollars to pay their Dollar costs, and the rest will be exchanged in order to pay for non Dollar denominated costs. If purchasing power parity holds, then the movement in the exchange rate will reflect relative movements in the inflation rates of the two countries such that the purchasing

power remain the same. Thus, if the Dollar is depreciating against the Yen, this must be attributable to a higher inflation rate in the US than in Japan. Deviations from purchasing power parity are demonstrated by examining the movement in real exchange rates[8]. Figure 4.5 shows the volatility of the **real** Yen/US$ between 1990 and 1997. The real rates have been obtained by adjusting the nominal rates with reference to the appropriate country producer price index.

Figure 4.5



Source: Datastream

The same long term appreciation of the real Yen/US$ rate is illustrated in the diagram, with the beginnings of depreciation appearing in 1996. The annual volatility figures are calculated in Table 4.4.

In the theory of purchasing power parity requires a constant real rate of exchange, but the volatility illustrated above strongly suggests that purchasing power parity does not hold in practice.

Table 4.4 illustrates the annual position during this period. The volatility of the real rate is almost as great as that of the nominal rate shown in Table 4.2.

Table 4.4: Real Exchange Rate Volatility Yen/US$ 1990-1996

	Average	Standard Deviation (SD)	Coefficient of variation	1.96 SD	1.96 SD as % of average annual rate
1990	173.934	7.95	4.6%	15.58	9.0%
1991	165.724	3.81	2.3%	7.47	4.5%
1992	159.253	4.25	2.7%	8.33	5.3%
1993	146.608	7.93	5.4%	15.54	10.6%
1994	137.956	4.87	3.5%	9.55	6.9%
1995	130.148	9.79	7.5%	19.19	14.7%
1996	153.373	5.58	3.6%	10.94	7.1%

Source: Datastream

The average annual rates again show an appreciation of the real Yen/US$ rate from 1990 to 1995. 1996 saw a depreciation in the real rate, as with the nominal rate. However, the real rate of depreciation is considerably greater as a result of a higher inflation rate in Japan compared to the US. The coefficient of variation shows the highest volatility in 1990, 1993, and particularly in 1995. Again the 1.96 standard deviation ranges are given in the final two columns.

The use of a price index in such an analysis is far from perfect. The basket of goods used to represent the price index differs from country to country and may not be

indicative of the movements in costs and freight rates in the shipping industry. The fact remains, however, that in a Dollar dominated industry, the volatility of the exchange rate can have a major impact on the operating profit where a large proportion of costs are denominated in other currencies. In order to assess the impact of this, the measures of volatility obtained in Tables 4.3 and 4.4 must be applied to the exposed flows derived in the following section.

Exposed Flows: Industry Cost and Revenue Structures

This second stage of the analysis requires an estimate of the exposure faced by the industry as far as the Yen/US$ exchange rate is concerned. This involves an investigation into the currency denomination of the revenues and costs, to assess the net Dollar revenues. These are the revenues which must be converted from US Dollars to meet costs denominated in Yen. The analysis was assisted by the availability of statistics on currency denomination relating to the major shipping companies, from the Ministry of Transport. The Ministry of Transport collects data from the major shipping companies to assess the exposure to the Yen/US$ exchange rate. The aggregate figures for the period 1990-1996 are reproduced in Table 5.

Table 4.5: Trends of percentages of operating revenue and expenses in US Dollars (Big 5 Shipping Companies)

Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
operating revenue	59.1	59.4	58.6	57.7	58.2	60.9	64.0	64.6	66.7	69.4
operating expenses	47.9	51.8	54.1	54.6	53.2	55.7	55.5	57.5	60.3	61.4
difference	11.2	7.6	4.5	3.1	5.0	5.2	8.5	7.1	6.4	8.0
Impact of foreign exchange volatility on operating incomes										
Real amount in 100 million Yen										
operating revenue	14,104	13,996	15,236	16,317	16,984	16,646	15,250	15,018	15,426	16,790
operating expenses	14,287	13,693	14,618	15,863	16,456	16,303	15,137	14,791	14,986	16,255
operating income	-182	303	618	454	528	343	113	227	440	535
Exchange rate used by Big 5 shipping companies										
Y/$	139	128	142	142	133	125	108 23	99.98	95.72	111 85

Source: Ministry of Transport (Japan)[9] unpublished data.

Note: the figures are based on non consolidated financial statements. 1987 and 1988 are the aggregate figures for 6 major shipping companies since two major companies merged in 1989.

The Table illustrates the percentage of revenues and expenses denominated in US Dollars for the 'Big 5'[10] companies 1987-1996. The percentage of Dollar revenues increases over the ten year period from 59.1% in 1987 to 69.4% in 1996, reflecting the increase in Dollar based trade. The proportion of Dollar costs also increases in response to this trend from 47.9% in 1987 to 61.4% in 1996. As will be seen from the later discussion, this increase in Dollar costs has been a policy decision of those companies. Consequently, the 'expense differences' have been maintained at reasonably low levels, but did creep up to 8% by 1996. The second part of the table indicates the absolute amounts expressed in millions of Yen at the exchange rates indicated.

The individual companies within the industry have adopted cost-reducing and cost-shifting policies in order to move as many as possible to a US Dollar denomination.

Such policies have been effected in a number of ways; the changing the flag registration, the use of foreign crew and the reduction in administrative expenses through downsizing the head office functions. The following discussion considers the cost structures in terms of the currency denomination and the ways in which they have changed as a result of the Yen appreciation.

Cost Structures

Fuel

Fuel expenses are denominated 100% in Dollars. As a result, they have fallen since 1986 with the appreciation of the Yen, and since 1991, they have continued to fall despite increases in operating tonnage, simply because of the exchange rate.

Port Charges

Port charges include fees imposed by ports when vessels enter or leave, tug charges, launch charges and canal tolls. Port charges are denominated in the domestic currency of the ports and are, therefore, denominated in a variety of currencies. These currencies are largely Deutschmarks, Dutch Guilders, or Singapore Dollars. Exposure to these other currencies is managed using forward exchange contracts but these form an insignificant part of the overall strategy which very much centres on the Yen and the Dollar.

General administrative expenses

The largest item in general administrative expenses is personnel (excluding seamen). Following the appreciation of the Yen, these expenses have been controlled by means of business restructuring, which has involved the relocation of head office functions outside Japan.

Repairs and Maintenance

These are largely Dollar based, as companies ensure that the work, regardless of where it is carried out, is Dollar denominated.

Crew expenses

A consequence of the cost reduction programme has been outsourcing of crews to a less costly Dollar denominated labour force. As a result, the number of Japanese seamen continues to decline. The achievable cost reductions are illustrated in Table 4.6. which compares the cost of flagging out with the use of foreign crew.

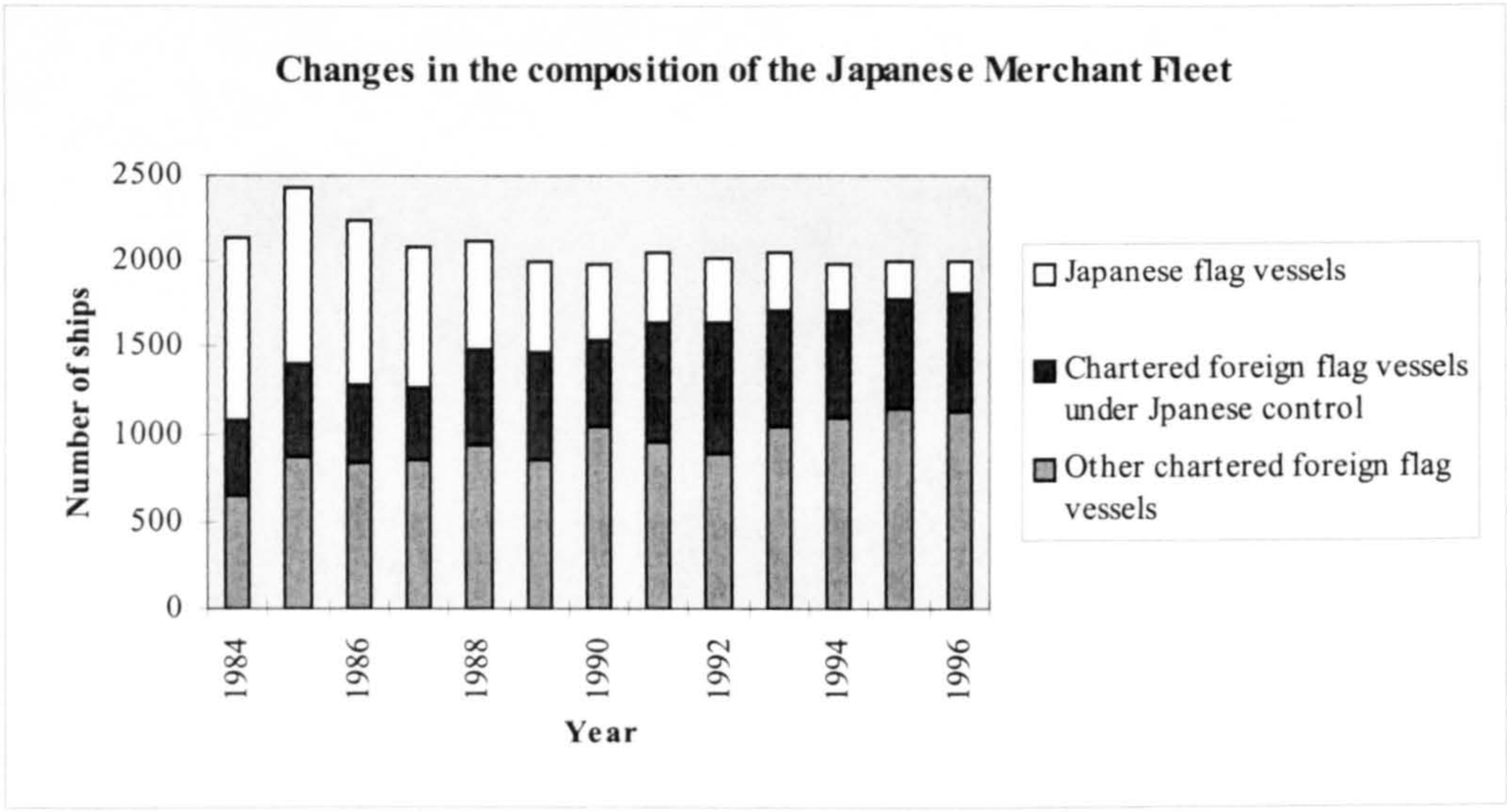
Table 4.6: Comparisons of Annual Crew Expenses Per Vessel 1998:

Crew composition	Costs in US Dollars
Manned with Japanese seamen only (11 seamen on modernised ship)	$2.34 million
Mixed manning on flag of convenience vessel (4 Japanese, 19 Southeast Asia seamen)	$1.56 million
Manned with Southeast Asian seamen (23 seamen)	$600,000

Source: Japanese Shipowners' Association
Based on an exchange rate of Y105.00 to US$1

The Table illustrates the fact that the use of flags of convenience is an effective means of changing the crew composition in favour of a cheaper source of labour. It can be seen that the use of a flag of convenience vessel with a mixed crew cuts the wage bill by one third, from $2.34 million to $1.56 million. An all Japanese crew of 11 men on a modernised ship is nearly 4 times as expensive as an all South East Asian crew of 23 men. Figure 4.6 shows the extent of movement in flag registration to acquire cheaper labour sources.

Figure 4.6: Changes in the composition of the Japanese Merchant Fleet 1984-1996



Source: MOT Maritime Transport Bureau[11]

In 1984 ships registered under the Japanese flag accounted for 49.4% of the total fleet. In 1996 this had fallen to 9.5%. In terms of dead weight tonnage, the percentages were 56.6% in 1984 and 20% in 1996. Clearly, the Japanese industry has increased the usage of foreign flag vessels to reduce costs. As part of the labour cost-cutting strategy the wage bill is paid in US Dollars, thus effecting a reduction of foreign currency exposure.

As a result of the measures outlined above, the level of exposure to the Yen/US$ exchange rate has been reduced significantly during the decade. This is shown in Table 4.7, which calculates the exposure for the industry as a whole, first by calculating the relevant figure for the 'Big 5', then by grossing up in accordance with the percentages of total freight income achieved by these major companies (Table 4.1). The estimate derived will be a prudent one, since it is probable that the smaller enterprises will carry a greater level of exposure than the major companies.

Table 4.7: Exposed Net Revenues for 'Big 5' and Industry (Billions of Yen)

		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Operating Revenue	Total	1410.4	1399.6	1523.6	1631.7	1698.4	1664.6	1525.0	1501.8	1542.6	1679.0
Operating Expenses	Total	1428.7	1369.3	1461.8	1586.3	1645.6	1630.3	1513.7	1479.1	1498.6	1625.5
Operating Revenue	Dollar	833.5	831.4	892.8	941.5	988.5	1013.7	976.0	970.2	1028.9	1165.2
Operating Expenses	Dollar	684.3	709.3	790.8	866.1	875.5	908.1	840.1	850.5	903.7	998.1
Net Dollar Revenues Big 5		149.2	122.1	102.0	75.4	113.0	105.7	135.9	119.7	125.3	167.2
Net Dollar Revenues Industry		186.5	152.6	127.5	94.1	140.5	125.7	155.8	129.3	130.3	170.6
As % of Dollar Revenues		22.4%	18.4%	14.3%	10.0%	14.2%	12.4%	16.0%	13.3%	12.7%	14.6%

Source: Ministry of Transport (Japan) and derived calculations

The Table shows the net Dollar revenues, i.e. the Dollar revenues less the Dollar costs and for the 'Big 5', and adjusts this exposure figure to reflect the industry as a whole. During the period under investigation this level of exposure fell from 186.5 billion Yen in 1987 to 94.1 billion Yen in 1990. Thereafter the exposure rose again, reaching 170.6 billion Yen in 1996. This was due to an increase in US Dollar based revenues which was not matched with a similar increase in US Dollar based costs. These changing levels of exposure are illustrated as a percentage of Dollar revenues, which were seen to fall to 10% in 1990, only to increase steadily up to 1996, but not up to the high level of the late 1980s.

The following section analyses specific information for two major companies in order to examine their individual policies regarding cost denomination, and to ensure consistency with the above aggregate data. Due to the sensitivity of the information which is not in the public domain, the company names are not given.

Company 1

Table 4.8 examines the cost matching process and the way in which this has changed over the past 10 years, by comparing the situation in 1988 with that of 1997. The table shows operating revenues and costs, and their currency denomination. The net Dollar revenues have to be converted to other currencies, mostly Yen, and these are taken to represent the Yen/US$ exposure.

Table 4.8: Company 1: Currency Denomination of Revenues and Costs 1988 and 1997

Company 1 : Year ended 31 March 1997 **Income Statement (Extract)**				
	Total	**US Dollar**	**Other**	**Yen**
	(Millions of Yen)			
Operating Revenue	348612	278890	13944	55778
Percentage	**100%**	**80%**	**4%**	**16%**
Operating expenses	-320884	-192530	-44924	-83430
General administrative expenses	-15447	-1699	-927	-12821
Total operating expenses	-336331	-194229	-45851	-96251
Percentage	**100%**	**57.8%**	**13.6%**	**28.6%**
Operating profit	**12281**	**84661**	**-31907**	**-40473**

Company 1 : Year ended 31 March 1988 Income Statement (Extract)				
	Total	**US Dollar**	**Other**	**Yen**
	(Millions of Yen)			
Operating Revenue	291652	233322	2917	55414
Percentage	**100%**	**80%**	**1%**	**19%**
Operating expenses	-281828	-135277	-25365	-121186
General administrative expenses	-13799	-966	-966	-11867
Total operating expenses	-295627	-136243	-26331	-133053
Percentage	**100%**	**46.1%**	**8.9%**	**45.0%**
Operating profit	**-3975**	**97079**	**-23414**	**-77639**

Source: Information supplied by the company[12] (unpublished)

The percentage of US Dollar denominated costs have increased to 57.8% in 1997 from 46.1% in 1988. This is reflected in the movement away from Yen into both US Dollars and other currencies. The reductions have been achieved mostly in chartering which is Dollar denominated, since the company are chartering their own vessels from their US subsidiary, in a strategic move to transfer costs into Dollars. Crew costs are essentially Dollar based, with a very small percentage in Yen.

General administrative costs are still largely based in Yen (86% in 1988 and 83% in 1997). There are no plans to move the administrative function abroad to alter this position.

Although not part of the operating expenses , financing also plays an important role in currency management. The company has a substantial US Dollar loan ($100m), on which it pays Dollar interest. Some of the financing arrangements have the facility to change the currency denomination at 6 monthly intervals, and thus, take advantage of currency or interest rate gains. At the date of the meetings in Japan (March 1997, see Appendix 2) interest rates in Japan were low relative to the US, and it was, therefore, to the advantage of the company to maintain substantial Japanese based debt. In fact, over the last five years the company has increased the Yen based debt from 61.4% to 67% and reduced US Dollar based debt from 30.1% to 22.1% of the total.

The percentage of US Dollar revenues for this company has been consistently around 80% for the period which is much higher than indicated by the aggregate figures. The US Dollar cost percentages are also below the total levels shown for the 'Big 5' by the Ministry of Transport, suggesting that this particular company faces a higher level of exposure than indicated by the aggregate data.

Company 2

Following the Plaza Accord in 1985[13] the appreciation of the Yen meant that income in Yen terms fell to half of its previous levels by the 1989. The continuing appreciation meant substantial losses in 1994, 1995, and 1996. In the case of company 2, again the policy is one of general cost cutting in the wake of increasing competition and downward pressure on the freight rates, particularly in the liner trade. This trade constitutes the largest proportion of operating revenues, as shown in Table 4.9, but because of its highly competitive nature[14], the company has moved more towards the differentiated tanker trade, particularly the LNG tankers.

Table 4.9: Company 2: Operating Revenue by Division

	Six month period ended 30 September			
Division	**1997**		**1996**	
	Million Yen	%	Million Yen	%
Liner	139,579	49.3	133,312	50.5
Tramp	93,597	33.1	87,094	33.0
Tankers	45,065	15.9	38,643	14.6
Others	2,942	1.0	3,562	1.4
Other operation	1,954	0.7	1,207	0.5
Total	283,140	100.0	263,810	100.0

Source: Company Annual Reports

In terms of revenue, the liner division accounts for 50% of the total business, the bulk trade for 33% and tankers for 16%. The composition of total business in terms of currency denomination, is shown in Table 4.10.

Table 4.10: Company 2: Currency Denomination of Revenues and Costs

	6-month period to 30/9/97	US Dollar	Yen	Other
Operating revenue	283,140	203861	79279	
Percentage	**100%**	**72%**	**28%**	
Operating expenses				
Voyage expenses	104,895	15%	5%	80%
Vessel expenses	9,805		100%	
Charterage paid	110,771	70%	30%	
Other vessel expenses	36,610		100%	
Other operating expenses	966		100%	
General & Administrative	12,326		100%	
Total operating expenses	275,377	93274	98183	83916
Percentages	**100%**	**33.8%**	**35.7%**	**30.5%**
Operating profit	7763	110587	-18904	-83916

Source: Information supplied by the Company (unpublished)

Revenue in US Dollars accounts for 72% of the total, the remainder being in Japanese Yen. The percentage of US Dollar costs is still only 33.8%. The company has adopted a major cost reduction policy, which has been achieved by a reduction in the number of administrative staff. Redundancies have been approximately 150 per year since 1994. This has been accompanied by a shift in some of the administrative offices to the US, Singapore and Australia. The head office for containers is moving to USA, and that for intra-Asian operations to Australia.

Again, such measures are determined by the basic philosophy of long term reduction of exposure to the Yen/US$ exchange rate. However, the exposure for Company 2 at 72% US Dollar operating revenues and 33.8% US Dollar operating expenses is still greater than those indicated by the aggregate figures. If both are correct, then much smaller exposure levels are being achieved by the other three major companies.

Operating Profit

Given these cost structures, it is possible to calculate the potential impact on operating profits of exchange rate volatility. The value at risk (VAR) approach takes the percentage movement in the real rate, represented by plus or minus 1.96 standard deviations, and applies it to the exposed flows for each country (assuming a normal distribution). In so doing, the maximum impact on operating profits can be derived at a 95% confidence level, since the other currency denominations are a much less significant proportion of overall expenditure. The results are illustrated in Table 4.11.

Table 4.11 : Sensitivity of Exposed Flows to Fluctuations in the Exchange Rate Japan (Billions of Yen)

	1990	1991	1992	1993	1994	1995	1996
Exposure	94.1	140.5	125.7	155.8	129.3	130.3	170.6
1.96 Standard Deviations	15.58	7.47	8.33	15.54	9.55	19.19	10.94
Average Annual Rate	173.934	165.724	159.253	146.608	137.956	130.148	153.373
1.96 Standard Deviations as % of Av. Annual Rate	8.96%	4.51%	5.23%	10.60%	6.92%	14.74%	7.13%
Impact on operating profit of exchange rate volatility +/- billions of Yen	8.429	6.333	6.575	16.514	8.951	19.212	12.169

Source: Own calculations[15]

The impact on operating profit is calculated from the exposure level and the volatility of the Yen/US$ exchange rate. The highest potential impact on operating profit was in 1993, 1995, and 1996. In 1993 and 1995 this was attributable to the high levels of exposure. The 1995 figure was more a result of the great volatility of the real exchange rate. The significance of these fluctuations is highlighted by examining the variations as a percentage of the actual operating profit for each of the years as in Table 4.12.

Table 4.12: Potential Fluctuations in the Operating Flows as a Percentage of Operating Profit

	1990	1991	1992	1993	1994	1995	1996
industry operating income	2037	2111	1980	1748	1622	1605	1713
industry operating expenses	1980	2045	1939	1734	1597	1559	1658
industry operating profit	57	66	41	14	25	46	55
fluctuations as % of actual operating profit	14.87%	9.65%	16.12%	122.14%	36.51%	41.97%	22.29%

Source: Own calculations based on figures from Ministry of Transport (Japan)

Thus, the combination of exposed flows and exchange rate volatility produces substantial fluctuations in the operating performance of the industries. The situation was at its worst in 1993, where the fluctuations themselves were high and the operating profit was low. The percentages remained high in 1995 and 1996 as a result of the potential fluctuation in those years.

It can be seen from Tables 4.11 and 4.12 that exchange rate volatility can and does have a dramatic impact on the operating performance of the business, due to the exposure, the volatility of the Yen/US$ exchange rate and the low level of operating profitability of the industry.

Conclusion

The Japanese industry has been forced to address the impact of exchange volatility on its profitability due to the long term appreciation of the Yen against the US Dollar. The strategic response has been natural hedging. Given the inability to change the denomination of revenues, this has taken the form of shifting as many costs as possible into US Dollars. Although the resulting exposed flows are still relatively high, mainly due to an increase in US Dollar revenues, there has been a slight reduction in the exposure, and the long term policy remains the same. However, the fact remains that in this low profitability industry, exposure to the high exchange rate volatility can and does have a dramatic impact on the operating profitability of the industry.

Endnotes

[1] The Big 5 , MOL, K Line, NYK, Navix and Showa are now the Big 3 since the mergers of MOL with Navix and NYK with Showa in 1999.

[2] Japan Maritime Research Institute (JAMRI) (1998) Mechanism of the Equilibrium of Supply and Demand in the Shipping Market (Part III) - Productivity Analysis (Dynamic State of Basic Unit of Cost) of Japanese Shipping Firms, No. 55, March.

[3] Japanese Shipowners' Association Report 1997.

[4] The Plaza Accord was an agreement made by the G5 nations, United States, France, Japan, Great Britain and West Germany in the Plaza Hotel in New York in September 1985. Its aim was to introduce a programme to force down the value of the Dollar against other major currencies and so improve American competitiveness. The effects of the policy were dramatic and in fact the Dollar value fell to such an extent that in 1986 the central banks of Japan, West Germany and Great Britain reversed their policy to stem the decline. In February 1987 the same 5 countries plus Canada and Italy (G7) met in Paris to agree a plan to slow down the decline. The Louvre Accord called for co-ordination of economic policy whilst supporting the fall in the Dollar with exchange rates pegged in narrow bands. This co-operation faded and the Dollar continued to fall.

[5] Yamada, H. 'The Ocean Shipping Economy-Identity formula of ocean freight rate and its cost (liner shipping)' (forthcoming)

[6] Op. cit.

[7] It could be argued that exchange rates are more likely to conform to a 't' distribution due to the presence of extreme values. In this case, a 't' distribution based on monthly data for one year would mean a coefficient of 2.179 and would give a result 11% greater. However, an examination of the research on exchange rate risk reveals that the normal distribution is frequently used, notably, Jorion, P. (1991) The Pricing of Exchange Rate Risk in the Stock Market, *Journal of Financial and Quantitative Analysis*, 26(3), pp. 363-376, and Cheung, Y. (1993) Long Memory in Foreign Exchange Rates, Journal of Business and Economic Statistics, 11(1), pp. 93-102.

[8] Purchasing Power Parity (PPP) theory states that the general level of prices when converted to a common currency will be the same in every country, assuming no transactions costs. This may be expressed as:
$P^h = SP^f$, where P^h is the price level in the home country, P^f is the price level in the foreign country, and S is the exchange rate or the price of a unit of foreign currency measured in a unit of domestic currency. If the general level of prices is a reasonable estimate of cost of production in one country, then the ratio of price levels for any 2 countries will be a reasonable estimate of competitiveness. If PPP holds, then competitiveness as measured in this way would be constant and equalised across countries, and no country would have a price advantage. In practice international competitiveness has been far from constant and deviations from PPP are often measured using real exchange rates. The real exchange rate is the price of foreign relative to domestic goods and services. In other words, it is the nominal exchange rate corrected for relative prices, P^f/P^h. One of the problems with this absolute PPP is that prices are measured using an index. If different base dates are used for the different countries, the results will be distorted. In this analysis the base rates used are the same and therefore this is not an issue.

[9] The data was provided by the Ministry of Transport in Japan and is unpublished.

[10] Op. cit.

[11] The Current Situation of Japanese Shipping (Summary) September 1997, Edited by Maritime Transport Bureau, Ministry of Transport, published by the Japan Maritime Development Association.

[12] This was based on the company's own analysis and discussion with a number of senior officials within the organisation.

[13] Op. cit.

[14] Competition in the liner sector is discussed in Appendix 4.

[15] The calculations are based on the exchange rate data from Datastream, own calculations of volatility and exposure levels shown in tables 4.4 and 4.5.

Chapter 5

Returns on Shares

Introduction

The objective of the statistical analysis is determine whether there is a relationship between the Yen/$US exchange rate and the share price returns of the 'Big 5'[1] companies. These companies account for a high percentage of the Japanese industry results and are taken, therefore, as representative of the whole industry[2]. As stated in Chapter 3, research has shown that changes in the exchange rate have a significant effect on the performance of firms involved in international activities[3], as measured by share prices or share price returns. Furthermore, there is more likely to be a lagged relationship between the changes in value of the Dollar and the value of the firm, rather than a contemporaneous one.

This analysis uses 4 stages. The first aims to determine the stationarity of the variable in order to enable the modelling process. The second develops a market model for the establishment of an expected return, which in turn enables the calculation of an abnormal return for stage 4. The third and fourth stages examine the relationship between exchange rate movements and share prices return. The third focuses on total return, and the fourth on abnormal or unanticipated return. This latter process allows an investigation of whether the exchange rate exposure is priced by the market. If this is the case, then the period over

which abnormal earnings accrue can be explained by the past change in the value of the Yen against the Dollar.

In all regressions involving exchange rate data, the log of exchange rates is used because its inverse also has the same properties of distribution.

Stage 1: Stationarity

The first stage of the analysis is to test the stationarity of the variables. As explained in Chapter 3[4], non-stationary variables cannot be modelled because of their changing characteristics, unless they are made stationary through differencing. In order to carry out the stationarity tests, it is necessary to determine the order of the Dickey Fuller test. This involves testing the residuals from the Dickey Fuller regressions using a Q test, to ensure that they are white noise errors. The Box Pierce calculated values[5] are compared to the critical values in the chi squared tables at *K-p* degrees of freedom, where k is the displacement, which should be high for low-order equations, and p is the number of autoregressive lags. The null hypothesis is that the residuals are white. This is rejected if the calculated Q is greater than the critical value in the χ^2 tables at the chosen level of confidence.

A non-stationary series can be identified by determining whether or not it has a unit root. For this analysis it is, therefore, necessary to test for stationarity of the data, and, where necessary, for the order of homogeneity, before proceeding with the regression techniques.

The formal test for a non-stationary series which follows a random walk, is the unit root test, introduced by Dickey and Fuller[6].

Table 5.1a shows the results of the Q test for the variables used. In each case *K* is taken as 21 and p is 1. The critical value in the chi squared tables for 20 degrees of freedom and 95% level of confidence is 31.41. The null hypothesis is that the residuals are white noise. A calculated Box Pierce statistic less than 31.41 means acceptance of this hypothesis, i.e. the residuals are white noise, and this regression can be used for the stationarity test. Rejection of the null hypothesis means that additional lags of the differenced variable must be added in order to augment the test.

In Table 5.1a the null hypothesis is accepted in all cases with the exception of the share prices for Mitsui OSK, NYK and K Line. For these variables more lags of the differenced variable were added.

Table 5.1a: Q Tests

H_0 = errors of Dickey Fuller regression are white noise:
Critical Value = chi squared k-p degrees of freedom, k=21, p=1

Variable	Box Pierce (calculated)	Critical Value	Accept/Reject
Log $/Yen Nominal	22.7375	31.41	accept
Log $/Yen Real	19.9456	31.41	accept
Share Prices			
Topix Index	27.8958	31.41	accept
Mitsui OSK	83.2247	31.41	reject
NYK	49.0054	31.41	reject
K Line	37.4512	31.41	reject
Navix	18.6483	31.41	accept
Showa	11.3672	31.41	accept
Share Price Returns			
Topix Index	14.1882	31.41	accept
Mitsui OSK	18.6366	31.41	accept
NYK	18.0093	31.41	accept
K Line	6.8112	31.41	accept
Navix	8.6411	31.41	accept
Showa	8.4509	31.41	accept

Table 5.1b shows the results of these Q tests. In the case of Mitsui OSK, 10 lags of the differenced variable had to be added in order to establish the stationarity test, whilst for NYK and K Line, 12 lags were needed before the white noise errors were evident.

The results show a different critical value, since the degrees of freedom change with the number of added lags.

Table 5.1b: Q Tests (with additional lags of differenced variable)

H_0 = errors of Dickey Fuller regression are white noise:
Critical Value = chi squared k-p degrees of freedom, k=21, p= various

Variable	number of lags	Box Pierce (calculated)	Critical Value	Accept/Reject
Share Prices				
Mitsui OSK	10	19.4403	19.68	accept
NYK	12	14.2282	16.92	accept
K Line	12	15.0880	16.92	accept

Table 5.1c shows the Q tests on first differences, where the non-differenced variable was shown to be non-stationary (see table 5.2a). In both cases the first differences needed no additional lags of the variable to establish the order of the stationarity test.

Table 5.1c: Q Tests First Differences (where necessary)

Variable	Box Pierce (calculated)	Critical Value	Accept/Reject
Log $/Yen Nominal	20.5651	31.41	accept
Log $/Yen Real	20.0465	31.41	accept

Having established the order of the test, the appropriate Dickey Fuller or Augmented Dickey Fuller test for stationarity is performed, using an F test.

The number of restrictions is 2 in all cases, but the number of variables differs according to the available data, and the regressors vary according to the order established by the Q tests.

The null hypothesis is that the variable is non-stationary, more specifically that it follows a random walk. Where the calculated value is less than the critical values obtained from Dickey Fuller tables, then the null hypothesis is accepted. The results are shown in Table 5.2a.

Table 5.2a: Dickey Fuller Tests (F)

H_0 = variable follows a random walk
Critical Value = $F_{q,n-k}$ in Dickey Fuller Table VI (see Appendix 3) (q is number of restrictions (2), n is number of observations (various), k is the number of regressors in the original equation (4).

Variable	Order	Calculated F	Critical F (DF tables)	Accept/Reject
Log$/Yen Nominal	1	1.6184	6.49 (110 obs)	Accept
Log $/Yen Real	1	1.1556	6.49 (109 obs)	Accept
ΔLog$/Yen Nominal	1	20.7054	6.49 (110 obs)	Reject
ΔLog$/Yen Real	1	22.3546	6.49 (109 obs)	Reject
Share Prices				
Topix Index	1	1.25	6.34 (316 obs)	Accept
Mitsui OSK	10	3.18	6.34 (308 obs)	Accept
NYK	12	2.11	6.34 (305 obs)	Accept
K Line	12	2.78	6.34 (305 obs)	Accept
Navix	1	4.12	6.49 (118 obs)	Accept
Showa	1	2.82	6.34 (197 obs)	Accept
Share Price Returns				
Topix Index	1	821.43	6.34 (316 obs)	Reject
Mitsui OSK	1	978.26	6.34 (316 obs)	Reject
NYK	1	1040.14	6.34 (316 obs)	Reject
K Line	1	96.05	6.34 (314 obs)	Reject
Navix	1	42.74	6.49 (117 obs)	Reject
Showa	1	65.00	6.49 (196 obs)	Reject

The calculated values are obtained from the following formula:

$$F = \frac{RSS_R - RSS_U / (q)}{RSS_U / (n-k)} \qquad (5.1)$$

where RSS_R is the residual sum of squires of the restricted equation

RSS_U is the residual sum of squares of the unrestricted equation

n is the number of observations

k is the number of regressors

q is the number of restrictions

These are compared with the critical values in the Dickey Fuller tables (see Appendix 3).

The results show that the nominal and real Yen/$US exchange rates are both non-stationary, as are all the share prices. The differenced exchange rates are obtained from the change in the exchange rate, i.e. exchange rate at period 1 minus exchange rate at period 0. In both cases the differenced exchange rates are stationary. The non-stationary share prices are made stationary by deriving the returns as follows:

$$\text{Return} = \frac{\text{Share Price}_t - \text{Share Price}_{t-1}}{\text{Share Price}_{t-1}} \qquad (5.2)$$

For each share price the share price return is stationary.

The results of the stationarity test using F are consistent with the t test, as shown in Table 5.2b.

Table 5.2b: Dickey Fuller Tests (t)

t test statistics (with trend critical values)
critical values from MacKinnon 1991

Variable	Order of test	Calculated t	Critical t (DF t tables)	Accept/Reject
Log$/Yen Nominal	1	-2.0692	-3.4387	Accept
Log$/Yen Real	1	-1.4425	-3.4504	Accept
ΔLog$/Yen Nominal	1	-8.0079	-3.4389	Reject
ΔLog$/Yen Real	1	-6.6531	-3.4508	Reject
Share Prices				
Topix Index	1	-1.5313	-3.4255	Accept
Mitsui OSK	10	-2.5014	-3.4259	Accept
NYK	12	-2.0380	-3.4260	Accept
K Line	12	-2.3923	-3.4255	Accept
Navix	1	-2.5455	-3.4478	Reject
Showa	1	-2.2399	-3.4336	Accept
Share Price Returns				
Topix Index	1	-12.8111	-3.4256	Reject
Mitsui OSK	1	-13.9867	-3.4256	Reject
NYK	1	-14.4168	-3.4256	Reject
K Line	1	-14.1208	-3.4256	Reject
Navix	1	-9.2896	-3.4481	Reject
Showa	1	-11.4015	-3.4337	Reject

The critical values are taken from MacKinnon (1991)[7]. This test examines the coefficient of the lagged variable to determine whether it is 1 or above. If this is the case, then the variable is non-stationary. Again the non-stationary variables are exchange rates and share prices, but the differenced versions are stationary.

This first stage has determined the stationary properties of the variables and, where necessary, the order of homogeneity. The exchange rates were made stationary by taking first differences. In the case of share prices, stationarity was achieved by using share price returns. These stationary variables can then be used in the regression processes in stages 2, 3 and 4.

Stage 2: The Market Model

The objective here is to establish an expected or 'normal' return on the investment in the various companies and, hence, calculate an 'abnormal' return to be used in the stage 4 regression. The market model serves to generate the expectation. This model is essentially a statistical regression which indicates a relationship between returns on a particular investment and the returns on a market index.

The returns on an investment are taken to be the return from capital gain. In other words:

$$r_{i,t} = \frac{p_{i,t} - p_{i,t-1}}{p_{i,t-1}} \qquad (5.3)$$

where $p_{i,t}$ is the price of the investment at time t

$p_{i,t-1}$ is the price of the investment at time t-1

Similarly:

$$r_{m,t} = \frac{p_{m,t} - p_{m,t-1}}{p_{m,t-1}} \qquad (5.4)$$

where $p_{m,t}$ is the market index at time t

$p_{m,t-1}$ is the market index at time t-1

For each company the share price data and the relevant market indices are used to generate returns as above. The returns data are then used in the market model regression to generate a model for the expected returns of the investment. Abnormal returns are then calculated by taking the difference between actual and expected returns for this period:

$$AR_{i,t} = r_{i,t} - \alpha_i - \beta_i r_{m,t} \qquad (5.5)$$

where:

$AR_{i,t}$ is the abnormal return for investment during period t

These abnormal returns are not anticipated and may be explained by a number of factors, one of which in the case of an international business is the change in the rate of exchange.

This stage develops a market model for the share price returns of each company. The Topix index[8] is used to calculate the market returns. The market model can then be used to calculate the abnormal returns for the more recent data. In each case 5 years of monthly data, 60 observations, were used to establish the market model from 1987 to 1991. The results of these calculations were then used to derive the abnormal returns from 1992 to1999. The exception was Navix, where data was only available from 1989, in which case only 54 observations could be used from 1989 to 1993 in order to establish the expected value from the market model. Abnormal returns were then calculated for the period 1994 to 1999.

The market models for each company's share price returns are shown in Tables 5.3a to 5.3e.

In each case the coefficient, the t statistic for the coefficient, and the coefficient of determination (R^2) are calculated. For the t tests, the null hypothesis is that the coefficient is 0. If the calculated t is less than the critical in the t tables, the null hypothesis is accepted. If the calculated value of t is greater than the critical value, then the null hypothesis is rejected, and the variable is seen to be significant. All tests are at a 95% level of

confidence. The R^2 indicates the power of the market index to explain the returns on the individual investment, and has a range of between 0 (no explanatory power) and 1 (perfect explanatory power). The 'β' coefficient is an indication of the extent to which the return moves with the market. A coefficient of 1 indicates a perfect correlation. Higher than 1 indicates that the investment is more risky than the market and lower than 1 is less risky than the market.

Table 5.3a: Market Model MOL

60 observations 1987M1 to 1991M12

	Coefficient	t calculated	t critical (95%)	accept/reject
α	0.01637	1.2411	2.00	accept
β	0.80507	5.8940	2.00	reject

R^2 = 0. 43391

Table 5.3b: Market Model NYK

60 observations 1987M1 to 1991M12

	Coefficient	t calculated	t critical	accept/reject
α	-0.0049	-0.5617	2.00	accept
β	1.1383	9.1589	2.00	reject

R^2 = 0.59122

Table 5.3c: Market Model K Line

60 observations 1987M1 to 1991M12

	Coefficient	t calculated	t critical	accept/reject
α	0.0244	1.5091	2.00	accept
β	1.4842	6.4990	2.00	reject

$R^2 = 0.42137$

Table 5.3d: Market Model Navix

54 observations 1989M7 to 1993M12

	Coefficient	t calculated	t critical	accept/reject
α	-0.0142	-1.2908	2.00	accept
β	1.0101	6.9702	2.00	reject

$R^2 = 0.48302$

Table 5.3e: Market Model Showa

60 observations 1987M1 to 1991M12

	Coefficient	t calculated	t critical	accept/reject
α	0.00997	0.6667	2.00	accept
β	0.78874	3.7364	2.00	reject

$R^2 = 0.19401$

For each model the residuals are white noise errors. In every case the R^2 have an approximate value of 0.4, with NYK particularly high at 0.59. The exception is Showa, where the R^2 is particularly low at 0.19. This situation was not significantly improved by the use of more observations. In each case the t statistics indicate that the coefficients of the market index are not equal to zero at a 95% confidence level. In other words, the market

index variable is significant. The coefficients derived above will be used in stage 4 to give an expected return for the period 1992 to 1999.

Stage 3: Regression of Total Returns Against Changes in Exchange Rate

This analysis examines whether the change in the rate of exchange has any explanatory power for returns on shares. To achieve this, the regression uses monthly data from 1990 to 1999.

Tables 5.4 to 5.6 show the significant results of the regressions for the companies. In each case, the analysis is done using first nominal, and then real exchange rate changes. Again the key statistics are the R^2 and the t values. The R^2 shows the extent to which the logged exchange rate movements affect the share price returns. Low values are expected here, because only one independent variable is being used and exchange rate movements are only one of many factors that impact on returns. The objective is to establish whether they are significant in explaining returns as current or lagged variables.

Table 5.4a: Regression of Total Returns on Nominal Exchange Rate Movements: MOL

Dependent Variable MOL Total Returns

106 observations 1990M8 to 1999M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.005384	-0.51359	2.00	accept
$\Delta ER_{t-5,t-6}$	-0.90285	-3.1774	2.00	reject

$R^2 = 0.088485$

Table 5.4b: Regression of Total Returns on Real Exchange Rate Movements: MOL

Dependent Variable MOL Total Returns

106 observations 1990M8 to 1999M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.0034920	-0.33643	2.00	accept
$\Delta RER_{t-5,t-6}$	-0.97515	-3.1952	2.00	reject

$R^2 = 0.089393$

In running the regression of the changes in both the nominal and the real exchange rate against share price returns, it was only the change which occurred five months previously that was a significant factor in explaining the current share price returns. Surprising is the fact that it is an **appreciation** rather than a depreciation of the Yen five months previously that has a positive affect on returns today. At first sight this is counter intuitive, since an appreciation in the Yen should lead to lower profitability of a non-US based shipping company. A possible explanation is perhaps in the management of the exposure. As explained in Chapter 4[9], the movement of many costs into US Dollars has the effect of

reducing the impact of changes in the value of the Yen against the Dollar. Furthermore, the appreciation of a currency may be indicative of the general economic prosperity affecting many businesses and industries.

Table 5.5a: Regression of Total Returns on Nominal Exchange Rate Movements: NYK

Dependent Variable NYK Total Returns

106 observations 1990M8 to 1999M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.010556	-1.3010	2.00	accept
$\Delta ER_{t-5,t-6}$	-0.66215	-2.8049	2.00	reject

$R^2 = 0.070326$

Table 5.5b: Regression of Total Returns on Real Exchange Rate Movements: NYK

Dependent Variable NYK Total Returns

106 observations 1990M8 to 1999M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.0092860	-1.1451	2.00	accept
$\Delta RER_{t-5,t-6}$	-0.66565	-2.7918	2.00	reject

$R^2 = 0.069718$

The results of NYK are consistent with those of MOL. However, in this case, the nominal rates have a slightly better explanatory power than the real rates. In both cases the movement in exchange rates five months previously is significant at the 95% level.

Table 5.6a: Regression of Total Returns on Nominal Exchange Rate Movements: K Line

Dependent Variable K Line Total Returns

106 observations 1990M8 to 1999M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.0025640	-0.19382	2.00	accept
$\Delta ER_{t-5,t-6}$	-1.0280	-2.8427	2.00	reject

$R^2 = 0.072098$

Table 5.6b: Regression of Total Returns on Real Exchange Rate Movements: K Line

Dependent Variable K Line Total Returns

106 observations 1990M8 to 1999M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.0004692	-0.03547	2.00	accept
$\Delta RER_{t-5,t-6}$	-1.0916	-2.8066	2.00	reject

$R^2 = 0.070409$

K Line results in table 5.6 confirm the same five month lagged relationship for both nominal and real rate movements, with the real exchange rate model showing a higher coefficient of determination.

The results for Navix and Showa are less convincing than those of the other three companies. In both cases there were no significant exchange rate variables for either the nominal or the real rates.

This investigation into the impact of exchange rate movements on the total returns on shares shows surprising results. In three out of the five cases, it is exchange rate changes of

five month ago which affect the current returns. Furthermore, the coefficients of this five month lagged variable is relatively large in all cases, ranging between -0.66 and -1.09. Particularly interesting is the positive effect on returns caused by an appreciation in the Yen against the US Dollar. It is especially difficult to explain this result in the context of the shipping industry, where an appreciation of the domestic currency has a detrimental effect on profits, except in the context of signifying a healthy economic and business environment. This phenomenon is explored later in the chapter with an analysis of the sub periods which examine the possible impact of the Asian Crisis on business confidence.

Stage 4: Regression of Abnormal Returns against Exchange Rate Changes

This stage investigates whether these movements in exchange rates are priced by the market. An assessment of this is made by regressing *abnormal* returns against exchange rate movements. As in stage 3, the statistics used to measure the relationship are the R^2, the coefficient of determination, and the t values of the coefficients of the exchange rate variables.

The final regression of abnormal returns against share returns is run using the data from 1990 to 1999. The fitted or expected values from stage 2 are then subtracted from the actual return for the period, to give an abnormal return. This abnormal return is regressed against the changes in the rate of exchange, both nominal and real, to determine the part played by these movements in explaining the unexpected return. Significant t values for the coefficients of the change in the exchange rate would suggest that they are not considered by the market in determining the share price and thus can explain the abnormal return.

The number of observations for this analysis is smaller than in stage 3 because the earlier data were used to establish the expected values.

The regression is performed for the three companies which had significant variables in the regressions in stage 3, MOL, NYK and K Line. Navix and Showa were excluded from the analysis, since exchange rate movements were shown in stage 3 to have no impact on the returns on shares. The results are shown in tables 5.7 to 5.9. For each company two tables are given, one for the nominal exchange rates and the other for the real exchange rates.

Table 5.7a: Regression of Abnormal Returns on Nominal Exchange Rate Movements: MOL

Dependent Variable MOL Abnormal Returns

90 observations 1992M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.18135	-2.4869	2.00	reject
$\Delta ER_{t-5,t-6}$	-0.0033428	-1.9233	2.00	accept

$R^2 = 0.044433$

Table 5.7b: Regression of Abnormal Returns on Real Exchange Rate Movements: MOL

Dependent Variable MOL Abnormal Returns

90 observation 1992M2 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.017319	-2.3825	2.00	reject
$\Delta RER_{t-5,t-6}$	-0.42805	-2.0871	2.00	reject

$R^2 = 0.047165$

The regressions for MOL show different results for the nominal and real exchange rate changes. In the case of nominal movements, the five month lagged change is not significant in explaining the current abnormal returns. This indicates that the market prices this factor. However, the real exchange rate movement five months previously is significant in explaining abnormal returns, which suggests that this factor is not taken into consideration by the market and thus leads to abnormal return.

Table 5.8a: Regression of Abnormal Returns on Nominal Exchange Rate Movements: NYK

Dependent Variable NYK Abnormal Returns

90 observations 1992M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.0011519	0.18260	2.00	accept
$\Delta ER_{t-5,t-6}$	-0.23079	-1.3912	2.00	accept

$R^2 = 0.021519$

Table 5.8b: Regression of Abnormal Returns on Real Exchange Rate Movements: NYK

Dependent Variable NYK Abnormal Returns

90 observation 1992M2 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.0016380	0.26009	2.00	accept
$\Delta RER_{t-5,t-6}$	-0.24645	-1.3870	2.00	accept

$R^2 = 0.021393$

For NYK, there are no significant variables at the 95% level of confidence. The five month movements are therefore built into market expectations of the share price returns.

Table 5.9a: Regression of Abnormal Returns on Nominal Exchange Rate Movements: K Line

Dependent Variable K Line Abnormal Returns

90 observations 1992M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.022606	-2.3291	2.00	accept
$\Delta ER_{t-5,t-6}$	-0.47311	-1.8534	2.00	accept

$R^2 = 0.037570$

Table 5.9b: Regression of Abnormal Returns on Real Exchange Rate Movements: K Line

Dependent Variable K Line Abnormal Returns

90 observations 1992M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.021608	-2.2281	2.00	reject
$\Delta RER_{t-5,t-6}$	-0.49541	-1.8106	2.00	accept

$R^2 = 0.035915$

The K Line regressions are consistent with NYK. The five month lagged exchange rate movement is not significant in explaining the current abnormal share price return.

The regressions of abnormal returns against changes in the exchange rate of three companies show little evidence that the change in the real exchange rate five months ago has an impact on the current level of abnormal returns, suggesting that this factor is priced by the market. In all three cases, the results using nominal and real rates are consistent, the exception being MOL, where the real rates movements five months previously are shown to be significant in explaining current abnormal returns.

Sub Period Analysis: Pre and Post Asian Crisis

The data was divided into two sub periods, pre and post the Asian Crisis to examine whether this can provide an explanation for the surprising results obtained in stage 3. The impact of the Asian Crisis on the Yen was felt in June 1997 with a ?% depreciation in one month. The sub periods therefore comprise 82 observations from August 1990 to May 1997 (pre Crisis) and 25 observations from June 1997 to June 1999 (post Crisis). The results presented in Tables 5.10 to 5.13.

Pre Asian Crisis

Table 5.10a: Pre Asian Crisis Regression of Total Returns on Nominal Exchange Rate Movements: MOL

Dependent Variable MOL Total Returns

82 observations 1990M8 to 1997M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.00761	-0.0690	2.00	accept
$\Delta ER_{t-3,t-4}$	0.78032	2.1911	2.00	reject

$R^2 = 0.056612$

Table 5.10b: Pre Asian Crisis Regression of Total Returns on Real Exchange Rate Movements: MOL

Dependent Variable MOL Total Returns

82 observations 1990M8 to 1997M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.00926	-0.8447	2.00	accept
$\Delta RER_{t-3,t-4}$	0.88835	2.2693	2.00	reject

$R^2 = 0.060478$

Table 5.11a: Pre Asian Crisis Regression of Total Returns on Nominal Exchange Rate Movements: NYK

Dependent Variable NYK Total Returns

82 observations 1990M8 to 1997M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.00903	-0.95798	2.00	accept
$\Delta ER_{t-3,t-4}$	0.63756	2.09630	2.00	reject

$R^2 = 0.05207$

Table 5.11b: Pre Asian Crisis Regression of Total Returns on Real Exchange Rate Movements: NYK

Dependent Variable NYK Total Returns

82 observations 1990M8 to 1997M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.01036	-1.1079	2.00	accept
$\Delta RER_{t-3,t-4}$	0.73337	2.1947	2.00	reject

$R^2 = 0.056788$

Table 5.12a: Pre Asian Crisis Regression of Total Returns on Nominal Exchange Rate Movements: K Line

Dependent Variable K Line Total Returns

82 observations 1990M8 to 1997M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.005457	-0.3838	2.00	accept
$\Delta ER_{t-3,t-4}$	0.88763	1.9344	2.00	reject

$R^2 = 0.044685$

Table 5.12b: Pre Asian Crisis Regression of Total Returns on Real Exchange Rate Movements: K Line

Dependent Variable K Line Total Returns

82 observations 1990M8 to 1997M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.00733	-0.5189	2.00	accept
$\Delta RER_{t-3,t-4}$	1.00580	1.9928	2.00	accept

$R^2 = 0.047293$

Table 5.13a: Pre Asian Crisis Regression of Total Returns on Real Exchange Rate Movements: Showa

Dependent Variable Showa Total Returns

82 observations 1990M8 to 1997M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00994	0.8111	2.00	accept
$\Delta ER_{t-3,t-4}$	0.93318	2.3590	2.00	reject

$R^2 = 0.065036$

Table 5.13b: Pre Asian Crisis Regression of Total Returns on Real Exchange Rate Movements: Showa

Dependent Variable Showa Total Returns

82 observations 1990M8 to 1997M5

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00789	0.6451	2.00	accept
$\Delta RER_{t-3,t-4}$	0.98047	2.2432	2.00	reject

$R^2 = 0.059176$

The regressions showed significant variables for MOL, NYK and Showa. It is interesting that the results are so different from those in stage 3. In this pre Asian Crisis analysis, the

significant lag is a three month one in all the regressions shown both for nominal and real exchange rate movements. Particularly important is the fact that in all cases a depreciation in the Yen against the Dollar has a positive impact on share price returns. For the shipping industry, this situation is more plausible.

Post Asian Crisis

The next sub period examines the experience during and post the Crisis, a period of depreciation of the Yen, followed by recovery. The depreciation began in June 1997 and this is taken as the start of this period. Unfortunately the data set is much smaller in this analysis with only 25 observations, but the outcomes are consistent. These results are presented in Tables 5.14 to 5.16.

Table 5.14a: Post Asian Crisis Regression of Total Returns on Nominal Exchange Rate Movements: MOL

Dependent Variable MOL Total Returns

25 observations 1997M6 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.01634	0.6865	2.00	accept
$\Delta ER_{t-5,t-6}$	-1.38100	-2.9960	2.00	reject

$R^2 = 0.28071$

Table 5.14b: Post Asian Crisis Regression of Total Returns on Real Exchange Rate Movements: MOL

Dependent Variable MOL Total Returns

25 observations 1997M6 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.01861	0.7768	2.00	accept
$\Delta RER_{t-5,t-6}$	-1.43240	-2.9361	2.00	reject

$R^2 = 0.27263$

Table 5.15a: Post Asian Crisis Regression of Total Returns on Nominal Exchange Rate Movements: NYK

Dependent Variable NYK Total Returns

25 observations 1997M6 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.00113	-0.07790	2.00	accept
$\Delta ER_{t-5,t-6}$	-0.91575	-3.2610	2.00	reject

$R^2 = 0.31617$

Table 5.15b: Post Asian Crisis Regression of Total Returns on Real Exchange Rate Movements: NYK

Dependent Variable NYK Total Returns

25 observations 1997M6 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00035	0.0237	2.00	accept
$\Delta RER_{t-5,t-6}$	-0.93530	-3.1228	2.00	reject

$R^2 = 0.29775$

Table 5.16a: Post Asian Crisis Regression of Total Returns on Nominal Exchange Rate Movements: K Line

Dependent Variable K Line Total Returns

25 observations 1997M6 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.02413	0.8521	2.00	accept
$\Delta ER_{t-5,t-6}$	-1.82030	-3.3194	2.00	reject

$R^2 = 0.32390$

Table 5.16b: Post Asian Crisis Regression of Total Returns on Real Exchange Rate Movements: K Line

Dependent Variable K Line Total Returns

25 observations 1997M6 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.02703	0.9355	2.00	accept
$\Delta RER_{t-5,t-6}$	-1.8338	-3.1156	2.00	reject

$R^2 = 0.29679$

The results of these post Crisis regressions show the same result as the whole period data. In all three cases, MOL, NYK, and K Line the five month lagged movement in the exchange rate is significant and furthermore is negative, indicating an appreciation in the Yen against the Dollar. Again, there are no significant variables in the regressions for Navix and Showa. It appears from this result that the post Crisis data is distorting the whole data set used in stage 3. Post the Asian Crisis, the appreciating Yen is a signal of a better economic and business climate which has a positive effect on share prices, despite the fact that it is has a negative impact on the profitability of the shipping industry.

Conclusion

This investigation of exchange rate movements, with reference to both nominal and real rates, in relation to share price returns, shows no evidence of a contemporaneous link. However, there is convincing evidence of a lagged relationship between the variables. In the case of the three largest companies the exchange rate movement five months previously is shown to be significant for the current return on shares. The results using nominal rates and real rates are not significantly different.

In examining the ability of the exchange rate movements to explain abnormal returns, two of the same three companies show no relationship between the nominal exchange rate movement five months ago and the current abnormal return as measured against a market model. This result suggests that such a movement in the exchange rate is taken into account by the market in the pricing of the company shares and thus abnormal returns cannot be made from knowledge about exchange rate risk. The exception was MOL, where the real rate movement Five months ago was a significant variable in the regression.

The direction of the movement is also surprising, since it is a past appreciation in the Yen which has a positive effect on the share price returns. This is counter intuitive, when one considers that the operation is Dollar based, and that an appreciation in the Yen leads to falling Yen revenues and, ultimately, profits.

A number of explanations may be put forward to explain this phenomenon. First, as shown in chapter 4[10], there is considerable natural hedging on the part of the Japanese

companies, since they have adopted a policy of transferring as many costs as possible into Dollars in order to reduce their exposure. Thus, though less well placed to take advantage of a depreciating Yen, a well hedged business will be insulated from the harmful effects of an appreciating Yen. This may explain a neutral impact of an appreciation of the domestic currency, but not necessarily a positive one. A possible reason could be that a strong domestic currency is often a reflection of a healthy economy and it is this fact which is being reflected by the change in the exchange rate.

To this end it was decided to test this impact of business confidence by an examination of the data pre and post the Asian Crisis of 1997. The data was therefore divided into two sub periods and the regressions of exchange rate movements on share price returns repeated for each period. The outcome was important in explaining the performance of the Japanese company share in terms of exchange rate movements. Before the Asian Crisis, a depreciation in the Yen three months ago had an impact on the current performance of share price returns. This is a logical result since a depreciation in the Yen against the Dollar in the shipping industry enables exchange gains to be made. Post the Asian Crisis however, this effect is distorted by the general level of business confidence. The results show that an appreciation in Yen five months previously has a positive impact on today's share price return. It appears that, in this period of market turmoil, the general economic climate was paramount in perception of performance by the market. It will be interesting to see if this phenomenon continues following the period of recovery in Japan.

Endnotes

[1]As previously stated, the 'Big 5' comprise MOL, NYK, K Line, Navix and Showa.

[2] The 'Big 5'account for a high percentage of operating revenue of the whole Japanese industry. The figures are quoted in Chapter 4, Table 4.1.

[3]Bartov, E. and Bodnar, G. M. (1994) Firm Valuation, Earnings, Expectations, and Exchange Rate Exposure Effect, *Journal of Finance* ,44 (5), pp. 1755-85, Jordan, P. (1990) The exchange rate exposures of US Multinationals, *Journal of Business*, 63,pp 353-376., Amihud, Y. (1993) Evidence on exchange rates and valuation of equity shares, in Amihud, Y., and Levich, R., eds., *Exchange Rates and Corporate Performance*, Business One Irwin, Homewood, Illinois, USA., and Bodnar, G. M., and Gentry, W. M. (1993) Exchange Rate Exposure and Industry Characteristics: Evidence from Canada, Japan, and U.S., *Journal of International Money and Finance*, 12, pp.29-45.

[4] See page 57.

[5] Box, G. E. P. and Pierce, D. A. (1970) Distribution of Residual Autocorrelations in Autoregressive Integrated Moving Average Time Series Models, *Journal of American Statistical Association*, 65, December, 1509-26.

[6] Dickey, D.A. and W.A. Fuller (1979) Distribution of the Estimators for Autoregressive Time Series with a Unit Root, *Journal of the American Statistical Association*, 74, pp. 427-31. Dickey, D. and Fuller, W. (1981) Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root, *Econometrica*, 49, pp. 1057-1072.

[7] MacKinnon, J.G. (1991) Critical Values for Cointegration Tests, Ch. 13, in *Long-Run Economic Relationships: Readings in Cointegration*, eds Engle, R. F and Granger, C.W.J., Oxford University Press, Oxford.

[8] The Topix Index is a market index of shares on the Tokyo Stock Exchange. Since the companies under investigation are quoted on the Tokyo Exchange, this is the appropriate market index here.

[9] See page 87.

[10] See page 88-91.

PART C: The Norwegian Experience

Chapter 6: Operating profit

Chapter 7: Returns on Shares

Chapter 6

Operating Profits

Introduction

This chapter analyses the potential effects of fluctuations in the Krone/US$ exchange rate on the operating results of the Norwegian shipping industry. The availability of data enables an analysis on an aggregate level for the entire Norwegian owned and registered fleet, using data from the Official Statistics of Norway. The approach, as detailed in Chapter 3, requires three stages. The first stage is to examine the Krone/US$ exchange rate volatility during the past decade and to calculate the standard deviations for each year as the measure of dispersion. Stage two sets out to estimate the level of exposure, i.e. the net US Dollar revenues. This is the level of exposure which arises from the necessity to convert US Dollar revenues into other currency denominations, in order to meet the various non-Dollar expenses. In the case of Norway, exposure levels have been assessed on the basis of official statistics and extensive interviews with directors of companies, maritime organisations and financiers (see schedule of meetings in Appendix 2). Finally, the potential movement in operating profit may be calculated by applying the volatility measures, obtained in stage one, to the exposed net revenues. This is achieved by examining the effect on profit of 1.96 standard deviation of exchange rate change either side of the average rate in order to give the variation at a 95% confidence level.

The Chapter begins with a brief analysis of the Norwegian shipping industry in order to illustrate its significance for world shipping and the domestic economy. It also discusses various policies which have been recently adopted, and which have made an impact on the cost structures of the companies operating within the industry.

The Norwegian Shipping Industry

Norway plays a key role in world shipping, controlling 10% of the world fleet, which represents approximately 1,400 vessels, totalling 48 million dead-weight tons. This fleet provides for a diverse range of cargoes: crude oil, coal, cars, chemicals, gas, and cruise passengers. Chemical and gas tankers have become a particular specialism for Norwegian shipowners, who control around 20% of the world fleet in this area.[1]

The importance of the maritime industry for the Norwegian economy is illustrated by figures for Gross Domestic Product. In 1993 transport and communications accounted for 10.2% of Gross Domestic Product, to which water transport contributed 3.1%. Furthermore, the shipping industry in the same year generated 15% of Norwegian exports, worth 47 billion Norwegian Krone.[2] In terms of employment, the number of Norwegian seafarers in domestic and foreign fleets totals 16,000, and the number of foreign nationals on board Norwegian ships is 48,000. Employment ashore, directly dependent on the shipping industry, is estimated at 60,000 jobs[3].

The present situation represents a dramatic improvement on that of the mid 1980s, when the industry had been crippled by rising costs and competition from the other flags, notably those of Liberia and Panama. The rules and regulations applying ships registered under these flags were such, that companies could significantly reduce their costs, and many Norwegian owners, therefore, chose to re-register under these flags.

Dramatic policy changes were needed in response to this trend. New technology and operating methods were employed to lower operating costs, and companies tried to establish niche markets where superior expertise was required. A real turning point arrived in 1987 when the trend of flagging out was halted by the establishment of the Norwegian International Ship Register (NIS), which allowed the Norwegian companies to compete on equal terms with other flag states. For example, it enabled them to employ non-Norwegian seaman and pay them wages negotiated in their home countries. In consequence, during the two years following this policy change, the tonnage under the Norwegian flag trebled.

Another significant change has been the recent introduction of a new shipping taxation system. The new regime replaced a corporate tax with a tonnage based model. As a result, ships owned by the companies based in Norway can defer tax until a dividend becomes payable. This has led to both a rise in the number of ships registered under the NIS flag and an increase in the amount of profits reinvested, rather than paid out as a dividend.

The industry has also become extremely important on the Oslo Stock Exchange; of the 236 companies listed on the Exchange (31 December 1998), 59 are shipping and offshore companies. Market capitalisation of the sector accounts for 24.6% of the total market capitalisation of the exchange[4].

Table 6.1 shows the operating results for the Norwegian registered, foreign-going fleet from 1990 to 1995. The focus here is on the more recent performance of the industry, although the latest aggregate results are for 1995. During this period the industry has consistently achieved earnings in excess of NKr 30 billion. After a peak in 1991 there was a fall of 12%, but the position has steadily improved since 1993.

Table 6.1: Operating Results: Norwegian Controlled, Foreign-Going Fleet (Millions Norwegian Krone)

	Norwegian flag			**Foreign flag[1]**			**Total**
	Op. earnings	Op. expend[2]	Op. results	Op. earnings	Op. expend[2]	Op. results	Op. results
1990	35 357	25 821	9 535	15 532	12 138	3 394	12 929
1991	37 323	26 881	10 444	16 662	13 452	3 209	13 653
1992	32 939	25 871	7 067	15 254	12 667	2 587	9 654
1993	34 674	27 011	7 663	15 563	12 819	2 744	10 407
1994	35 608	27 529	8 079	14 817	12 454	2 363	10 443
1995	34 183	25 850	8 333	14 067	11 903	2 164	not available

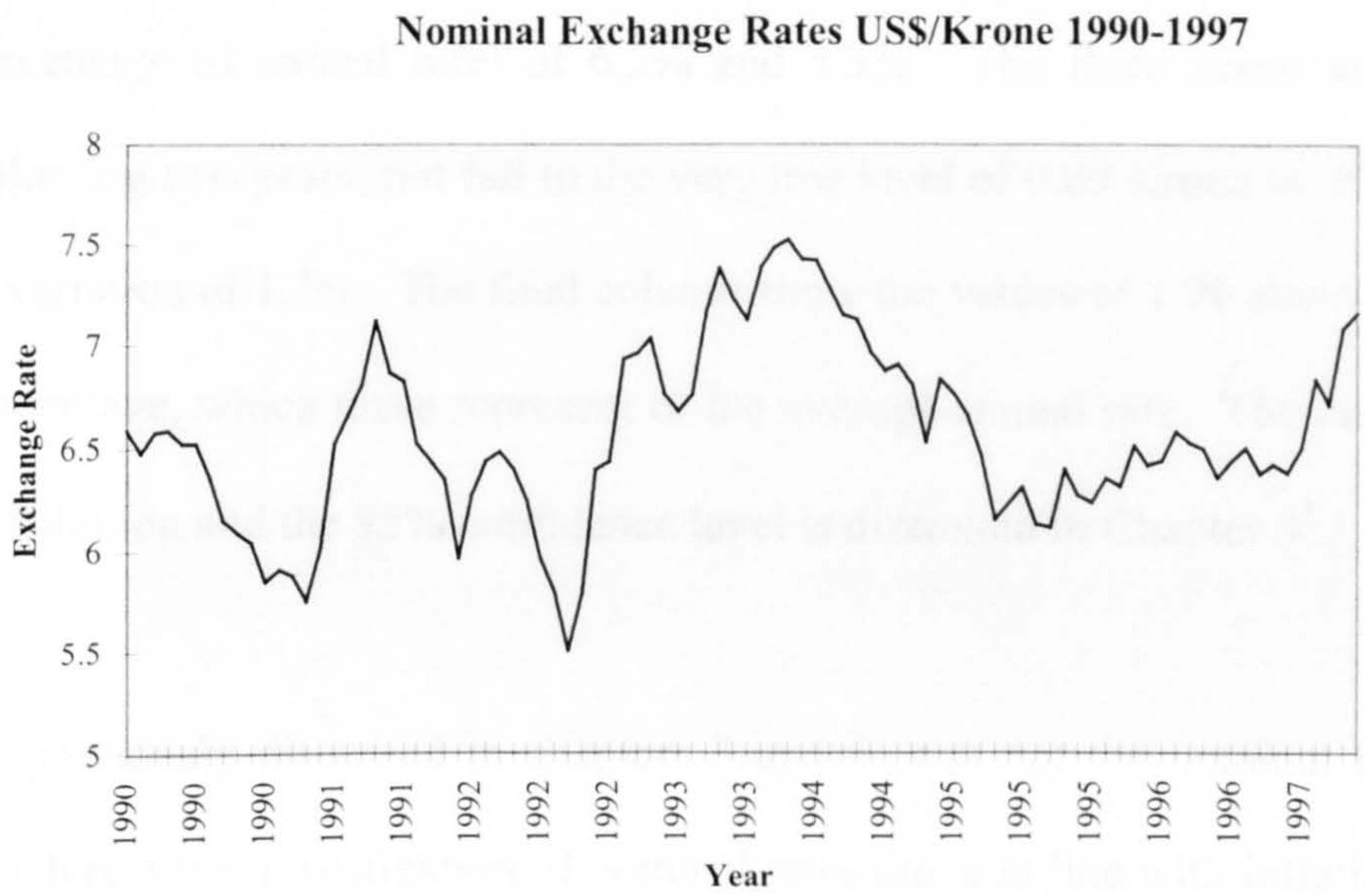
[1]Vessels controlled by Norwegians but operated under a foreign flag
[2]before depreciation.
Source: SSB Official Statistics of Norway.

These results have been converted to Krone, which has the effect of concealing the gains and losses arising from currency fluctuations. Each company faces varying degrees of risk, depending on its particular cost structure. The type of business dictates part of this structure. For example, deep-sea shipping inevitably means that most port dues are payable in currency other than Dollars. The nationality of the seafarers in many cases dictates the currency denomination of the wage bill. Administrative and managerial expenses depend on the location of the head office, which will mean a non-Dollar denominated liability. These effects will be examined in more detail later in the Chapter.

Exchange Rate Volatility

As previously discussed, the potential fluctuations in the operating results come from the interaction of volatile exchange rates on income which must be converted into other currencies. This section analyses those fluctuations in the Krone/US$ exchange rate. Figure 6.1 illustrates how the nominal rate has changed since 1990. The rate fluctuates around an average of 6.5 Krone to the Dollar, between a low point of 5.5 and high of 7.5 over the seven year period. The most prominent cycle is from the lowest point in 1992 to the high in 1993. This was followed by a marked appreciation of the Krone in 1994. Despite this cycle, there is no obvious trend in terms of long term appreciation or depreciation of the Krone/US$ rate, with both upward and downward movements maintaining a relatively consistent average rate for the period.

Figure 6.1:



The above volatility can be quantified by calculating the standard deviation around an average annual rate as in Table 6.2. This confirms what is shown in figure 6.1, with the considerable volatility of the early part of the decade settling down in the mid 1990s.

Table 6.2: Nominal Exchange Rate Volatility Krone/US$ 1990-1996

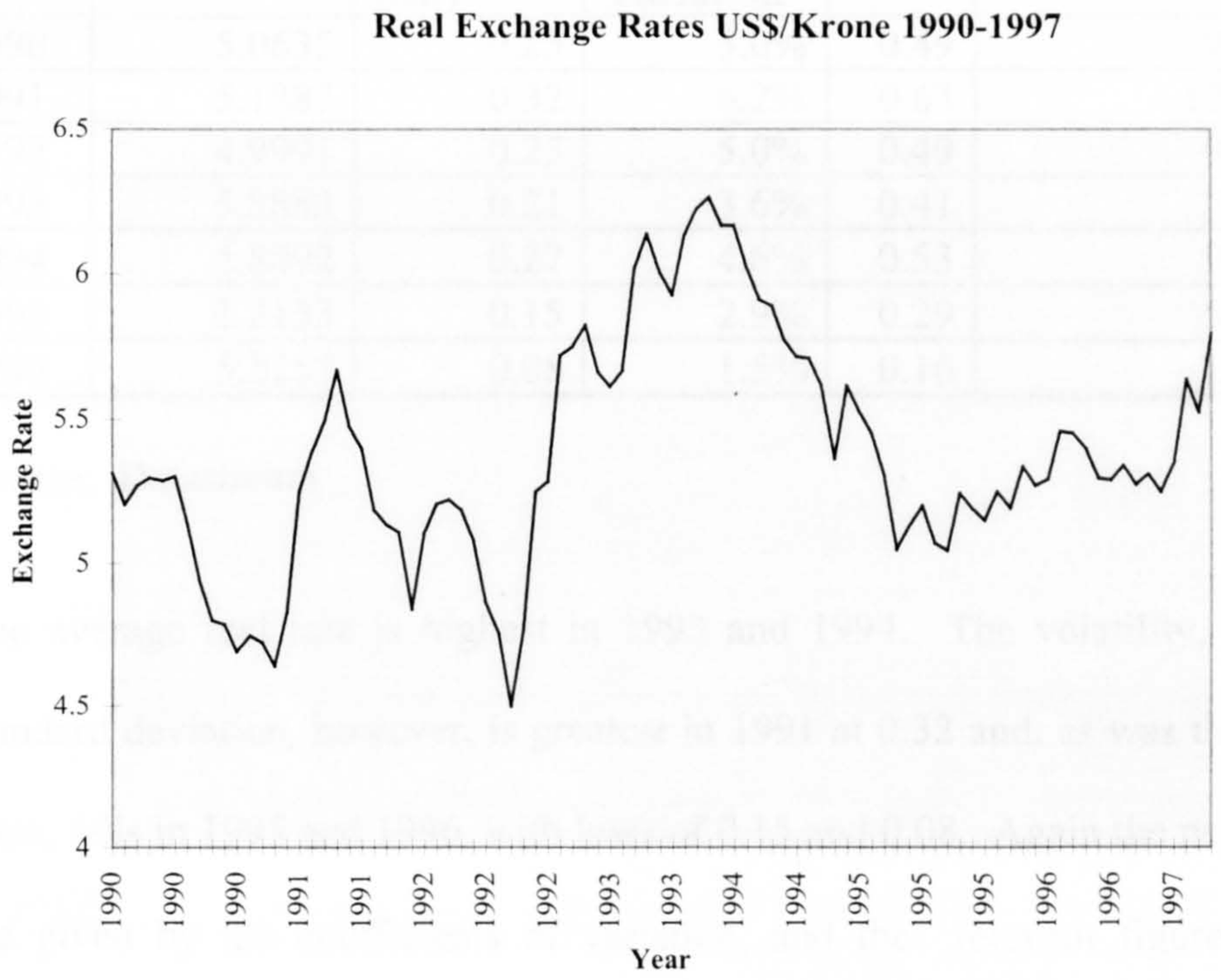
Year	Average Rate	Standard Deviation	Coefficient of Variation	1.96 SD	1.96 SD as % of average
1990	6.3084	0.28	4.4%	0.55	8.6%
1991	6.4824	0.42	6.5%	0.82	12.7%
1992	6.1429	0.33	5.3%	0.65	10.4%
1993	7.0758	0.27	3.8%	0.53	7.4%
1994	7.0724	0.30	4.2%	0.59	8.2%
1995	6.3450	0.20	3.2%	0.39	6.3%
1996	6.4524	0.09	1.2%	0.15	2.4%

Source: Datastream

The greatest volatility occurs in 1991 and 1992, as is seen by the standard deviations of 0.42 and 0.33 Krone and the respective coefficients of variation (standard deviation as percentage of annual rate) of 6.5% and 5.3%. The fluctuations are less marked in the following two years, but fall to the very low level of 0.09 Krone in 1996, with a coefficient of variation of 1.2%. The final column show the values of 1.96 standard deviations and the percentage, which these represent of the average annual rate. The rationale for the normal distribution and the 95% confidence level is discussed in Chapter 3[5].

As previously discussed in chapters 3 and 4, it is not the nominal rate, but the real rate which requires investigation. If nominal rates move in line with inflation differentials in the two countries, there is no change in the relative competitive position and real rates remain constant. Problems arise when this is not the case, as demonstrated by movements in the real rate of exchange[6]. These movements in the real rate (nominal adjusted by the producer price index for the two countries) are presented in Figure 6.2.

Figure 6.2



As in the case of the Yen, the volatility of the real Krone/US$ rate suggests that again exchange rate movements do not move in line with inflation differentials in the two countries. In fact, it can be seen from Figure 6.2 that the real rates show a similar pattern to that of the nominal ones, with a slightly lower level of volatility. The lowest point is around 4.5 Krone to the US Dollar and the highest around 6.3 Krone. The same short cycles are visible with no apparent long term trend. The calculations using these real rates are presented in Table 6.3.

Table 6.3: Real Exchange Rate Volatility Krone/US$ 1990-1996

	Average Rate	Standard Deviation (SD)	Coefficient of Variation	1.96 SD	1.96 SD as % of annual rate
1990	5.0635	0.25	5.0%	0.49	9.8%
1991	5.1887	0.32	6.2%	0.63	12.2%
1992	4.9991	0.25	5.0%	0.49	9.8%
1993	5.8883	0.21	3.6%	0.41	7.1%
1994	5.8492	0.27	4.6%	0.53	9.0%
1995	5.2133	0.15	2.9%	0.29	5.7%
1996	5.3257	0.08	1.5%	0.16	2.9%

Source: Datastream

The average real rate is highest in 1993 and 1994. The volatility, as measured by the standard deviation, however, is greatest in 1991 at 0.32 and, as was the case with nominal rates, falls in 1995 and 1996, with lows of 0.15 and 0.08. Again the percentage movements are given by the coefficients of variation, and the relevant figures for 1.96 standard deviations are shown in the final columns. Assuming a normal distribution of exchange rates, this suggests that 95% of the time the Krone/US$ exchange rate will be plus or minus this percentage of the average annual rate. For example, in 1992, the movement would be plus or minus 12.2% of 5.1887 Krone to the US Dollar.

In order to assess the impact of such exchange rate fluctuations on profitability, the measures of volatility obtained above must be applied to the exposed net Dollar revenues. This exposure is derived through analysis of the Dollar denominated operating revenues and the Dollar denominated operating expenditure. Because these net revenues must be converted into other currencies, primarily Krone, these are exposed to fluctuation in the real Krone/US$ exchange rate. In the case of Norway, these details have been obtained

through direct discussion with representatives of the Norwegian shipping industry (see Appendix 2 for list of meetings).

Cost Structures

Currency denomination has an important effect on revenue and cost structures. Such denominations are discussed in detail in what follows. The most recent aggregate statistics for Norway are for the years 1994 and 1995[7]. These official statistics detail the operating earnings and expenditure for Norwegian ships registered in the Norwegian foreign-going trade. Given that the majority of earnings are Dollar denominated, this analysis focuses on operating expenditure. Each category is analysed in turn, to assess its currency denomination. Although the time series under consideration is short, it is very detailed, and the intention is to show the most recent levels of exposure.

The aggregate operating expenditure figures from Table 6.1 are analysed by category and by currency denomination, and are shown in Table 6.4.

Table 6.4: Analysis of Operating Expenditure for Norwegian Flag, Foreign-going Ships (Millions Krone)

	1995				1994			
		Currency denomination				Currency denomination		
		US$ %	NKr %	Other %		US$ %	NKr %	Other %
Brokers' commission	783	100			879	100		
Voyage expenditure	5 481	41		59	6 024	41		59
Bunkers	2 365	100			2 386	100		
Wages and social	4 166	49	51		4 397	50	50	
Repairs & maintenance	3 142	100			3 077	100		
Time charter hire	5 956	100			6 192	100		
Administration	1 756		100		1 781		100	
Other	2 197		100		2 797		100	
Total	**25 846**	**64%**	**24%**	**12%**	**27 533**	**62%**	**25%**	**13%**

Source: Operating account (not currency denomination) SSB Official Statistics of Norway

In what follows, each type of expenditure detailed above is considered in turn.

Brokers' commission is always charged in US Dollars. Hence, no further analysis is required.

One of the major items of voyage expenditure is port dues, some of which are generally paid in the domestic currency of the port, for example, Dutch Guilders, Singapore Dollars, Sterling, Deutschmarks, and Japanese Yen. The currency required is determined, therefore, by the foreign port at which a Norwegian registered vessels arrives. Based on tonnage arriving in port, port dues are estimated at approximately 41% Dollar and 59%

non-Dollar denominated currency. This is illustrated in Table 6.5, which details the arrivals at foreign ports of Norwegian registered vessels. Though only data for 1994 are available, these nevertheless provide some basis for extrapolation of the 1995 port dues.

Table 6.5: Port dues based on arrivals at foreign ports 1994

	Tonnage 1000 gross tons	**As a Percentage**	**Percentage non-Dollar**
Europe	282 291	35	35
Africa	41 685	5	
North America	237 402	29	
South America	38 781	5	
Asia	200 199	24	24
Oceania	18 229	2	
Total	**818 589**	**100**	**59**

Source: SSB

In the case of bunkers, in other words, fuel costs, the Dollar is the main currency of settlement, and it is, therefore, assumed that such costs will be in US Dollars.

Wages and social expenditures have been divided between US Dollars and Krone, based on the number of Norwegian and foreign crew. The figures for 1995, based on information from the National Insurance Administration, are 16, 579 Norwegian crew and 16, 035 foreign crew. The 1994 figures are 15, 908 Norwegian and 15, 924 foreign. It can be assumed that the Norwegians are paid in Krone and other seafarers in US Dollars. The currency split based on these figures is, therefore, 51% Krone and 49% US Dollars for 1995 and a 50:50 split for 1994.

Repair and maintenance work uses a variety of currencies, but as far as possible shipowners try to ensure that the majority of this work is paid for in US Dollars. To claim that the US Dollar is the sole currency used would be an overstatement, but it would be fair to say that any small percentage chosen for non-Dollar expense would be purely arbitrary, and would not make a significant difference to the results. In this category 100% US Dollar costs are assumed.

Time charter hire costs are assumed to be 100% US Dollars, since freight rates are Dollar denominated.

The administrative and management function is based at the headquarters of the shipping companies, the majority of which are in the home country. Hence these costs will be paid exclusively in Krone.

The exact composition of the other expenses is not clear. However, examination of a number of financial statements of Shipping companies reveal that this includes substantial restructuring costs which are likely to be denominated in Krone.

Table 6.5 shows that in 1995 24% (1994, 25%) of operating expenditure was dependent on the Krone/US$ exchange rate. A further 12% in 1995 (13% in 1994) of operating expenditure was dependent on a variety of other exchange rates such as the Guilder/ US Dollar and Sterling/US Dollar. The net Dollar revenues can, therefore, be calculated as the

Dollar denominated operating revenues less the Dollar denominated operating expenditure, as illustrated in Table 6.6.

Table 6.6 Exposure (Millions NKr)

	1995	**1994**
Operating revenues Dollar based	34183	35608
Operating expenditure Dollar based	16534	17202
Net Dollar revenues	17649	18406
As % of Dollar Operating Revenue	51.6%	51.7%

Source: Calculations based on Official Statistics of Norway

The Table shows the levels of Dollar based revenue which is exposed to exchange rate fluctuations. For 1995 the figure is 17,649 Million Krone, and for 1994 18,406 Million Krone. For both years this represents around 52% of Dollar based operating revenues. The industry, therefore, maintains high levels of exposure to fluctuations in the value of the Krone. From discussions with the shipping community, it appears that this is a strategic decision, which allows it to use the exchange rate both as a hedging and a speculation tool.

Sensitivity of Operating Results

Given this degree of exposure, it is possible to calculate the potential impact of exchange rate volatility on operating results. Such a calculation is based on the percentage movement in the real rate, represented by plus or minus 1.96 standard deviations applied to the exposed flows. By this means, the impact on operating results can be derived at a 95% confidence level. The prime consideration is the exposure of the domestic currency to the Dollar, since the other currency denominations are a much less significant proportion of overall expenditure. The results are illustrated in Table 6.7.

Table 6.7 : Sensitivity of Exposed Flows to Fluctuations in the Krone/US$ Exchange Rate

Norway (Millions Krone)

	1995	**1994**
Exposure (net Dollar revenues)	17649	18406
1.96 standard deviations	0.39	0.59
Average annual rate	6.3450	7.0724
1.96 standard deviations as percentage of average annual rate	6.272%	8.232%
impact on exposed net revenues	1106.95	1515.18

Source: Derived from own calculations

The calculations apply the measures of real exchange rate volatility from Table 6.3 to the net Dollar revenues obtained from Table 6.6. It can be seen that a relatively small change in the rate of exchange can have a dramatic effect on the results. For 1995, it meant a plus

or minus 1107 Million Krone change in operating results, and for 1994 a 1515 Million Krone difference. The impact on profitability is further confirmed, by calculating the movements as a percentage of operating profits as in Table 6.8.

Table 6.8: Potential fluctuations in the operating flows, as a percentage of operating profit

	1995	**1994**
Operating profit	8337	8076
Exchange Rate Fluctuations as percentage of operating profit	13.3%	18.8%

Source: Calculations from SSB Official Statistics of Norway data

Exchange rate volatility led to a +/-13.3% change in the operating profit for 1995 and +/-18.8% for 1994. These potential effects can be reduced by a variety of short term hedging techniques, such as the use of the forward exchange market, currency options and futures[8]. However, this analysis serves to illustrate the levels of exposure and their potential impact on the operating performance.

Conclusion

The objective of this chapter has been to measure the impact of exchange rate fluctuations on the operating performance of the Norwegian shipping industry. The results reflect both the exchange rate volatility, the high level of exposure and the low profit margins. The Krone has experienced no long term trend against the US Dollar, and as a result, the Norwegian shipping companies elect to maintain an exposure of approximately 52%, which allows them to speculate on favourable movements in the rate of exchange. The results show the degree to which these fluctuations do impact on the operating profits, and the importance of effective strategic management to minimise the downside exchange rate risk.

Endnotes

[1] information supplied by the Norwegian Shipowners' Association November 1997

[2] SSB: Official Statistics of Norway

[3] Information supplied by the Norwegian Shipowners' Association

[4] Information supplied by the Oslo Bourse

[5] It could be argued that exchange rates are more likely to conform to a 't' distribution due to the presence of extreme values. In this case, a 't' distribution based on monthly data for one year would mean a coefficient of 2.179 and would give a result 11% greater. However, an examination of the research on exchange rate risk reveals that the normal distribution is frequently used, notably, Jorion, P. (1991) The Pricing of Exchange Rate Risk in the Stock Market, *Journal of Financial and Quantitative Analysis*, 26(3), pp. 363-376, and Cheung, Y. (1993) Long Memory in Foreign Exchange Rates, Journal of Business and Economic Statistics, 11(1), pp. 93-102.

[6] The basis of this arguments lies in the theory of Purchasing Power Parity (PPP) theory which states that the general level of prices when converted to a common currency will be the same in every country, assuming no transactions costs. This may be expressed as:
$P^h = SP^f$, where P^h is the price level in the home country, P^f is the price level in the foreign country, and S is the exchange rate or the price of a unit of foreign currency measured in a unit of domestic currency. If the general level of prices is a reasonable estimate of cost of production in one country, then the ratio of price levels for any 2 countries will be a reasonable estimate of competitiveness. If PPP holds, then competitiveness as measured in this way would be constant and equalised across countries, and no country would have a price advantage. In practice international competitiveness has been far from constant and deviations from PPP are often measured using real exchange rates. The real exchange rate is the price of foreign relative to domestic goods and services. In other words, it is the nominal exchange rate corrected for relative prices, P^f/P^h. One of the problems with this absolute PPP is that prices are measured using an index. If different base dates are used for the different countries, the results will be distorted. In this analysis the base rates used are the same and therefore this is not an issue.

[7] Whilst other statistics are published for later years, 1996 figures for operating earnings and expenditure are not yet available at the time of writing.

[8] Discussion with financiers and treasury mangers in Norway revealed that such short term hedging, particularly using the forward market is common amongst the larger companies.

Chapter 7

Returns on Shares

Introduction

Having established that exchange rate fluctuations affect the operating results of the shipping industry, the next step is to investigate whether the same fluctuations have an effect on share price returns. As discussed in Chapter 2, research has shown that changes in the exchange rate have a significant effect on the performance of firms involved in international activities as measured by share prices or share price returns. Furthermore, there is more likely to be a 'lagged' relationship between the changes in value of the Dollar and the value of the firm, rather than a contemporaneous one.

The methodology employed here will be the same as that used for the Japanese companies. Again there are four stages. The first is to determine the stationarity of the variable in order to enable the modelling process. The second is to develop a market model for the establishment of an expected return. This is done more effectively than in the Japanese case since the Oslo exchange quotes prices for a higher proportion of shipping companies than the Tokyo exchange[1]. The third stage examines the possible relationships between log exchange rate movements and total share price returns. The fourth allows an investigation of whether the exchange rate exposure is priced by the market by means of regressing

abnormal returns against exchange rate movements. If this is the case, then the period over which abnormal earnings accrue can be explained by the past change in the value of the Krone against the Dollar. The analysis uses results of four quoted companies which are taken as representative of the industry. In terms of operating revenue, these companies account for 31.2% of the total Norwegian shipping industry revenues[2].

Stage 1: Stationarity

The first stage of the analysis is to test the stationarity of the variables using a Dickey Fuller test. As explained in Chapter 3[3], non stationary variables cannot be modelled because of their changing characteristics, unless they are made stationary through differencing. In order to do the stationarity tests, it is necessary to determine the order of the Dickey Fuller test. This involves testing the residuals from the Dickey Fuller regressions, using a Q test, to ensure that they are white noise errors. The Box Pierce calculated values[4] are compared to the critical values in the chi squared tables at K-p degrees of freedom, where k is the displacement, which should be high for low order equations, and p is the number of autoregressive lags.

Table 7.1a shows the results of the Q test for all the variables used, the nominal and real Krone/US$ exchange rate, the change in the nominal and real Krone/US$ exchange rate, share prices and returns for Bergesen, Leif Hoegh, Wilhelmesen, and Bona Shipholding. In each case K is taken as 21 and p as 1. The critical value in the chi squared tables for 20 degrees of freedom and 95% level of confidence is 31.41. The exception is Bona Shipholding which, due to less available data, has fewer degrees of freedom as indicated in the table. In each case the null hypothesis is that the residuals are white noise. A

calculated Box Pierce statistic less than the critical value means acceptance of this hypothesis, i.e. the residuals are white noise, and this regression can be used for the stationarity test. Rejection of the null hypothesis means that additional lags of the differenced variable must be added to augment the test.

Table 7.1: Q Tests

H_0 = errors of Dickey Fuller regression are white noise:
Critical Value = chi squared K-p degrees of freedom, K=21, p=1

Variable	**Box Pierce (calculated)**	**Critical Value**	**Accept/Reject**
Log Krone/$US Dollar nominal rate	23.6817	31.41	accept
Log Krone/$US Dollar real rate	17.7106	31.41	accept
ΔLog Krone/$US Dollar nominal rate	16.7492	31.41	accept
ΔLog Krone/$US Dollar real rate	15.7111	31.41	accept
Share Prices			
Bergesen	18.3606	31.41	accept
Leif Hoegh	7.6550	31.41	accept
Wilhelmsen	26.9391	31.41	accept
Bona	18.4092	26.30	accept
Share Price Returns			
Bergesen	7.6469	31.41	accept
Leif Hoegh	17.6394	31.41	accept
Wilhelmsen	16.2440	31.41	accept
Bona	8.9862	25.00	accept

In Table 7.1a, the null hypothesis is accepted in all cases, therefore, no more lagged variables need to be added, and the order of the Dickey Fuller test is 1.

Next the appropriate Dickey Fuller or Augmented Dickey Fuller test for stationarity is performed using an F test. This is done by running the unrestricted model and then restricting it to omit the trend and the lag of the variable. The number of restrictions is, therefore, two in all cases, but the number of variables differs according to the available data and the regressors vary according to the order of the test.

The null hypothesis is that the variable is non-stationary, more specifically that it follows a random walk. Where the calculated value is less than the critical values obtained from Dickey Fuller tables, then the null hypothesis is accepted. The results are shown in Table 7.2a. The calculated values of the F statistic are obtained from the following formula.

$$F = \frac{RSS_R - RSS_U / (q)}{RSS_U / (n-k)} \tag{7.1}$$

where RSS_R is the residual sum of squares of the restricted equation

RSS_U is the residual sum of squares of the unrestricted equation

n is the number of observations

k is the number of regressors

q is the number of restrictions

Table 7.2a: Dickey Fuller Tests (F)

H_0 = variable follows a random walk
Critical Value = $F_{q,n-k}$ in Dickey Fuller Table VI (see Appendix) (q is number of restrictions (2), n is number of observations (various), k is the number of regressors in original equation (4).

Variable	Order	Calculated F	Critical F (DF tables)	Accept/Reject
Log Krone/$US Dollar nominal rate	1	3.7893	6.49(149obs)	accept
Log Krone/$US Dollar real rate	1	3.6361	6.49(112obs)	accept
ΔLog Krone/$US Dollar nominal rate	1	22.8110	6.49(148obs)	reject
ΔLog Krone/$US Dollar real rate	1	23.3648	6.49(111obs)	reject
Share Prices				
Bergesen	1	3.1085	6.49(148obs)	accept
Leif Hoegh	1	3.448	6.49(148obs)	accept
Wilhelmsen	1	2.6626	6.49(148obs)	accept
Bona	1	3.9015	6.73 (50obs)	accept
Share Price Returns				
Bergesen	1	28.0085	6.49(147obs)	reject
Leif Hoegh	1	28.6061	6.49(108obs)	reject
Wilhelmsen	1	34.4323	6.49(147obs)	reject
Bona	1	10.3247	6.73 (50obs)	reject

The results show that the nominal and real Krone/$US Dollar exchange rates are both non-stationary, as are all the share prices. The differenced exchange rates are obtained from the change in the exchange rate, i.e. exchange rate at period 1 minus exchange rate at period 0. In both cases the differenced exchange rates are stationary. The non-stationary share prices are made stationary by taking the share prices returns, which fits into the methodology described in Chapter 3.

$$\text{Return} = \frac{\text{Share Price}_t - \text{Share Price}_{t-1}}{\text{Share Price}_{t-1}} \qquad (7.2)$$

For each share price the share price return is stationary.

Note that the returns data excludes dividends as these are typically very low in the shipping industry and certainly for the companies under investigation as illustrated by the dividend history in Appendix 7.

The results of the stationarity test, using F, are consistent with the t test, as shown in Table 7.2b. The critical values are taken from MacKinnon 1991[5]. This test examines the coefficient of the lagged variable, to determine whether it is 1 or above. If this is the case, then the variable is non-stationary.

Table 7.2b: Dickey Fuller Tests (t)

t test statistics (with trend critical values)
critical values from MacKinnon 1991[6]

Variable	Order of test	Calculated t	Critical t (DF t tables)	Accept/Reject
Log Krone/$US Dollar nominal rate	1	-2.8511	-3.4405	accept
Log Krone/$US Dollar real rate	1	-2.6666	-3.4501	accept
Log ΔKrone/$US Dollar nominal rate	1	-7.9431	-3.4407	reject
Log ΔKrone/$US Dollar real rate	1	-6.8360	-3.4504	reject
Share Prices				
Bergesen	1	-2.1949	-3.4407	accept
Leif Hoegh	1	-2.5963	-3.4407	accept
Wilhelmsen	1	-2.3066	-3.4407	accept
Bona	1	-0.64068	-2.28825	accept
Share Price Returns				
Bergesen	1	-7.4845	-3.4409	reject
Leif Hoegh	1	-7.5499	-3.4515	reject
Wilhelmsen	1	-8.2988	-3.4409	reject
Bona	1	-3.6714	-2.9378	reject

Table 7.2b shows that the results, using the t tests, are consistent with those using an F test in Table 7.2a in all cases.

This first stage has determined the stationary properties of the variables and, where necessary, the order of homogeneity. The exchange rates were made stationary by taking first differences, the share prices by the use of share price returns which is essentially a first

difference. These stationary variables can then be used in the regression processes in stages 2 and 3 and 4.

Stage 2: The Market Model

As discussed in Chapter 5[7], the market model is essentially a statistical regression which indicates a relationship between returns on a particular investment and the returns on a market index. The share price data and the relevant market indices are used to generate returns for each company. This data is then used in the market model regression to generate a model for the expected returns of the investment. Abnormal returns are then calculated by taking the difference between actual and expected returns for this period.

These abnormal returns are not anticipated and may be explained by a number of factors, one of which for an international business is the change in the rate of exchange, which would suggest that exchange rate changes are not priced by the market.

The Norwegian stock exchange all share index was used to calculate the market returns. The market model could then be used to calculate the abnormal returns for the more recent data. As far as possible, five years of monthly data observations from 1987 to 1991 were used to establish the market model. The results were then used to calculate the abnormal returns from 1992 to 1999 in Tables 5 and 6. The exception was Leif Hoegh where, due to poor data availability, only 44 observations were used. Abnormal returns were then calculated for the period 1994 to 1999. Bona Shipholding was excluded from the analysis because of insufficient data. Share prices were only available from 1995 and this meant

that the number of observations were not enough to establish a market model and use it for predictive purposes.

The market models for each company's share price returns are shown in Tables 7.3a to 7.3d. In each case the coefficient, the t statistic for the coefficient, and the R^2 are calculated.

Table 7.3a: Market Model Bergesen

59 observations 1987M2 to 1991M12

	Coefficient	t calculated	t critical (95%)	accept/reject
α	+0.01756	2.0823	**2.00**	**reject**
β	+0.91937	10.2403	**2.00**	**reject**

$R^2 = 0.64785$

Table 7.3b: Market Model Leif Hoegh

44 observations 1990M5 to 1993M12

	Coefficient	t calculated	t critical	accept/reject
α	+0.01288	**1.2367**	**2.00**	**accept**
β	+0.82806	**8.2153**	**2.00**	**reject**

$R^2 = 0.61641$

Table 7.3c: Market Model Wilhelmsen

59 observations 1987M2 to 1991M12

	Coefficient	t calculated	t critical	accept/reject
α	+0.0071	0.5650	**2.00**	**accept**
β	+1.2495	9.2933	**2.00**	**reject**

$R^2 = 0.60241$

All cases show a high R^2 exceeding 60%. This is because shipping companies represent a high proportion of companies listed on the Oslo exchange. In December 1998, for example, the market capitalisation of the maritime companies was 26.4% of the total market capitalisation of the exchange[8]. For all models, the coefficient of the index is a significant variable at the 95% level, as measured by the t statistic. Although the coefficients of the market index are different in each case, all are around 1, suggesting that the returns move with the market itself.

The market model developed using data from 1987 to 1991 can then be used to give an expectation for 1992 to 1999 as the basis for the regression test in stage 4.

Stage 3: Regression of Total Returns against Exchange Rate Changes

This stage examines the relationship between total returns on the shares and movements in the log of the exchange rate. Significant coefficients for the exchange rate movements indicate that they do have explanatory power. In other words, exchange rate changes have an impact on the share price return. The analysis is performed, using both nominal and real exchange rates, for each of the four companies. As before, the relevant statistics are R^2 and t. The results are shown in Tables 7.4 to 7.8. The calculations are based on lags of

exchange rate movements of up to 6 months, since no significant lags were found after this period.

Table 7.4a: Regression of Total Returns on Nominal Exchange Rate Movements: Bergesen

Dependent Variable Bergesen Returns

107 observations 1990M8 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.00253	-0.2816	2.00	accept
$\Delta ER_{t,t-1}$	0.75359	2.5247	2.00	reject
$\Delta ER_{t-2,t-3}$	0.74999	2.5212	2.00	reject

$R^2 = 0.11098$

Table 7.4b: Regression of Total Returns on Real Exchange Rate Movements: Bergesen

Dependent Variable Bergesen Returns

107 observations 1990M8 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.00257	-0.2880	2.00	accept
$\Delta RER_{t,t-1}$	0.78265	2.6056	2.00	reject
$\Delta RER_{t-2,t-3}$	0.82299	2.7550	2.00	reject

$R^2 = 0.12386$

In the case of Bergesen, the results show a slightly better R^2 for the real exchange rate model compared to the nominal exchange rate model. In both regressions, however, the change in exchange rate in the last month and two months ago are significant variables, as measured by the statistics at 95% confidence level. The nominal rate model indicates that 75% of the change in the last month's exchange rate and 75% of the change in the rate two

month previously affects the total returns. The coefficients for the real rate are higher, showing the significance for total returns of 78% of the change in the last month's rate and 82% of the change in the rate two months ago.

Table 7.5a: Regression of Total Returns on Nominal Exchange Rate Movements: Leif Hoegh

Dependent Variable Leif Hoegh Returns

107 observations 1990M8 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00439	0.5323	2.00	accept
$\Delta ER_{t,t-1}$	0.63366	2.3171	2.00	reject
$\Delta ER_{t-2,t-3}$	0.56016	2.0552	2.00	reject

$R^2 = 0.085973$

Table 7.5b: Regression of Total Returns on Real Exchange Rate Movements: Leif Hoegh

Dependent Variable Leif Hoegh Returns

107 observations 1990M8 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00440	0.5358	2.00	accept
$\Delta RER_{t,t-1}$	0.64644	2.3391	2.00	reject
$\Delta RER_{t-2,t-3}$	0.60082	2.1860	2.00	reject

$R^2 = 0.091542$

The R^2 achieved for Leif Hoegh in tables 7.5a and 7.5b, although lower than those observed for Bergesen, again show a higher value for real rates. The results of both companies show that the same two variables, namely, the current log change in exchange rates and the log change two months ago, are significant, but with lower coefficients. In the case of Leif Hoegh, the nominal rate regression indicates that 63% of the change in the log of last month's exchange rate and 56% of the change in the log rate two month earlier

affect the total returns. For the real rates, 65% of the change in the log of last month's rate and 60% of the change in the log rate two months ago is significant for the returns.

Table 7.6a: Regression of Total Returns on Nominal Exchange Rate Movements: Wilhelmsen

Dependent Variable Wilhelmsen Returns

107 observations 1990M8 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00735	0.39119	2.00	accept
$\Delta ER_{t,t-1}$	1.1571	3.14650	2.00	reject

$R^2 = 0.093346$

Table 7.6b: Regression of Total Returns on Real Exchange Rate Movements: Wilhelmsen

Dependent Variable Wilhelmsen Returns

107 observations 1990M8 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00730	0.6919	2.00	accept
$\Delta RER_{t,t-1}$	1.22400	3.4470	2.00	reject

$R^2 = 0.10165$

The Wilhelmsen results differ from the previous two in that only the contemporaneous change in the log exchange rate is a significant variable, and coefficient are higher at 1.16 and 1.22.

Table 7.7a: Regression of Total Returns on Nominal Exchange Rate Movements: Bona

Dependent Variable Bona Returns

53 Observations 1995M2 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00376	0.4793	2.00	accept
$\Delta ER_{t,t-1}$	0.50438	1.6233	2.00	accept
$\Delta ER_{t-2,t-3}$	0.55245	1.7884	2.00	accept

$R^2 = 0.10092$

Table 7.7b: Regression of Total Returns on Real Exchange Rate Movements: Bona

Dependent Variable Bona Returns

53 Observations 1995M2 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	0.00418	0.5325	2.00	accept
$\Delta RER_{t,t-1}$	0.49698	1.5776	2.00	accept
$\Delta RER_{t-2,t-3}$	0.58054	1.8574	2.00	accept

$R^2 = 0.098589$

Though with Bona Shipholding the number of observations is reduced, this is still sufficient to perform a meaningful regression. In this case the R^2 is higher for the nominal rate regressions, but again the current change and change two months previously are significant variables. The significant coefficients in the nominal model are 0.50 and 0.55. In the real rate regression they are 0.50 and 0.58.

The results show a significant relationship in all cases between contemporaneous movements in both the nominal and real exchange rates and current share price returns.

For three of the companies the change in the exchange rate two months earlier is also a significant variable. The direction of movement as expected is such that a depreciation in the Krone against the US$ has a positive effect on returns. This result is not surprising, when one takes account of the levels of exposure maintained by the Norwegian companies, as discussed in Chapter 6[9]. Though this means that they can take advantage of a favourable depreciation in the exchange rate, an appreciation in the Krone will have a negative affect on share price returns. The change in the exchange rate two months previously is consistent with previous studies on multinational business, which have found that the effect is not current, but lagged[10]. In the case of these shipping companies, however, the more convincing evidence points to a contemporaneous link.

Stage 4: Regression of Abnormal Returns against Exchange Rate Changes

The previous analysis examined whether the change in the rate of exchange has any explanatory power for the total returns on shares. This final stage investigates whether the changes in the log of the exchange rate are priced by the market. Results are obtained by regressing abnormal or unexpected returns against the exchange rate changes. If the coefficients are significant, then the exchange rate can explain unanticipated returns, suggesting that they are not priced.

The market models from stage 2 are used to develop the expectation based on data to 1991. This line of best fit is then used to derive an expectation for the subsequent period from 1992-1999. The abnormal returns for this period are calculated as the difference between the actual and fitted values.

For three companies, regression models are run, using logs of nominal and real exchange rate movements. The statistics used to measure the relationship are the coefficient of determination R^2 and t tests at the 95% confidence level. The results are shown in Tables 7.8 to 7.10 and focus on the variables or lags found to be significant in the previous analysis in stage 3. It should be noted that, because of insufficient data to develop an expectation, Bona Shipholding was excluded from this part of the analysis.

Table 7.8a: Regression of Abnormal Returns on Nominal Exchange Rate Movements: Bergesen

Dependent Variable Bergesen Abnormal Returns

90 observations 1992M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.02463	-4.5547	2.00	reject
$\Delta ER_{t,t-1}$	0.24020	1.3170	2.00	accept
$\Delta ER_{t-2,t-3}$	0.12620	0.6935	2.00	accept

$R^2 = 0.024404$

Table 7.8b: Regression of Abnormal Returns on Real Exchange Rate Movements: Bergesen

Dependent Variable Bergesen Abnormal Returns

90 observations 1992M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.02473	-4.5828	2.00	reject
$\Delta RER_{t,t-1}$	0.24053	1.3100	2.00	accept
$\Delta RER_{t-2,t-3}$	0.17493	0.9533	2.00	accept

$R^2 = 0.028670$

Table 7.9a: Regression of Abnormal Return on Nominal Exchange Rate Movements: Leif Hoegh

Dependent Variable Leif Hoegh Abnormal Returns

66 observations 1994M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	t critical 90%	accept/reject
Constant	-0.01657	-2.4273	2.00	1.671	reject
$\Delta ER_{t,t-1}$	0.05587	0.1987	2.00	1.671	accept
$\Delta ER_{t-2,t-3}$	0.21706	0.7837	2.00	1.671	accept

$R^2 = 0.010071$

Table 7.9b: Regression of Abnormal Returns on Real Exchange Rate Movements:

Dependent Variable Leif Abnormal Returns

66 observations 1994M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	t critical 90%	accept/reject
Constant	-0.01646	-2.4220	2.00	1.671	reject
$\Delta RER_{t,t-1}$	0.04877	0.1732	2.00	1.671	accept
$\Delta RER_{t-2,t-3}$	0.27974	1.0139	2.00	1.671	accept

$R^2 = 0.016215$

Table 7.10a: Regression of Abnormal Returns on Nominal Exchange Rate Movements: Wilhelmsen

Dependent Variable Wilhelmsen Abnormal Returns

90 observations 1992M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.00312	-0.3741	2.00	accept
$\Delta ER_{t,t-1}$	0.29435	1.0428	2.00	accept

$R^2 = 0.012207$

Table 7.10b: Regression of Abnormal Return on Real Exchange Rate Movements: Wilhelmsen

Dependent Variable Wilhelmsen Abnormal Returns

90 observations 1992M1 to 1999M6

Variable	Coefficient	t calculated	t critical 95%	accept/reject
Constant	-0.003120	-0.3835	2.00	accept
$\Delta RER_{t,t-1}$	0.33085	1.1635	2.00	accept

$R^2 = 0.015150$

In all cases the results show no evidence of a relationship between abnormal returns and the change in the log exchange rate, either nominal or real. The fact that exchange rate changes are significant in explaining total returns but not abnormal returns suggests that these effects are anticipated and priced by the market.

Conclusion

This chapter used regression techniques to analyse the impact of exchange rate changes on share price returns as a measure of performance. It examined individual Norwegian companies as representative of the Norwegian shipping industry as a whole. The results for these companies are markedly different from those of Japan. In most cases the real rates have greater explanatory power than the nominal ones and there is evidence of a contemporaneous relationship between exchange rate movements and returns. A depreciation in the value of the Krone against the US$ in all cases has a positive effect on returns. Furthermore, in three out of the four companies investigated, there is evidence that the change in the log of the exchange rate two months earlier has a lagged affect on the current level of returns.

The market models developed as basis for the calculation of expected return are much better than those derived in the Japanese case. This could be attributable to the fact that maritime companies account for 26.4% of market capitalisation on the Oslo exchange and thus the explanatory power of the market model for these companies is relatively high. The expectations thus developed from these models are likely to be more reliable in the derivation of the abnormal returns than in the Japanese case, where maritime companies account for 0.2% of the total market capitalisation.

When examining abnormal returns there is no evidence to suggest that exchange rates changes, contemporaneous or lagged, can explain unanticipated returns, suggesting that these changes are priced by the market.

The results of this regression analysis for the Norwegian companies are consistent with evidence presented in Chapter 6 on exposure levels. Due to the high levels of exposure, fluctuations in the Krone/US$ exchange rates have a more immediate impact on company performance.

Endnotes

[1] Stock Exchange Information is contained in Appendix 6.

[2] The analysis of revenues is based on operating revenues for 1995 for the total industry (Official Statistics of Norway) and Annual Reports of the companies for 1995.

[3] See page 57

[4] Box, G.E.P. and Pierce, D. A. (1970) Distribution of Residual Autocorrelations in Autoregressive-Integrated-Moving Average Time Series Models, *Journal of American Statistical Association*, 65, pp. 1509-26.

[5] MacKinnon, J.G. (1991) Critical Values for Cointegration Tests, Ch. 13, in *Long-Run Economic Relationships:Readings in Cointegration*, eds R.F. Engle and Granger, C.W.J., Oxford University Press, Oxford.

[6] Ibid.

[7] See page 114

[8] See Appendix 6.

[9] See page 151

[10] Bartov, E. and Bodnar, G. M. (1994) Firm Valuation, Earnings, Expectations, and Exchange Rate Exposure Effect, *Journal of Finance* ,44 (5), 1755-85. Jorion, P. (1990) The exchange rate exposures of US Multinationals, *Journal of Business*, 63,pp 353-376., Amihud, Y. (1993) Evidence on exchange rates and valuation of equity shares, in Amihud, Y., and Levich, R., eds, *Exchange Rates and Corporate Performance*, Business One Irwin, Homewood, Illinois, USA., and Bodnar, G. M., and Gentry, W. M. (1993) Exchange Rate Exposure and Industry Characteristics: Evidence from Canada, Japan, and U.S., *Journal of International Money and Finance*, 12, pp29-45.

PART D: Conclusions

Chapter 8: Comparisons

Chapter 9: Conclusion

Chapter 8

Comparisons

Introduction

This Chapter builds on earlier results for Japan and Norway[1] in presenting a comparative analysis of the two industries and of the companies within those two industries. In so doing it addresses the other hypotheses namely, that there is a significant difference between the results of the two countries and between the companies within each industry. This latter hypothesis is further explored by testing for evidence of a trade or sector effect, whether, for example, the liner trade is affected in a different way from, say, the bulk carrier trade. In the Japanese case, the effect of the Asian crisis is also investigated, by analysing results in two sub periods, pre- and post-crisis. The analysis begins with the impact of exchange rate changes on operating results, as first seen in Chapters 4 and 6. This is followed by a cross sectional regression analysis using all the data, and all companies in both industries, before investigating the firm-specific and sector effects within each industry.

Operating Results

Chapters 4 and 6 investigated the operating flows exposed to fluctuations in the movements of the domestic currency against the US Dollar. This exposure is calculated as the level of net US Dollar revenues[2], since these are the amounts which must be converted into other currencies. Table 8.1 compares the levels of exposure for both

Japan and Norway, as measured by the net Dollar revenues as a percentage of total Dollar operating revenues.

Table 8.1: Exposure for Japan and Norway

	Net Dollar Revenues as % of Dollar Operating Revenue	
Year	Japan	Norway
1987	22.4	NA
1988	18.4	NA
1989	14.3	NA
1990	10.0	NA
1991	14.2	NA
1992	12.4	NA
1993	16.0	NA
1994	13.3	52.7
1995	12.7	51.6
1996	14.6	NA

Source: Calculations in Chapters 4 and 6

The Japanese industry has employed policies to reduce the level of exposure to exchange rate risk by shifting costs into US Dollars. With the exception of the 16% level in 1993, the figures in Table 8.1 illustrate the effectiveness of this strategy. The Norwegian industry on the other hand maintains a higher level of exposure. Although aggregate data is only available for 1994 and 1995, discussion with Norwegian industry specialists[3] suggests that these levels have been maintained throughout the ten year period at around 50%.

The other key factor in assessing the impact of exchange rate fluctuations is the exchange rate movement itself in terms of volatility and trends. The volatility is calculated using basic standard deviation for the Yen/US Dollar and Krone/US Dollar

exchange rates. The trend can be seen from the average annual rates achieved during the 1990s. These are illustrated in Table 8.2.

Table 8.2: Exchange Rate Volatility (based on real exchange rates)

	Average Annual Rate		Coefficient of Variation %	
Year	Japan	Norway	Japan	Norway
1990	173.934	5.0635	4.6	5.0
1991	165.724	5.1887	2.3	6.2
1992	159.253	4.9991	2.7	5.0
1993	146.608	5.8883	5.4	3.6
1994	137.956	5.8492	3.5	4.6
1995	130.148	5.2133	7.5	2.9
1996	153.373	5.3257	3.6	1.5

Source: Calculations based on data from Datastream

The Table shows lower levels of volatility for Japan in the early part of the decade compared to Norway. However, by 1995 the situation is reversed. Clearly this annual volatility does not reflect any trend towards appreciation or depreciation. This is indicated by the average annual rates, which show a long term appreciation of the Yen against the Dollar, but no particular trend for the Krone against the US Dollar.

In order to measure the impact of exchange rate fluctuations on operating results, the standard deviations can be applied to the exposed flows in Table 8.1. The 'VAR' approach takes the percentage movement in the real rate represented by plus or minus 1.96 standard deviations applied to the exposed flows for each country (assuming a normal distribution). In so doing the maximum impact on operating profits can be derived at a 95% confidence level. The results of the analysis are presented in Table 8.3.

Table 8.3 : Sensitivity of Exposed Flows to Fluctuations in the Exchange Rate

	Fluctuations as % of Operating Profit	
Year	Japan	Norway
1990	14.87	NA
1991	9.65	NA
1992	16.12	NA
1993	122.14	NA
1994	36.51	18.8
1995	41.97	13.3
1996	22.29	NA

Source: Calculations based on information in Tables 8.1 and 8.2

Table 8.3 shows the fluctuation in the exchange rate as a percentage of operating profit. It serves to highlight that the effect is more dramatic for the Japanese industry despite its lower levels of exposure. The reason for this is partly the higher volatility of the Yen against the Dollar, and the fact that the major companies in the Japanese industry have much lower operating profit margins than those of the Norwegian industry.

Table 8.4 provides evidence of these low margins. For the Japanese companies they are rarely above the 5% level over the thirteen year period, whereas the Norwegian companies enjoy much higher levels, and even a 10% margin is not unusual.

Table 8.4: Operating Profit Margins (as %)

	MOL	NYK	KLINE	BERG	LEIF	WILH
1987	-1.5	2.69	-0.63	15.50	NA	4.10
1988	-0.66	2.07	0.21	22.26	NA	2.02
1989	1.78	3.54	3.90	17.01	NA	4.93
1990	4.43	3.1	4.90	21.05	16.44	9.16
1991	2.48	3.46	3.06	27.48	20.75	8.13
1992	4.31	3.8	3.77	7.69	14.80	6.89
1993	3.35	4.17	2.59	9.23	14.76	4.36
1994	2.42	2.36	1.40	-3.40	3.75	1.40
1995	2.95	3.80	2.49	6.35	9.51	6.45
1996	4.26	3.92	5.35	12.72	9.77	7.84
1997	4.95	4.74	4.89	21.51	15.71	16.49
1998	5.65	4.29	5.20	19.95	16.82	14.98
1999	6.62	4.41	4.19	12.50	NA	NA

Such low margins mean that exchange rate movements can make a dramatic percentage change to the overall operating results.

The comparative analysis of the impact of exchange rate fluctuation on the operating results finds that, despite its lower levels of exposure, the effect is greater for the Japanese industry, due to Yen/US Dollar volatility and the low operating profit margins experienced by the sector.

Cross Sectional Analysis

The following sections examine the impact on share price returns experienced by the industries in Chapters 5 and 7 on a comparative basis. Since the use of real exchange rates in earlier regressions were not significantly different from the nominal ones, these analyses are confined to changes in the log nominal exchange rates. On the same basis, total returns are the only dependent variable. The first comparative analysis is a company-specific analysis for each separate industry in order to test whether there are

significant differences between the results of the companies within each industry. The regressions are again run, using changes in the log exchange rate.

Formally, this can be written:

$$R_{ct} = \alpha + \beta ER_{ct} + \varepsilon_{ct} \qquad (8.2)$$

for c = company 1, 2 and 3 and t = 1, 2,....T time periods

Company-Specific Comparison

Japan

Since the merger of MOL with Showa and NYK with Navix there are only three 'big' companies in Japanese shipping. The more recent share price data is thus only available for these three companies. This following analysis is therefore based on data for the 'Big 3', MOL, NYK and K Line. The firm-specific effects are investigated using an F statistic, to test whether the constant terms are all equal. The calculated value is obtained from the following equation:

$$F_{(n-1),(nT-n-K)} = \frac{R^2u - R^2p/(n-1)}{1 - R^2_U/(nT-n-K)} \qquad (8.2)$$

where u is unrestricted regression

p is the pooled or restricted regression (single constant)

K is the number of regressors

n is the number of firms

T is the number of observations for each firm

Table 8.5 shows the results of the company-specific analysis for the whole data set from 1986 to 2000.

Table 8.5 Japan Company-Specific: Whole Period

Sample 1986M9 to 2000M5
Dependent Variable: Returns on Shares

Variable	Coefficient	t value
Constant	0.001465	0.276598
$ER_{t-2,t-3}$	0.336830	2.411266
$ER_{t-3,t-4}$	0.410358	2.923291
$ER_{t-5,t-6}$	-0.604061	-4.285930
$ER_{t-6,t-7}$	-0.276293	-1.986220

$R^2 = 0.068145$

The results show the significance of an appreciation in the Yen against the Dollar of the five and 6 month lags which is effectively corrected by the depreciation of the two and three month periods. The overall effect is a very slight appreciation, with the coefficients total of -0.133166.

The fixed or company-specific effects are shown in the F test below.

Table 8.6: Japan Company-Specific: F test

Fixed Effects

Null hypothesis: Constants are equal	
F (2,492) calculated	0.416
F (2,492) critical	3.00
Accept null hypothesis	

The F test shows that there are no significant firm-specific effects. The results of the individual companies within the Japanese industry are not detectably different.

The following analysis divides the data between two sub periods, pre and post the Asian crisis. The pre-crisis results are shown in Table 8.7.

Table 8.7: Japan Company-Specific: Pre-Asian Crisis

Sample 1986M9 to 1997M5
Dependent Variable: Returns on Shares

Variable	Coefficient	t value
Constant	0.002670	0.453811
$ER_{t-3,t-4}$	0.579903	3.468248
$ER_{t-6,t-7}$	-0.318047	-1.917892

$R^2 = 0.040911$

In this case, the significant lags are at six months, with an appreciation in the Yen/US$ rate, and at three months, with a larger depreciation having an impact on current returns. The dominant effect for this period is the depreciation in the Yen. Again, there are no firm-specific effects as evidenced by the F test below:

Table 8.8: Japan Company-Specific: F Test

Fixed Effects

Null hypothesis: Constants are equal	
F (2,379) calculated	0.382
F (2,379) critical 5%	3.00
Accept null hypothesis	

Post-Asian Crisis

An examination of the post-crisis period reveals a more rapid response to exchange rate movements, since it is the changes of five months ago and of two months ago which have an effect on the current level of returns. Again, there is evidence that an appreciation of the Yen five months previously and a smaller depreciating movement two months ago have a positive impact. In this period, however, the overall effect is one of appreciation affecting the current level of return, as illustrated in Table 8.9.

Table 8.9: Japan Company-Specific: Post-Asian Crisis

Sample 1997M6 to 2000M5
Dependent Variable: Returns on Shares

Variable	Coefficient	t value
Constant	0.001301	0.116930
$ER_{t-2,t-3}$	0.702429	2.878577
$ER_{t-5,t-6}$	-1.092504	-4.445744

$R^2 = 0.242551$

An examination of the effects of the different companies shows that there are no significant differences.

Table 8.10: Japan Company-Specific: F test

Null hypothesis: Constants are equal	
F (2,100) calculated	0.053
F (2,100) critical 5%	3.07
Accept null hypothesis	

The comparative analysis of the Japanese situation reveals that there are no differences in the way in which exchange rate movements affect the returns for MOL, NYK and K Line. However, the Asian crisis does appear to influence the results. In the pre-crisis period the depreciation of the Yen has the dominant effect, whereas the post- crisis

period sees the positive effect of an appreciation on returns. Furthermore, the impact is more immediate following the crisis. These results are consistent with those achieved in Chapter 5 with the regressions for the individual companies, in that the dominant effect before the crisis was of depreciation affecting returns in a positively, whereas in the subsequent period, it is an appreciation. These differences between the pre and post-crisis results are investigated using a Wald test on the coefficients in the following section. This test indicates significant differences between the coefficients of the variables, and is carried out by isolating the pre and post-crisis exchange rate movements. Where a particular lag is significant in either case, be it the in the pre or post-crisis period, it is included in the regression. Table 8. 11 shows the results of this analysis. The dummy variable is set to 0 in the pre-crisis period and 1 in the post-crisis period.

Table 8.11 Wald Test Japan: Asian Crisis Effects

preER refers to the exchange rate movements pre the Asian crisis
postER refers to the exchange rate movements post the Asian crisis

Variable	Coefficient	t value
$preER_{t-2,t-3}$	0.101039	0.592494
$preER_{t-3,t-4}$	0.484584	2.860148
$preER_{t-5,t-6}$	-0.172649	-1.020573
$preER_{t-6,t-7}$	-0.340112	-2.011511
$postER_{t-2,t-3}$	0.773197	3.072937
$postER_{t-3,t-4}$	0.264498	1.022583
$postER_{t-5,t-6}$	-1.225279	-4.715775
$postER_{t-6,t-7}$	-0.408102	-1.610439
Constant	0.003860	0.643209
Dummy	-0.002789	-0.216969

$R^2 =$ 0.094101

The results of the test indicate the significance of the three and six month lags for the pre-crisis period and the two and five for the post-crisis period. The Wald test below is

based on a null hypothesis that the coefficients pre and post are the same. This hypothesis is clearly rejected and thus there is a significant difference between the results of the two periods.

Table 8.12: Wald Test on Coefficients Pre and Post Crisis

Null hypothesis: $preER_{t-2,t-3} = postER_{t-2,t-3}$ $preER_{t-3,t-4} = postER_{t-3,t-4}$ $preER_{t-5,t-6} = postER_{t-5,t-6}$ $preER_{t-6,t-7} = postER_{t-6,t-7}$	
F (4,491) calculated	5.136150
F (4,491) critical 5%	2.37
Reject null hypothesis	

Norway

The same analysis is performed using the data for the Norwegian industry, first the whole period and then an analysis between the pre and post-crisis periods. The results of the regression for the whole period from 1997 to 2000 is shown in Table 8.13.

Table 8.13: Norway Company-Specific: Whole Period

Sample 1987M8 to 2000M4
Dependent Variable: Returns on Shares

Variable	Coefficient	t value
Constant	0.007876	1.634575
$ER_{t,t-1}$	0.974289	5.717848
$ER_{t-2,t-3}$	0.503364	2.913190
$ER_{t-6,t-7}$	0.366967	2.135900

$R^2 = 0.092402$

As with the separate company regressions there is a strong and significant contemporaneous and two month lagged effect of the exchange rate movement on the returns. The difference in results emerging from the cross sectional analysis compared

to the individual company regressions is the significance of the six month lag, illustrating that some information regarding exchange rate changes take a longer time to affect the share price. As is the case with the Japanese industry, there are no significant differences between the results of the companies operating within the industry, as shown by the F test in Table 8.14.

Table 8.14: Norway Company-Specific: F test

Null hypothesis: Constants are equal	
F (2,417) calculated	0.636
F (2,417) critical 5%	3.00
Accept null hypothesis	

For consistency, the data is analysed between the same sub periods as in the Japanese case in order to detect any differences between the variables obtained, and different company-specific effects in those periods. Table 8.15 shows the results for the pre-crisis period.

Table 8.15: Norway Company-Specific: Pre Crisis Period

Sample 1987M8 to 1997M5
Dependent Variable: Returns on Shares

Variable	**Coefficient**	**t value**
Constant	0.013563	2.459676
$ER_{t,t-1}$	1.281004	6.862243
$ER_{t-2,t-3}$	0.506456	2.652860
$ER_{t-6,t-7}$	0.710351	3.681809

$R^2 = 0.159685$

These results are consistent with those for the whole period analysis, and the F test in Table 8.16 again shows no company-specific effects.

Table 8.16: Norway Company-Specific: F test

Null hypothesis: Constants are equal	
F (2,345) calculated	0.3002
F (2,345) critical 5%	3.00
Accept null hypothesis	

The post-crisis results are shown in Tables 8.17 and 8.18. It should be noted that the number of observations is significantly reduced in this analysis.

Table 8.17: Norway Company-Specific: Post Crisis Period

Sample 1997M6 to 2000M4
Dependent Variable: Returns on Shares

Variable	**Coefficient**	**t value**
Constant	-0.004125	-0.464061
$ER_{t-4,t-6}$	0.734838	2.156052

$R^2 = 0.042012$

Table 8.18: Norway Company-Specific: F test

Null hypothesis: Constants are equal	
F (2,98) calculated	0.3496
F (2,98) critical 5%	3.15
Accept null hypothesis	

Although there are again no firm-specific differences in the post-crisis period, the results are somewhat surprising, since the Asian crisis was not expected to have an impact on the experience of the Norwegian industry. The outcome suggests that the impact is slower for Norway in this period, since there is no contemporaneous link

between exchange rate movements and share prices, but a relationship which is lagged by four months. The difference between the results pre and post-crisis was again tested using a Wald test. The results are shown in Table 8.19.

Table 8.19: Wald Test Norway: Asian Crisis Effects

Variable	Coefficient	t value
$preER_{t,t-1}$	1.327361	7.147590
$preER_{t-2,t-3}$	0.496555	2.659218
$preER_{t-4,t-5}$	0.252040	1.337316
$preER_{t-6,t-7}$	0.706109	3.744162
$postER_{t,t-1}$	0.125296	0.286009
$postER_{t-2,t-3}$	0.563143	1.412788
$postER_{t-4,t-5}$	0.787316	2.081569
$postER_{t-6,t-7}$	-0.468500	-1.198626
Constant	0.013723	2.545844
Dummy	-0.020455	-1.737330

$R^2 = 0.153247$

Table 8.20: Wald Test on Coefficients Pre and Post Crisis

Null hypothesis: $preER_{t,t-1} = postER_{t,t-1}$ $preER_{t-2,t-3} = postER_{t-2,t-3}$ $preER_{t-4,t-5} = postER_{t-4,t-5}$ $preER_{t-6,t-7} = postER_{t-6,t-7}$	
F (4,416) calculated	4.6535
F (4,416) critical 5%	2.37
Reject null hypothesis	

Tables 8.19 and 8.20 confirm the significant differences between the variables pre- and post- the Asian crisis. The test examines all the significant variables in both periods and then in the null hypothesis sets the lags pre and post crisis equal to one another. This hypothesis is rejected by the result of the F test in table 8.20. In the pre crisis period, the impact is immediate, with the current movements in exchange rates having the greatest effect. After the crisis, however, there is a only one significant lag which shows that the change four month previously affects the current level of returns.

The above cross sectional analysis confirms the result obtained in Chapters 5 and 7, namely that exchange rate movements do affect the share price returns of the industry and the individual companies operating in it. From the analysis there are no company-specific effects in either industry. In other words, all Japanese companies and all Norwegian companies provide the same significant variables. In the models developed, there are, however, clear differences in the significant lags for the two industries, and indeed in the pre- and post-crisis periods. The significance of these is examined in the following section on industry specific differences.

Industry Differences

The industry-specific comparison investigates whether there are significant differences between the results of the two industries. Again the regression model incorporates time series and cross sectional data as follows:

$$R_{it} = \alpha + \beta ER_{it} + \varepsilon_{it} \qquad (8.3)$$

for i = industry, Japan or Norway and t = 1, 2,....T time periods

Such analysis uses three stages: the first for the whole period, the second and third for the pre and post crisis periods. All regressions test for differences between the constant term and the coefficients of the regressors. The constants are tested using a dummy variable, where the dummy is equal to 1 for the Japanese industry and 0 for the Norwegian industry. The coefficients are tested by isolating the lagged variables and performing a Wald test.

The results of the regression for the whole period are examined in Table 8.21.

Table 8.21 Industry Comparative: Whole Period

Sample 1986M8 to 2000M4
Dependent Variable: Returns on Shares

Variable	Coefficient	t value
Constant	0.008024	2.175411
$ER_{t,t-1}$	0.266449	2.398208
$ER_{t-2,t-3}$	0.368658	3.352999
$ER_{t-3,t-4}$	0.312095	2.853263
$ER_{t-5,t-6}$	-0.348815	-3.170997

$R^2 = 0.039513$

The significant variables are the current change in the exchange rate, and the changes of two, three and five months previously. The regression confirms the apparent anomaly first seen in Chapter 5, where an appreciation in the exchange rate has a positive effect on current returns. The fact that the overall impact is one of a depreciation suggests that this is adjusted by the subsequent movements.

The models combine the features of Norway and Japan as analysed in Chapters 5 and 7. It is interesting, however, that the dummy variable is not significant according to the t statistic. In other words, there is no difference between the constant terms. This is confirmed by an F test , which examines the R^2 of the unrestricted and restricted models and compares it to the calculated F with the critical F statistic from the appropriate tables. The results are in Table 8.22 below.

Table 8.22: Industry Comparative: F test

Null hypothesis: Dummy variables are equal to zero	
F (1,923) calculated	0.1903
F (1,923) critical 5%	3.84
Accept null hypothesis	

The next test examines significant differences between the coefficients, using a Wald test.

Statistically, the objective can be expressed as follows:

$$\begin{bmatrix} R_{J1} \\ . \\ . \\ R_{Jn} \\ R_{N1} \\ . \\ . \\ R_{Nn} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ . & . \\ . & . \\ 1 & 0 \\ 0 & 1 \\ . & . \\ . & . \\ 0 & 1 \end{bmatrix} \begin{bmatrix} ER_{J1} & 0 \\ . & . \\ . & . \\ ER_{Jn} & 0 \\ 0 & ER_{N1} \\ . & . \\ . & . \\ 0 & ER_{Nn} \end{bmatrix} \begin{bmatrix} \alpha_J \\ \alpha_N \\ \beta_J \\ \beta_N \end{bmatrix} \begin{bmatrix} \varepsilon_{J1} \\ . \\ . \\ \varepsilon_{Jn} \\ \varepsilon_{N1} \\ . \\ . \\ \varepsilon_{Nn} \end{bmatrix} \tag{8.4}$$

where:

R_J is the return on the shares of the Japanese companies for time periods 1 to n

R_N is the return on the shares of the Norwegian companies for time periods 1 to n

ER_J is the Yen/US$ exchange rate for time periods 1 to n

ER_N is the Krone/US$ exchange rate for time periods 1 to n

α_J is the constant for Japan

α_N is the constant for Norway

β_J are the coefficients for Japan

β_N are the coefficients for Norway

ε_J is the error term for Japan

ε_N is the error term for Norway

The null hypothesis (H_0) is : $\alpha_J = \alpha_N$ and $\beta_J = \beta_N$

The constant terms have already been tested above using the dummy variables, thus what follows is a test of the coefficients.

Separating all the variables and lags of variables between Japan and Norway facilitates the testing for different coefficients of the two models as shown in Table 8.23

Table 8.23 Wald Test: All data

YER is the Yen/US$ exchange rate
KER is the Krone/US$ exchange rate

Variable	Coefficient	t value
$YER_{t,t-1}$	-0.110243	-0.795008
$YER_{t-2,t-3}$	0.366132	2.755040
$YER_{t-3,t-4}$	0.323092	2.435511
$YER_{t-5,t-6}$	-0.545293	-4.063687
$YER_{t-6,t-7}$	-0.327173	-2.424089
$KER_{t,t-1}$	0.978931	5.146444
$KER_{t-2,t-3}$	0.474816	2.457685
$KER_{t-3,t-4}$	0.257146	1.358431
$KER_{t-5,t-6}$	0.051752	0.272227
$KER_{t-6,t-7}$	0.354240	1.844462
Constant	0.007545	1.406819
Dummy	-0.004572	-0.621787

$R^2 = 0.073342$

The results show different significant variables for Japan and Norway which are consistent with the separate industry analysis presented earlier in the Chapter. The Wald test below starts with the hypothesis that the coefficients a of the variables are equal for both countries.

Table 8.24: Wald Test on Coefficients for Japan and Norway

Null hypothesis: $YER_{t,t-1} = KER_{t,t-1}$ $YER_{t-2,t-3} = KER_{t-2,t-3}$ $YER_{t-3,t-4} = KER_{t-3,t-4}$ $YER_{t-5,t-6} = KER_{t-5,t-6}$ $YER_{t-6,t-7} = KER_{t-6,t-7}$	
F (5,913) calculated	6.451708
F (5,913) critical 5%	2.12
Reject null hypothesis	

The Wald test shows that there is a significant difference between the variables of the two industries, Japan and Norway for the whole period from 1987 to 2000.

Asian Crisis

The next section divides the data into two sub periods, to cover the results pre- and post- Asian crisis, since this factor proved to be influential in the results of the Japanese industries. This analysis follows the same procedure as that outlined above, testing first the constants then the coefficients of the variables. Table 8.25 shows the results for the pre-crisis period

Table 8.25: Industry Comparative: Pre-Asian Crisis

Sample 1986M8 to 1997M5
Dependent Variable: Returns on Shares

Variable	Coefficient	t value
$ER_{t,t-1}$	0.326802	2.510833
$ER_{t-3,t-4}$	0.387640	2.973076
Constant	0.012557	2.952969

$R^2 =$ 0.020242

The regression produces different results. Both the current and the three month lag are significant, and in both cases, it is a depreciation in the domestic exchange rate which

has a positive impact on returns. The dummy variable is not significant in the pre-Asian crisis regression and is thus not included in the above table. Again this is confirmed by the F test in Table 8.26.

Table 8.26: Industry Comparative: F test

Null hypothesis: Dummy variables are equal to zero	
F (1,721) calculated	0.7042
F (1,721) critical 5%	3.84
Accept null hypothesis	

Again the data is reorganised to test the coefficients with a Wald tests. The results are shown in Table 8.27.

Table 8.27 Wald Tests: Pre Asian Crisis

Variable	**Coefficient**	**t value**
$YER_{t,t-1}$	-0.226875	-1.367090
$YER_{t-2,t-3}$	0.102297	0.641928
$YER_{t-3,t-4}$	0.465675	2.932192
$YER_{t-6,t-7}$	-0.404611	-2.482839
$KER_{t,t-1}$	1.277396	6.166752
$KER_{t-2,t-3}$	0.479239	2.236413
$KER_{t-3,t-4}$	0.177655	0.835055
$KER_{t-6,t-7}$	0.701936	3.275784
Constant	0.013627	2.227412
Dummy	-0.009358	-1.126369

$R^2 = 0.087865$

The results of the test are again consistent with the individual industry regressions. The Wald test on the coefficients show that they is a significant difference between the results of Japan and Norway for the pre-crisis period.

Table 8.28: Wald Test on Coefficients for Japan and Norway

Null hypothesis: $YER_{t,t-1} = KER_{t,t-1}$ $YER_{t-2,t-3} = KER_{t-2,t-3}$ $YER_{t-3,t-4} = KER_{t-3,t-4}$ $YER_{t-6,t-7} = KER_{t-6,t-7}$	
F (4,704) calculated	11.09973
F (4,704) critical 5%	2.37
Reject null hypothesis	

Post-Asian Crisis

The period following the Asian crisis inevitably has fewer data points. However, at over 30 observations for each company this is sufficient to gain a meaningful result. The sample period starts from June 1997.

Table 8.29: Industry Comparative: Post- Asian Crisis

Sample 1997M6 to 2000M5
Dependent Variable: Returns on Shares

Variable	Coefficient	t value
Constant	0.001301	0.116930
$ER_{t-2,t-3}$	0.702429	2.878577
$ER_{t-5,t-6}$	-1.092504	-4.445744

$R^2 = 0.242551$

The post- crisis data shows the positive impact of the five month lagged appreciation in the exchange rate. There is a part adjustment three months later of a 70% change in the log exchange rate, but the overall effect is negative. The result suggests that in the post-crisis period an appreciation in the exchange rate is seen as very positive. This is not so surprising following the dramatic fall in business confidence during the crisis. Against such a background, an appreciation in the exchange rate is indicative of improving

business and economic conditions. As far as the market was concerned, this factor outweighed the potentially damaging impact of the appreciating Yen for the maritime industry.

In this period the same dummy variable is used, but the coefficient is not significantly different from zero and is, therefore, excluded from the final regression.

Table 8.30: Industry Comparative: F test

Null hypothesis: Dummy variables are equal to zero	
F (1,198) calculated	0.134
F (1,198) critical 5%	3.84
Accept null hypothesis	

The F test above demonstrates that there is no significant difference between the constants of the Japan and Norway. The Wald test below test for differences between the coefficients.

Table 8.31 Wald Tests: Post Asian Crisis

Variable	Coefficient	t value
$YER_{t-2,t-3}$	0.759869	3.366997
$YER_{t-4,t-5}$	-0.236832	-1.037293
$YER_{t-5,t-6}$	-1.125376	-5.055738
$KER_{t-2,t-3}$	0.689896	1.665698
$KER_{t-4,t-5}$	0.828930	2.092612
$KER_{t-5,t-6}$	0.403820	1.009686
Constant	-0.012006	-1.095395
Dummy	0.012509	0.842866

$R^2 = 0.197019$

Table 8.32: Wald Test on Coefficients for Japan and Norway

Null hypothesis: $YER_{t-2,t-3} = KER_{t-2,t-3}$ $YER_{t-4,t-5} = KER_{t-4,t-5}$ $YER_{t-5,t-6} = KER_{t-5,t-6}$	
F (3,208) calculated	5.061411
F (3,208) critical 5%	2.60
Reject null hypothesis	

As expected, the results of the Wald test shows significant differences between the coefficients in the post-crisis period.

The lags are found to be significantly different for the two industries, Japan and Norway, and indeed for the pre and post crisis periods. In the Norwegian case, the current movements together with the two and six month lags in the exchange rate have an effect on current returns. The contemporaneous lag is not surprising when considering the high level of exposure which the Norwegian industry sustains. However, the net profit margins for the Norwegian companies are higher than those of the Japanese, which would lower the expected impact of exchange rate movements as far as shareholders are concerned. In both cases, the Asian crisis has a notable influence on the results, but the impact is more dramatic in the Japanese experience. In the post-crisis period the effect of an appreciation in the Yen and the business confidence that this exudes outweigh the negative impact of appreciation on performance. The effect is slower than the Norwegian case, which is consistent with the lower levels of exposure, but seems surprising when taking into account the very low net profit margins experienced by the Japanese companies (see Table 8.33). With

such low margins a small change in the exchange rate can have a huge impact on performance in terms of profits available to shareholders.

Table 8. 33 Net Profit Margins (Profit After Tax)

	MOL	NYK	KLINE	BERG	LEIF	WILH
1987	-1.66	-0.57	-2.15	9.68	NA	-4.4
1988	-2.77	0.28	-2.56	2.70	NA	-0.9
1989	1.02	0.55	-0.15	3.77	NA	2.54
1990	2.87	1.52	0.64	17.21	-4.05	2.42
1991	0.95	0.78	-0.53	3.85	6.15	2.62
1992	0.47	0.78	0.97	0.95	8.29	4.37
1993	1.12	0.85	-0.46	4.55	10.03	-2.29
1994	-0.95	0.70	0.60	3.11	8.68	4.97
1995	-0.68	0.45	0.80	8.56	10.36	3.24
1996	0.67	0.33	0.64	35.54	21.49	2.42
1997	0.77	1.37	1.37	11.41	9.64	13.27
1998	1.22	0.73	0.37	17.44	10.63	6.99
1999	0.86	1.14	0.38	7.65	NA	NA

Source: Annual Reports

Sector Analysis

A further hypothesis is that the type of trade, namely: liner, dry bulk, tanker, car carrier, has an impact on the results. This is more difficult to test, since all the companies are diversified. In other words, their activities are not limited to any one sector. In some cases, there is even diversification into non-maritime activities, such as logistics and freight forwarding, although these trades are closely related to the maritime industry. Table 8.35 presents an analysis of the dominant trade for each company based on either operating revenue or operating profit. A full list is available in Appendix 5 .

Table 8.34 Types of Trade

Company	Dominant Trade	Percentage
MOL	Liner	41.3%
NYK	Bulk and Car Carriers	57.6%
K LINE	Liner	46.8%
BERG	Tankers	50.3%
LEIF	Car Carriers	57.3%
WILH	Liners	94.3%

Source: Annual Reports 1999 for Japanese Companies, 1998 for Norwegian Companies

The hypothesis that the sector has an influence was tested by setting up a dummy variable for the liner sector, and by running the regressions for all the data. In all cases the dummy variable was found to be not significantly different from zero, suggesting that type of trade does not affect the result. In this case, the result is an inference, because of the fact that the analysis is based on corporate data and there is diversification in all cases.

Conclusion

This Chapter has provided a comparative analysis of the two industries, Japan and Norway, and the major companies operating in them. It finds that the effect on operating results is more dramatic in the Japanese case despite the lower levels of exposure. This is due to the volatility of the Yen against the US Dollar and to the very low operating margins achieved. As far as the impact on share performance is concerned, there are significant differences between the experience of the two industries, Japan and Norway, but that there are no significant company-specific effects within those industries. Although all the companies operate across a diversity of trades within the industry, it is possible to draw some conclusions about the impact of sectors

on the analysis from the dominant trade of each. This comparison also shows no significant differences between the experience of the different sectors.

The difference between the pre- and post- Asian crisis experiences is interesting in both cases. In the Norwegian case it is surprising to find that the crisis has any impact, but the results strongly indicate that the reaction to exchange rate movement is much slower in this period. The effect is more dramatic in the Japanese case, where an appreciation of the Yen yields positive returns and a more immediate effect. In the wake of the crisis, it appears that the business confidence exuded by such an appreciation outweighs the costs for the maritime industry.

Endnotes

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[1] See Chapters 4, 5, 6 and 7 on pages 71, 105, 137, and 156.

[2] This is calculated as the Dollar operating revenues less the Dollar operating expenses.

[3] See Appendix 2 for calendar of meetings with industry specialists.

Chapter 9

Conclusion

This thesis began with the hypothesis that exchange rate fluctuations have a significant impact on the performance of the shipping industry. It analysed the impact from both a corporate and investment perspective, and found that in both cases the industry is significantly affected by exchange rate risk. Exchange rate movements affect all international business, but the shipping industry is particularly vulnerable. The first reason for this is that it is an industry in which the majority of revenues are US Dollar denominated and, therefore, non-US companies are negatively affected by a relative appreciation in their domestic currencies. Secondly, it is a low margin industry at both the operating and net profit levels, and thus small movements in the rate of exchange can have a dramatic impact on profitability. The net profit position is an important factor in investor and market perception of the industry, and translates into particularly low dividend payouts. These factors of revenue structure and low profitability make the industry particularly susceptible to exchange rate fluctuations.

The findings of the study arise from an analysis of two major maritime nations, which have been subject to differing patterns of exchange rate fluctuations against the US Dollar. Japan has experienced long term appreciation of the Yen, whilst no significant trend has emerged for the Norwegian Krone. Two methodologies enabled an analysis from both a corporate

and investor perspective. The impact of foreign exchange fluctuations on corporate performance can be seen by the variation in operating results. This is evident for both Japan and Norway. The way in which this effect is translated into the share price returns depends on the profitability, non-trading activity (such as the sale and purchase of vessels) and the investor's perception of the problem. As far as Japan is concerned, the impact on the share price is unexpected. There is some evidence that an appreciation in the Yen had a positive impact on returns. However, in the case of Norway there is a more convincing contemporaneous link between depreciating exchange rate movements and returns on listed shares.

Cross sectional regressions facilitated the testing of further hypotheses at a comparative level: firstly, on whether there was a significant difference between the experience of the two industries, Japan and Norway; secondly, whether within these industries different results were obtained by the different companies; thirdly, a test for sector specific differences, in that is to say, variations between the types of trade, such as the liner, bulk, tanker, carrier trades. In performing this analysis, the added impact of the Asian crisis on the industry was also examined. The results showed statistically significant differences between the national industries, but not between the companies within them, or indeed between the trade sectors. The impact of the Asian crisis on both the results of Japan and Norway was interesting as it highlighted different significant variables in the pre and post crisis period. The results were particularly significant in the Japanese case, with an appreciation in the Yen positively influencing returns following the crisis and a depreciation having the positive impact in the pre-crisis period.

These results are discussed in more detail in the following sections, first in terms of operating profit and then of share price returns.

Operating Profits

The effect of exchange rate volatility was calculated by measuring the volatility itself and applying it to the amounts exposed to exchange rate risk. This exposure was taken as the net US Dollar revenues of the two industries.

Japan

During the period under investigation the level of exposure for the Japanese industry fell from 186.5 billion Yen in 1987 to 94.1 billion Yen in 1990, due to a strategy of natural hedging. From this point there was an increase to 170.66 billion Yen in 1996. As a percentage of US Dollar revenues, this level of exposure had fallen over the period from 22.4% in 1987 to a relatively low 12.7% in 1995, followed by only a slight increase to 14.6% in 1996.

Given this exposure, exchange rate volatility had a noticeable impact on operating profits. The period under review is characterised by an appreciating Yen, the average annual rate of 173.934 Yen to the US Dollar being reduced to 130.1458 Yen in 1995. Within each year volatility is high, particularly in 1990 (with a 4.6% coefficient of variation) and in 1995 (with a 7.5% coefficient of variation). The measure of exchange rate volatility applied the exposed net Dollar revenues revealed possible fluctuations as percentage of operating profits, reaching a level of 122.14% in 1993 falling to 36.51% and 41.97% in 1994 and

1995 respectively. This large impact on performance, despite the low levels of exposure, is due directly to the volatility of the Yen against the Dollar and the low operating profit of the Japanese companies.

Norway

In comparing the impact of exposure on the Japanese and Norwegian industries, it should be noted that, whereas aggregate data for Japan were available for the period 1987-1996, only years 1994-1995 are available for Norway. The net US Dollar revenue was 18,406 Million Krone in 1994 and 17,649 Million Krone in 1995. As a percentage of Dollar denominated operating revenue, this was approximately 51%. The exposure in the Norwegian industry is, therefore, substantially higher than in Japan. Exchange rates for the Krone against the US Dollar were, however, less volatile during the 1990s, and this translated into a reduced impact on the operating results of the Norwegian industry. In 1994 the coefficient of variation was 4.6% and in 1995 2.9%. The potential fluctuations in operating results as a percentage of operating profit were 18.8% in 1994 and 13.3% in 1995. Even with the high level of exposure, the percentage impact on operating profits is relatively low because of the higher margins and low volatility of the Krone against the Dollar.

This analysis has demonstrated that both industries are exposed to exchange rate risk, but to varying degrees. The Norwegian industry, however, maintains a much higher level of exposure than the Japanese; but despite this, the potential impact of exchange rate fluctuations on the operating profit of Japan is much higher in percentage terms than that of

Norway. This is due partly to the relatively higher volatility of the exchange rate between the US Dollar and Yen, and to the fact that in Japan operating profit is a smaller percentage of operating revenue than in Norway. In 1994 and 1995 (the years for which a direct comparison is possible), the operating profit as a percentage of operating revenue of the Norwegian industry was 22.7% and 24.4% respectively. For the same years, the operating profit as a percentage of operating revenue of the Japanese industry, was 1.5% and 2.9%.

The results for both countries, however, illustrate the sensitivity of operating profit to movements in the real exchange rate, and serve to highlight the need for effective foreign exchange risk management for the whole industry.

Share Price Returns

The regression technique examined the relationship between exchange rate changes and share price returns. A number of factors are captured by share prices and returns on shares. These reflect not only operating profit, but also non-trading profitability, economic conditions, and general perception of the company by the investor. The impact of exchange rate changes on share price returns is, thus, indicative both of the effect of these other activities and of the opinion and insight of the market.

The regression analysis was performed at various levels. First, there was an analysis of individual shipping companies for each country, which examined the impact of nominal and real exchange rate movements on total and abnormal returns. The abnormal returns were based on the difference between actual and expected returns, where the expectation

was derived using a market model. It is important to note that the market models obtained for the Norwegian companies are more reliable because the Oslo exchange has a high proportion of shipping and maritime business, whereas the Tokyo exchange has a much larger and more diverse listing[1]. The results may also have been affected by the fact that the Japanese companies have other non-maritime sectors, which form part of their overall results, whereas in Norway the groups are almost exclusively shipping based. The other regressions use cross sectional analysis, in order to compare the results of the two industries, different companies within those industries, and the various trading sectors. All these regressions use a sub period analysis to examine the impact of the Asian crisis. The results for the two industries are considered in the following sections.

Japan

The results for the individual companies showed consistent results for all three major companies, with exchange rate movements significantly affecting total share price returns, but not abnormal returns. This suggested that the market is aware of the exchange rate risk and prices it. In all cases, there were no clear differences between the regression using nominal and real exchange rates.

The sub period analysis pre and post the Asian crisis of 1997 produced different results in all cases. In the pre crisis period, the significant variable is the depreciation three month previously which positively affects current returns, but in the post crisis period, it is an appreciation five months previously which has the significant impact. This latter result is counter intuitive when one considers that in a Dollar based operation, an appreciation in the Yen against the Dollar leads to falling Yen revenues and ultimately falling profits.

Cross sectional analysis confirmed the significant differences in the results of the pre- and post- crisis periods. However, it further suggested the significance of other lagged variables. In the period from 1987 to 1997, the negative six month lagged exchange rate was also significant, providing evidence of the positive impact of appreciation before the crisis, but not playing the dominant role. Post the crisis 1997 to 2000, the two month lagged movement is also a significant variable to counter some of the appreciation of the five month movement. However,, the appreciation is more influential in this period. These significant variables in these sub periods also suggest that the impact of exchange rate fluctuations is more immediate in the post-crisis period.

A number of explanations may be put forward to explain this phenomenon. First, as shown in Chapter 4, there is considerable natural hedging on the part of the Japanese companies. This manifests itself in a policy of transferring as many costs as possible into Dollars, in an attempt to reduce their exposure. More important is the economic prosperity indicated by an appreciating currency, particularly in the post crisis period, when the Japanese were looking to the Yen as an indicator of improving economic conditions. This improving economic climate was the dominant factor in determining the market's perception of the industry's performance. It will be interesting to see how long this phenomenon continues.

Norway

In the case of Norway, again there is consistency between the result of the three companies under investigation, which showed a significant link between exchange rate movements and total return. As in the Japanese case, the were indications that the market priced the exchange rate risk and that there were no differences in results achieved using real and nominal exchange rate movements. In other respects the result for the Norwegian industry are markedly different from those of Japan.

In all cases there is a contemporaneous relationship for all companies analysed. Current changes in the Krone/$US exchange rate have a significant effect on current share price returns, with a depreciation in the Krone having a positive effect. This is consistent with the evidence presented in Chapter 6, in which Norwegian companies chose to maintain an exposed position in order to take advantage of such movements. In two cases, namely Bergesen and Leif Hoegh, there is also a lagged relationship, whereby the movement of two months previously affects the current share price returns.

Again, these results are confirmed by the cross sectional analysis, but equally there is no significant difference between the experience of the Norwegian companies within the industry. The cross sectional regressions also indicate a significance of the six-month lag in determining the current level of returns. The contemporaneous change, however, remains dominant.

A surprising result in the Norwegian case is the impact of the Asian crisis on the results. The same sub period analysis revealed differences between the significant variables in the pre and post crisis periods. In the period up to 1997, the strong contemporaneous effect is significant alongside the smaller changes in the two month and six month lags. After the crisis, the only significant lag is the four month one, which suggests a slower reaction to such movements in this period. This is the direct opposite of the Japanese experience.

The results of this regression analysis for the Norwegian companies are consistent with evidence presented in Chapter 6 on exposure levels, where the high levels of exposure, results in fluctuations in the Krone/US$ exchange rates having a more dramatic impact on company performance.

Comparisons

Whilst there were no significant differences between the results of the different companies within each industry, cross sectional analysis revealed differences between the coefficients of the Japanese and Norwegian models. In the Japanese case, the impact of exchange rates on returns is slower, and indeed there is evidence that a depreciation in the Yen/US$ rate has a positive effect. In the Norwegian industry, the result is felt more rapidly and with appreciation always affecting returns in a negative way. Such variations between the two industries are significant for the pre and post crisis periods.

Trade sector

In analysing the 'Big 3' companies for both industries, it is possible to make inferences about the sectors most affected. The difficulty with this analysis was that all companies are engaged in a diverse range of activities (combinations of liner, dry bulk, car carrier, tanker, gas carriers and a small amount of cruise shipping). The Norwegian companies under investigation are almost exclusively maritime, whereas the analysis is further complicated by the existence of some non maritime operations in the Japanese companies[2]. Despite such difficulties it was possible to identify a dominant trade for each company and test for differences between the results of these sectors. This analysis, however, found no significant difference between the experience of the different shipping sectors. This is not surprising, since each sector suffers the same revenues, cost structure, and exposure to exchange rate fluctuations.

Conclusion

Measurement of the impact of exchange rate volatility on the performance of these two major shipping nations reveals its significance, both in terms of operating results and share price returns. Impact on operating results is a function of the level of exposure, the exchange rate volatility, and the operating profit margin. Japan is more severely affected, despite it lower levels of exposure, because of the higher volatility of the Yen and the very low margins experienced by all the major companies in the industry. As far as performance of shares is concerned, the exposure appears to play a more important role. For the Norwegian industry, where exposure is high at around 50%, the impact on returns is felt more immediately, with a substantial contemporaneous depreciation of the Krone affecting the current returns. For Japan, where the exposure levels are much lower at 10-15%, the impact on share price returns is less marked. In fact, there is evidence that an appreciation has a positive impact. This apparently perverse situation can be explained partly by the low exposure, and partly in terms of improving business and economic conditions, particularly in the wake of the Asian crisis. In the post-crisis period, the confidence exuded by an appreciating Yen has the greater influence on returns even for the maritime industry.

The results indicate the importance of the strategic response to exchange rate risk, the consequences of the active Japanese policy of shifting as many costs as possible into Dollars, in an attempt to minimise exposure, and the effects of the Norwegian companies' decision to maintain their exposure, in order to profit by speculation on the movement in the rate of exchange. Such strategies have been largely formulated in the light of recent

history. During the 1980s and 1990s the Japanese shipping industry was a prey to the effects of long term appreciation of the Yen, whereas no such trend emerged for the Krone.

The analysis of the fundamental and dramatic effects of foreign exchange risk on the performance of two major shipping nations was used here to exemplify the effects of such risks on world shipping in general. The degree of impact is clearly related to level of exposure. Exposure itself cannot always be seen as a negative, since it allows the industry to take advantage of favourable movements. High levels of exposure allow greater benefit from these favourable movements but require active management to minimise the downside risk. Lower exposure, on the other hand, allows a more passive approach to be taken. Whatever its level, some exposure is inevitable, and requires effective management. Whilst this thesis highlights a lack of uniformity in approach, it is clear from the cases examined that both the Japanese and Norwegian industries are acting rationally given the economic and commercial conditions in which they are operating.

Endnotes

[1] The maritime companies represent 26.4 % of the Oslo Exchange (31.12.99) and 0.2% of the Tokyo Exchange (31.3.99) in terms of market capitalisation.

[2] See Appendix 5.

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Data Sources

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Mitsui OSK Lines
Nippon Yusen Kabushiki Kaisha
Kawasaki Kisen Kaisha
Bergesen Group
Leif Hoegh
Wilhelmsen

Official Statistics of Norway 1994, 1995, 1996

Ministry of Transport (Japan)

JAMRI Reports

Datastream: Codes

Yen/US$ exchange rate	JAPAYE$	
Krone/US$ exchange rate	MBNOKSP	
MOL	J:MO@N	932300
NYK	J:NY@N	930449
K Line	J:KK@N	932298
Bergesen	N:BEA	745249
Leif Hoegh	N:LHO	775919
Wilhelmsen	N:WWI	929581

Japanese Shipowners' Association

Norwegian Shipowners' Association

Japanese Development Bank

Christianna Bank

Intertanko

APPENDICES

Appendix 1: Contractual agreements

Some shipowners are attempting to neutralise the effect of currency fluctuations by the insertion of clauses in the contract between the owner and the charterer. Intertanko suggest three paragraphs as follows:

1. The money of payment is the US Dollar, and the money of account is made up of five predominant shipping currencies. It is, however, left open to the Owners/ Charterers to select appropriate currencies. The parties may also wish to have a weighted average in relation to their expenditure, this may be done by accumulation of the currencies which are important as expenditure currencies.

   If currencies are included for which more than one quotation is made depending upon the transaction involved, the decisive quotation may be specified by a special provision if not, it should be presumed that the one commonly used for freight transaction is the decisive one.

2. The Basic Exchange Rates are to be stipulated at the date when the charter party is signed. To insure against abnormal quotation of that date, an average quotation is to be calculated.

   It is presupposed that the Quarterly Exchange Rates are to be calculated every third month on a similar average basis.

It may be noted that as for the exchange rate for Dollars in relation to pound sterling, the inverse rate of that commonly used must be taken in the calculation.

As the service of providing quotations free of charge by Citibank NA London is now well established, it is recommended that the parties to the contract take advantage of this service.

3. For revision of the freight, reference is always made to the 'Basic Exchange Rates' and not the revised rates as is the case in our other clause. If there is a variation of at least 2%, a revision is due but another percentage may be agreed upon. If the Dollar is strengthened there will be a reduction of the freight, if it is weakened, there will be an increase of the freight rate.

It has been pointed out that it may be reasonable that the parties should bear some of the risk and that the clause should not be given full effect. This may coincide with the principle in other charter party clauses. The clause suggests that the parties should take 50% of the risk, and this principle would certainly be feasible if the Owner has some expenses in US Dollars.

As it is generally felt that market charter rates reflect currency uncertainties during the shorter term, it is found that the parties to the contract may take the full risks during the first six months or the first year of the period of the charter party, depending on the length of the charter. This is another point that may be agreed upon during negotiation.

Appendix 2 : Schedule Of Meetings

OSLO 1997

Date	Time	Company	Contact
Tuesday 25 November 1997	10:00	**Intertanko** Grange-Rolvs gate 5 PO Box 2829 Solli N-0204 Oslo Phone: 22 12 26 40	Erik Ranheim Director
Wednesday 26 November 1997	09:30	**Bergesen dy ASA** Drammensveien 106 PO Box 2800 Solli N-0204 Oslo Phone: 22 12 05 05	Gutav Huuse (Treasury)
Wednesday 26 November 1997	11:45	**Nordisk Skibsrederforening** Kristinelundv 22 PO Box 3033 Elisenberg N-0207 0010 Oslo Phone: 22 55 47 20	Frode Grotmol (Advokat)
Thursday 27 November 1997	10.00	**Fearnleys** Ship Brokers Grev Wedels Plass 9 Oslo	Jarle Hammer Director
Thursday 27 November 1997	12:00	**Christiania Bank** Middelthuns gate 17 PO Box 1166 Sentrum 0107 Oslo Phone: 22 48 50 00	Anne Stark-Johansen (First Vice President)
Friday 28 November 1997	10.00	**Norges Referiforbund** Radhusgt 25 N-0116 Oslo Phone: 22 40 15 00	Ole Kristian Baervahr

JAPAN 1998

Date	Time	Company	Contact
Monday 9 March 1998	14.30	**Japanese Shipowners Association** 2nd Floor Kaiun Building 2-6-4, Hirakawa, Chiyoda-ku Tokyo	Mr Nobuo Masuda Director General JSA Mr Tetsuro Umemoto
Tuesday 10 March 1998	10.00	**Ministry of Transport Maritime Industries Division** 6th Floor, 2-1-3, Kasumigaseki Chiyoda-ku Tokyo	Mr A Kimura
Tuesday 10 March 1998	14.00	**Kawasaki Kisen Kaisha** Hibiya Central Building 1-2-9, Nishi Shimbashi Minato-ku Tokyo	Mr T Kobayashi Assistant General Manager of Planning Group
Wednesday 11 March 1998	10.00	**Japan Maritime Research Institute (JAMRI)** 9th Floor Kaiun Building 2-6-4, Hirakawa-cho, Chiyoda-ku Tokyo	Mr Hideo Yamada Research Director
Thursday 12 March 1998	10.00	**Sanwa Research Institute** 10th Floor Shimbash Sanwa Toyo Building 1-11-7, Shimbashi, Minato-ku Tokyo	Mr Ryo Narumai
Thursday 12 March 1998	14.00	**Japan Development Bank** 2nd Floor 1-9-1, Otemachi, Chiyoda-ku Tokyo	Mr Kan Ishi
Friday 13 March 1998	10.30	**Mercantile Marine University of Tokyo**	Professor Yamagishi
Friday 13 March 1998	14.00	**Mitsui OSK Lines** 14th Floor, Shosen-Mitsui Building, 2-1-1, Toranomon Minato-ku Tokyo	Mr Heihachiro Echizen-Ya Managing Director
Monday 16 March 1998	12.30	**Japanese Shipowners Association**	Mr Hideo Usami General Manager

		4th Floor, Shosen-Mitsui Building 5 Kaigan-Dori, Chuo-ku Kobe	
Tuesday 17 March 1998	13.30	**University of Mercantile Marine** 5-1-1, Fukae-minami, Higashi-nada Kobe	Professor Kenji Ishida

Appendix 3

Distribution for F for $(\alpha,\beta,\rho)=(\alpha,0,1)$ in $y_t=\alpha+\beta t+\rho y_{t-1}+u_t$

Sample size	Probability of a smaller value							
N	0.01	0.025	0.05	0.10	0.90	0.95	0.975	0.99
25	0.74	0.90	1.08	1.33	5.91	7.24	8.65	10.61
50	0.76	0.93	1.11	1.37	5.61	6.73	7.81	9.31
100	0.76	0.94	1.12	1.38	5.47	6.49	7.44	8.73
250	0.76	0.94	1.13	1.39	5.39	6.34	7.25	8.43
500	0.76	0.94	1.13	1.39	5.36	6.30	7.20	8.34
infinity	0.77	0.94	1.13	1.39	5.34	6.25	7.16	8.27
Standard error	0.004	0.004	0.003	0.004	0.015	0.020	0.032	0.058

Source: Dickey and Fuller Op. cit. Table V1 p. 1063, 1981

Appendix 4 : Liner Conferences and Alliances

Liner conferences were established in the late 19th century in an attempt to gain stability of freight rate structure in the liner trade and to obtain the scale necessary for frequent services. A conference is an informal association of liner operators which acts collectively to limit competition between themselves and from external operators. A conference will instigate a uniform freight rate structure for a diverse set of commodities on particular routes. The United Nations defines a conference as follows[1]:

> 'The word 'conference' denotes, not a single system but a generic term covering a whole variety of common services and common obligations undertaken by shipowners serving particular trades. Broadly speaking, the term denotes a meeting of lines, serving any particular route, aimed at agreements on uniform and stable rates of freight and the provision of services under stated working conditions in that trade. It ranges from a very informal associations to a well developed organisation, with a permanent secretariat behind it. The obligation the parties to such agreements undertake towards one another will vary as widely as do the agreements themselves. .....

It further defines the shipping conference as:

> 'an unincorporated association of mutually competitive liner operators, maintained for the purpose of (1) controlling competition among its members: and (2) strengthening the members through co-operative action in their competitive fight against non-member carriers.'

The conferences soon developed into strong cartels with substantial monopoly power. For this reason they came under scrutiny, particularly in the US and UK. In defence of their associations, the conference participants argued that the alternative to conferences would be chaotic markets which could not maintain price stability or quality of service. This view was adopted by the enquiries and resulted in the conferences being given immunity from anti-trust laws in the developed nations.

The conditions necessary for an effective conference may be summarises as follows (Gilman 1985)[2]. The also makes clear the importance of the anti-trust legislation.

'the crucial requirements are the ability to negotiate, fix and police rates, including intermodal rates, whilst member lines need to be allowed to form consortia or operating clubs. To maintain the integrity of the conference, provisions for independent rate action and service contracts are best avoided. Immunities from anti monopoly laws need to be complete, whilst any safeguards relating to the conference function should take the form of clear cut prohibition. This last provision is particularly important as attempts to ensure conformance with broad regulatory standards, capable of wide interpretation, tend to lead to excessive regulatory intervention, costly litigation and possibly to an eventual paralysis in decision taking. (p.126)

Gilman further stresses that within this system a competitive structure may exist.

'Provided that the conditions set out above are satisfied, the rest of the system does not have to be restrictive. In particular, conferences may be as open and tying arrangements relatively weak. In a system of this type there would be rationalising and co-operative forces at work but there would also be scope for competition, and the eventual competitive structure would depend on the character of the route....' (p. 126)

Conference agreements removed competition with respect to the freight rates, but within this structure competition still exists through quality differentiation. Also the individual operators still controlled their own cost structures and risk management policies (McConville 1999)[3].

More recently the US Ocean Shipping Reform Act of 1998 (OSRA) has had an impact on the operation of the conference system. From the 1 May 1999 the new act, OSRA, replacing the Shipping Act of 1984, is expected to promote freer competition in the shipping industry with respect to the US trades, previously regulated by the US government.

Under the previous act conferences had to file their contract rates with the US Federal Maritime Commission (FMC), and the rates were made public. Special rates to certain customers were permitted, but the rate again had to be disclosed. Under the new regime conference members have the right to offer shippers preferential treatment, on condition that a minimum cargo volume is guaranteed, without disclose of that rate. There is also no requirement that shippers with the same terms of shipment be guaranteed contracts

with identical terms. Disclosure of ports covered by the contract, commodities, minimum cargo volume and duration of contract is, however, required.

The rate setting function, traditionally performed by the conferences, has thus disappeared, and each company can contract with shippers on the basis of its own business.

With containerisation came the need for large capital investment. This was achieved through the creation of consortia, strategic partnerships and mergers and acquisitions. The consortia were characterised by pooling agreements and by financial and operational co-operation. Strategic partnerships were involved in co-operative operation, which included shared equipment as a means of creating greater cost efficiencies. Mergers and acquisitions are the most extreme form of integration on all levels, operational, financial, and managerial.

The fierce competition, together with a wave of mergers and acquisitions has forced some reorganisation of consortia and alliances in recent years. On the 'trunk line' Asia-Europe and Asia-North American Service a new Grand Alliance, comprising Hapag-Lloyd Malaysia International Shipping Corporation, Orient Overseas Container Line, P&O Nedlloyd and NYK, began full operation in spring 1998. The alliance has a combined fleet of 93 vessels, 369,552 TEUs operating on 6 routes to North America and 6 routes to Europe[4]. K Line operates in co-operation with Yangming Marine Transport Corporation of Taiwan and China Ocean Shipping Group (COSCO) of China[5]. The New World Alliance of MOL, NOL/APL of Singapore, and HMM of South Korea was formed in 1997. The alliances operate on a system of share assets

(approximately 100 vessels) and other resources, which has been instrumental in the reduction of costs on routes to North America and Europe[6].

Appendix 5: Diversity of Trades of Major Shipping Companies

Shipping Companies : Operating Position by Type of Trade

The following is an analysis of the sources of revenue or profit of the companies under investigation in terms of maritime and non maritime trade. The maritime revenue, where possible, is further analysed in terms of the various sectors in order to highlight the diversity of business activities.

Comments

Japan

All of the Big 3 Japanese companies are predominantly maritime, with these activities accounting for around 80% of the revenue in the case of MOL and K Line, and 75% in the case of NYK. Their other activities are in transportation, covering areas such as logistics, freight forwarding and terminal operation.

Within the maritime trade all companies are engaged in a diverse range of activities: liner, dry bulk, car carrier, tanker, gas carriers and a small amount of cruise shipping. MOL and K Line have the greatest proportion of their business in the container trade, whereas NYK is more involved in the tanker sector.

The diversity of trade means that all the companies have reduced exposure to one particular sector.

Norway

The Norwegian companies under investigation are almost exclusively maritime, the exception being Wilhelmsen which is engaged in a small amount of agency and ship management activity. Due to availability of information, the analysis by shipping sector is done on the basis of operating profit. This will clearly bias the analysis towards the more profitable sectors not the highest in terms of income generation.

As with the Japanese companies, there is a degree of diversity of maritime trades. Bergesen Group is predominantly involved in gas Carriers and tankers, Leif Hoegh with car carriers and liner trade, and Wilhelmsen primarily with liner and some bulk activity.

Mitsui OSK Line

Results for year to 31 March 1999

Trade	Percentage of Operating Revenue
Maritime	82.8%
Services Incidental to Transportation (note 1)	12.4%
Other	4.8%
Total	100%

Source: MOL Annual Report 1999

Note 1: These incidental services include shipping agent and harbour terminal operation, cargo forwarding and warehousing

The Maritime Revenue may further be analysed by shipping sector as follows:

Sector	Percentage of Maritime Operating Revenue
Liner	41.3%
Bulk and Car Carriers	28.9%
Tankers and Gas Carriers	15.7%
Cruise Ships	8.8%
Domestic Ferries	5.3%
Total	100%

K Line

Results for Year to 31 March 1999

Trade	Percentage of Operating Revenue
Maritime	81.0%
Services Incidental to Transportation (note 2)	16.3%
Other	2.7%
Total	100%

Source: K Line Annual Report 1999

Note 2: These incidental services comprise Logistics Services, Container Terminal Operations and Transportation Business in North America, Air Freight Forwarding

The Maritime Revenue may further be analysed by shipping sector as follows:

Sector	Percentage of Maritime Operating Revenue
Container	46.8%
Bulk and Car Carriers	43.5%
Tankers and Gas Carriers	9.7%
Total	100%

NYK Line

Results for Year to 31 March 1999

Trade	Percentage of Operating Revenue
Maritime	74.4%
Oil Wholesaling	9.3%
Real Estate	1.6%
Other	14.7%
Total	100%

Source: NYK Annual Report 1999.

The Maritime Sectors are categorised as follows. In this case the revenues for the sectors are not disclosed and the analysis is, therefore, based on dead weight tonnes operating in each trade.

Sector	Percentage of Maritime Operating Revenue
Container	7.6%
Bulk and Car Carriers	57.6%
Tankers and Gas Carriers	33.7%
Cruise	0.1%
Other	1.0%
Total	100%

Bergesen d.y. Group

Results for Year to December 1998

Trade	Percentage of Operating Profit
Maritime	100%

Source: Bergesen Annual Report 1998.

The Maritime Sectors are categorised as follows.

Sector	Percentage of Maritime Operating Profit
Gas Carriers	42.1%
Tankers	50.3%
Dry Bulk	7.6%
Total	100%

Leif Hoegh

Listed on the Oslo Stock Exchange in December 1987. The oil and bulk activities were demerged into Bona Shipholding in 1992.

Results for Year to 31 December 1998

Trade	Percentage of Operating Profit
Maritime	100%

Source: Leif Hoegh Annual Report 1998.

The Maritime Sectors are categorised as follows.

Sector	Percentage of Maritime Operating Profit
Gas Carriers	7.1%
Dry Bulk	7.4%
Liners	22.0%
Car Carriers	57.3%
Reefers	6.2%
Total	100%

Wilhelmsen

Results for the Year to 31 December 1998

Trade	Percentage of Operating Profit
Maritime	87.9%
Agency	6.4%
Ship Management	5.7%
Total	100%

Source: Wilhelmsen Annual Report 1998.

The Maritime Sectors are categorised as follows.

Sector	Percentage of Maritime Operating Revenue
Liners	94.3%
Tanker & Dry Bulk	5.7%
Total	100%

Bona Shipping

The oil and bulk activities of Leif Hoegh were demerged into Bona Shipholding in 1992. This company was delisted on 25 August 1999 when it merged with Northwest.

Appendix 6: Stock Exchange Information

Stock Exchange Information

Oslo

	Market Capitalisation 31.12.98 (NOK Million)
Shipping & Offshore	**127,168**
Total	**465,996**
Shipping & Offshore as % of Total	**26.4%**

Source: Oslo Bors

Tokyo

	Market Capitalisation 31.3.99 (Billion Yen)
'Big 3'	
MOL	**201.64**
NYK	**471.50**
K Line	**98.36**
Total	**771.50**
'Big 3' as % of Total	**0.17%**

Source: Tokyo Stock Exchange and Annual Reports of 'Big 3' Companies

Appendix 7: Dividend History

	MOL (Yen)	NYK (Yen)	KLINE (Yen)	BERG (Krone)	LEIF (Krone)	WILH (Krone)
1987	0	3.85	0	0.62	NA	0
1988	0	4	0	0.62	NA	0
1989	0	4	0	0.75	NA	0.6
1990	3.88	4	0	0.85	0	0.75
1991	3.88	4	0	1	0	1
1992	3.88	4	0	1	1.88	1.3
1993	4	4	0	1	2.82	1.5
1994	0	4	0	1	2.82	2
1995	0	4	0	1	2.82	2.5
1996	0	4	0	1	3.77	3.25
1997	0	4	0	2.01	3.94	4.49
1998	4	4	3	3	3.94	5.53
1999	4	4	3	3.23	NA	NA

Source: Annual Reports

Appendix 8: Data

Japan

Date	MITSUI	NAVIX	NYK	KLINE	SHOWA	TOPIX	YEN/US$	US	JAPAN
							RATE	PPI	PPI
1986M1	207.76		310.58	140	288.7	1047.08			
1986M2	192.23		285.58	128	306.09	1048	191.45		
1986M3	200.97		302.89	151	316.52	1099.69	179.5		
1986M4	247.57		475.96	160	347.83	1260.13	178.25		
1986M5	221.35		357.69	145	419.13	1246.45	169.8		
1986M6	242.71		385.58	220	395.65	1309.83	174.85		
1986M7	259.22		410.58	215	439.13	1355.68	162.8		
1986M8	295.14		485.58	260	413.91	1411.29	153.65		
1986M9	317.47		552.89	225	348.7	1543.08	153.8		
1986M10	263.1		475.96	170	365.22	1492.81	154.03		
1986M11	217.47		385.58	160	347.83	1407.96	164.1		
1986M12	238.83		418.27	173	379.13	1514.76	162.2		
1987M1	223.3		442.31	158	373.91	1562.55	158		
1987M2	242.71		498.08	190	343.48	1762.07	152.45		
1987M3	289.31		586.54	195	320	1805.61	153.66		
1987M4	325.24		699	223	345.22	1902.24	146.85		
1987M5	297.08		639	220	326.96	2114.92	140.05		
1987M6	308.73		635	231	363.48	2156.68	145.33		
1987M7	287.37		585	240	405.22	2042.53	146.8		
1987M8	266.01		550	220	378.26	2018.89	150.85		
1987M9	286.4		590	228	417.39	2153.2	141.6		
1987M10	309.7		616	256	450.43	2108.33	146.1		
1987M11	318.44		619	288	469.57	1914.87	136.95		
1987M12	275.72		557	245	539.13	1851.86	133.25		
1988M1	248.54		490	213	565.22	1725.83	121		
1988M2	308.73		525	238	600	1925.83	129.35		
1988M3	310.67		587	249	607.83	2089.11	128.31		
1988M4	370.87		625	265	713.04	2130.2	123.85		
1988M5	404.85		686	275	835.65	2213.08	124.8		
1988M6	412.61		700	332	821.74	2151.17	125.37		
1988M7	538.82		775	480	765.22	2163.66	134.35		
1988M8	480.57		756	394	721.74	2249.1	132.48		
1988M9	411.64		671	320	721.74	2093.2	136.3		
1988M10	588.34		770	420	746.96	2125.78	133.6		
1988M11	670.86		830	490	800	2155.62	125.37		
1988M12	776.68		920	580	1026.09	2282.5	121.45		
1989M1	713.58		868	515	1000	2357.03	124.98		
1989M2	748.53		908	564	1017.39	2445.05	129.45		
1989M3	838.82		907	590	904.35	2443.76	128.15		
1989M4	900.95		975	806	865.22	2467.52	132		
1989M5	966.97		1120	887	956.52	2503.26	134		
1989M6	942.7	1120	1040	935	991.3	2518.21	142.6		
1989M7	888.33	1120	1010	882	1252.17	2467.15	141.25		

1989M8	935.9	1130	1140	930	1191.3	2627.62	136.05		
1989M9	881.53	1080	1070	898	1165.22	2602.51	145.82		
1989M10	878.62	999	1030	906	1086.96	2703.58	139.62		
1989M11	910.66	1180	1100	1040	1217.39	2691.19	143.75		
1989M12	970.85	1240	1150	1050	1347.83	2819.63	143.4		
1990M1	1097.06	1200	1170	1120	1304.35	2881.37	143.75	117.6	99.4
1990M2	990.27	1120	1050	1000	1156.52	2754.09	144.85	117.4	99.5
1990M3	926.19	1070	990	915	1095.65	2536.01	149.85	117.2	100.1
1990M4	762.12	795	765	680	921.74	2069.33	158.85	117.2	100.5
1990M5	810.66	900	881	810	808.7	2214.78	158.75	117.7	100
1990M6	917.46	941	953	955	921.74	2426.55	151.75	117.8	99.9
1990M7	786.39	896	868	840	921.74	2348.7	150.95	118.2	99.8
1990M8	719.4	771	800	782	895.65	2246.68	147.15	119.3	100
1990M9	548.53	630	615	581	609.56	1945.92	144.05	120.4	100
1990M10	398.05	517	505	391	560.87	1523.43	136.78	122.3	100
1990M11	512.61	549	575	540	686.96	1794.79	130.6	122.9	100.2
1990M12	451.45	560	500	415	578.26	1671.22	135.65	122	100.6
1991M1	466.98	501	555	435	513.04	1733.83	135.8	122.3	100.5
1991M2	461.15	531	553	416	436.52	1704.26	131.5	121.4	99.9
1991M3	597.07	600	677	586	586.96	1931.66	134.65	120.9	100.1
1991M4	634.94	600	652	550	735	1959.96	139.75	121.1	99.7
1991M5	597.07	556	616	528	708	1998.45	138.25	121.8	99.7
1991M6	595.13	520	635	577	648	1965.29	139.15	121.9	99.7
1991M7	554.36	506	618	532	650	1868.12	138.45	121.6	99.5
1991M8	531.06	470	620	531	577	1852.22	137.55	121.7	99.4
1991M9	533.97	475	601	512	470	1749.7	136.8	121.4	99.1
1991M10	582.51	503	649	575	577	1851.07	133.3	122.2	98.6
1991M11	590.28	539	654	611	575	1881.76	129.65	122.3	98.6
1991M12	530.09	460	578	516	531	1692.4	130.1	121.9	98.5
1992M1	533.97	466	577	534	561	1714.68	124.8	121.8	98
1992M2	490.28	415	564	465	515	1632.62	126.25	122.1	98.1
1992M3	458.24	401	559	436	550	1561.07	129.65	122.2	98.4
1992M4	383	321	444	365	511	1359.67	134.55	122.4	98.4
1992M5	389	351	460	329	605	1313.41	132.7	123.2	98.2
1992M6	401	321	490	385	638	1360.54	126.82	123.9	97.9
1992M7	369	305	471	355	605	1258.98	125.4	123.7	98
1992M8	351	240	472	335	550	1207.44	127.2	123.6	98.1
1992M9	398	317	519	423	555	1370.27	122.83	123.3	97.7
1992M10	390	300	476	408	572	1304.43	119.8	124.4	97
1992M11	372	250	489	378	596	1280.44	123.73	124	97.1
1992M12	355	279	496	357	694	1304.08	124.1	123.8	97.1
1993M1	340	250	492	350	711	1307.66	124.82	124.2	97
1993M2	355	260	498	353	710	1300.01	125.1	124.5	96.6
1993M3	336	270	452	303	761	1276.25	118.75	124.7	96.1
1993M4	409	306	585	390	790	1471.19	113.95	125.5	95.6
1993M5	449	356	647	425	865	1620.79	110.83	125.8	95.3
1993M6	455	362	613	413	942	1637.25	107.1	125.5	94.8
1993M7	447	332	602	375	840	1598.03	107.38	125.3	94.7
1993M8	439	344	615	411	821	1654.79	104.45	124.2	94.1
1993M9	456	345	646	418	842	1689.41	105.35	123.8	94.1

1993M10	413	296	606	386	853	1634.09	105.9	124.6	93.9
1993M11	395	257	598	338	874	1619.75	108.21	124.5	93.8
1993M12	352	246	574	291	711	1443.87	108.8	124.1	93.9
1994M1	344	293	535	280	730	1439.31	112.395	124.5	94
1994M2	397	348	635	342	902	1643.1	107.64	124.8	93.5
1994M3	394	355	604	350	1020	1645.48	104.615	124.9	93.3
1994M4	361	350	566	327	1040	1571.18	103.45	125	93
1994M5	359	358	596	350	1050	1593.48	101.775	125.3	93.1
1994M6	430	405	645	400	1010	1693.58	104.65	125.6	93
1994M7	400	360	639	375	1020	1662.16	98.705	126	92.8
1994M8	386	371	637	361	962	1629.82	98.85	126.5	93
1994M9	415	359	662	380	959	1639.91	99.665	125.6	92.9
1994M10	400	362	635	372	908	1579	99.82	125.8	92.6
1994M11	422	351	656	417	996	1579.35	96.755	126.1	92.6
1994M12	391	343	650	384	940	1519.2	99.34	126.2	92.9
1995M1	378	361	654	400	984	1559.09	99.77	126.6	93
1995M2	337	314	565	343	910	1464.14	99.46	126.9	92.9
1995M3	300	269	549	324	748	1327.6	96.75	127.1	92.3
1995M4	292	257	500	265	655	1250.61	86.19	127.6	91.6
1995M5	300	260	537	297	690	1331.98	83.57	128.1	91.4
1995M6	260	204	509	260	617	1260.6	85.1	128.2	91.3
1995M7	225	228	468	222	568	1194.28	84.63	128.2	91.5
1995M8	249	243	536	248	669	1314.15	88.29	128.1	92.1
1995M9	306	286	595	312	710	1425.04	97.415	127.9	92.7
1995M10	281	265	580	295	705	1422.07	100.585	128.7	92.5
1995M11	265	240	540	266	790	1405.95	103.025	128.7	92.6
1995M12	301	276	591	301	745	1497.65	101.33	129.1	92.6
1996M1	331	309	599	328	790	1577.7	103.155	129.4	92.8
1996M2	357	321	613	368	943	1624.52	107.115	129.4	92.8
1996M3	330	298	596	344	916	1564.83	105.455	130.1	92.7
1996M4	353	358	619	364	910	1649.75	107.5215	130.6	92.8
1996M5	377	328	640	380	1040	1697.61	105.115	131.1	92.6
1996M6	356	328	634	340	1070	1658.64	108.285	131.7	92.6
1996M7	382	309	635	363	1100	1708.21	109.575	131.5	92.8
1996M8	347	289	601	319	965	1597.38	106.755	131.9	92.6
1996M9	322	280	570	307	1000	1539.67	109.165	131.8	92.7
1996M10	337	272	588	320	1050	1622.91	111.295	132.7	92.8
1996M11	320	273	561	298	970	1557.57	113.59	132.6	93.1
1996M12	299	240	544	288	1120	1542.19	113.78	132.7	93.4
1997M1	277	190	524	264	1000	1470.94	116.07	132.6	93.7
1997M2	252	201	476	242	920	1367.74	121.77	132.2	94.3
1997M3	236	205	469	235	969	1379.58	120.825	132.2	94.2
1997M4	222	183	426	221	920	1363.05	123.04	131.6	95.8
1997M5	225	205	472	216	970	1453.24	126.27	131.5	95.1
1997M6	260	211	490	250	985	1507.83	116.505	131.3	94.4
1997M7	238	188	440	228	975	1529.38	114.9	131	94.5
1997M8	204	175	400	191	985	1512.79	118.4	131.3	94.5
1997M9	206	164	425	182	900	1402.23	120.78	131.7	94.6
1997M10	157	121	400	125	865	1388.45	120.85	131.8	93.3
1997M11	193	128	439	173	852	1277.12	121.45	131.5	93.6

1997M12	193	115	379	169	910	1274.44	128.87	131.4	94
1998M1	181	78	358	158	700	1175.03	130.57	130.6	93.7
1998M2	223	131	378	186	760	1262.09	126.56	130.5	92.7
1998M3	237	118	422	217	747	1296.97	125.53	130.5	92.5
1998M4	203	102	455	197	756	1231.53	133.68	130.7	92.5
1998M5	190	92	435	189	820	1217.7	133.45	130.6	92.6
1998M6	210	92	475	224	821	1196.7	139.66	130.4	93.1
1998M7	242	94	465	244	748	1270.75	137.92	130.7	93.1
1998M8	244	86	449	249	800	1245.24	145.63	130.3	93.3
1998M9	217	72	419	212	860	1110.15	136.4	130.6	92.3
1998M10	195	73	408	198	806	1015.72	135.75	131	90.7
1998M11	175	68	384	170	630	1065.84	114.95	130.7	90.2
1998M12	196	54	380	176	697	1142.26	122.12	131.3	89.9
1999M1	182	47	357	152	595	1086.99	113.45	131.7	89.1
1999M2	185	49	342	152	530	1119.37	115.05	131.1	89.2
1999M3	182	60	387	168	466	1107.81	119.83	131.6	89.3
1999M4	241	56	486	235	506	1300.44	120.55	132.2	89.2
1999M5	275	56	465	280	571	1337.12	120.22	132.4	89.5
1999M6	273	56	504	286	612	1317.48	120.63	132.3	

Norway

Date	Bergesen	Leif Hoegh	Wilhelmsen	Bona	Oslo	US	Norway	Krone/US$
				Shipping	Stock Index	PPI	PPI	Rate
1987M1	34.87		40.5		311.33			7.3625
1987M2	33.62		40		312.5			7.0075
1987M3	33.12		38		309.92			6.972
1987M4	35.25		37		316.3			6.84
1987M5	37.81		46		327.92			6.68
1987M6	46.12		52		324.89			6.7825
1987M7	46.56		66.5		340.76			6.688
1987M8	52.5		72.5		345.98			6.81
1987M9	49.37		63		357.91			6.6525
1987M10	54.37		73		384.04			6.7375
1987M11	43.25		50		263.8			6.501
1987M12	40		35		221.91			6.42
1988M1	41.25		32		219.14			6.25
1988M2	50.94		39		270.36			6.397
1988M3	54.06		42.5		290.55			6.343
1988M4	61.25		39		283.43			6.2315
1988M5	65		42		288.42			6.177
1988M6	71.25		39		288.27			6.27
1988M7	75		46		309.16			6.655
1988M8	81.25		58		330.25			6.8005
1988M9	73.5		52		326.7			6.9295
1988M10	82.5		52		354.83			6.8775
1988M11	88.75		70		382.08			6.64
1988M12	102.5		77		421.86			6.475
1989M1	106.25		83.5		452.11			6.5495
1989M2	107		97		507.26			6.735
1989M3	112		111		534.46			6.733
1989M4	108		122		545.27			6.8405
1989M5	124.75		110		584.37			6.86
1989M6	155		125		690.33			7.1625
1989M7	157.5		112		701.58			7.0585
1989M8	165		123.5		751.16			6.81
1989M9	163		164		781.34			7.1905
1989M10	163		153		793.61			6.925
1989M11	165		143		740.7			6.9025
1989M12	177.5		150		770.3			6.815
1990M1	194		160		800.07	117.6	145.8	6.59
1990M2	194		170		828.39	117.4	146.2	6.4825
1990M3	207.5		182		913.04	117.2	146.3	6.5775
1990M4	218	94.17	181		954.96	117.2	145.8	6.59
1990M5	218	90.82	172		928.87	117.7	145.3	6.525
1990M6	225	95.6	180		952.12	117.8	145	6.525
1990M7	200	86.04	157.5		865.15	118.2	146.4	6.357
1990M8	225	93.69	170		948.92	119.3	148.7	6.15
1990M9	157	80.31	126		746.44	120.4	152.8	6.092

1990M10	146	63.1	112		671.79	122.3	154.5	6.044
1990M11	123	57.36	100		592.61	122.9	153.4	5.8542
1990M12	135	66.44	85		579.34	122	152	5.914
1991M1	113	66.92	77		517.95	122.3	152.4	5.8832
1991M2	126	65.01	82		525.56	121.4	150.6	5.7528
1991M3	137	70.27	103		599.07	120.9	150.6	6.016
1991M4	138	76.48	120		620.4	121.1	150.6	6.5255
1991M5	133.5	78.39	107		565.63	121.8	150.8	6.6636
1991M6	161.5	86.04	124		624.41	121.9	151.1	6.81
1991M7	159	87	111		612.29	121.6	152.8	7.1225
1991M8	170	93.69	122		646.56	121.7	152.7	6.867
1991M9	172.5	97.51	121		665.91	121.4	153.6	6.8285
1991M10	173	94.65	108		636.75	122.2	153.9	6.525
1991M11	169	91.78	103		614.54	122.3	153.5	6.44
1991M12	129.5	75.53	75		472.45	121.9	151.8	6.355
1992M1	123.5	83.17	80		473.67	121.8	150.3	5.9675
1992M2	128	80.31	82		499.93	122.1	150.2	6.275
1992M3	113.5	72.66	71		458.24	122.2	151.3	6.4405
1992M4	103	61.19	55		410.79	122.4	152.2	6.486
1992M5	118	66.44	65.5		446.7	123.2	152.3	6.402
1992M6	109	71.7	71		423.06	123.9	152.7	6.2515
1992M7	90.5	60.23	55.5		362.85	123.7	151.9	5.965
1992M8	88.5	57.36	58		325.14	123.6	150.9	5.7975
1992M9	65	46.37	41.5		243.77	123.3	151.1	5.5073
1992M10	80.5	49.71	43		285.2	124.4	151.3	5.7908
1992M11	89	60.23	60		311.51	124	151.2	6.3956
1992M12	95	65.01	69		314.01	123.8	151	6.4364
1993M1	91.5	67.88	74		308.57	124.2	150.6	6.9334
1993M2	85	72.18	77.5		319.53	124.5	150.7	6.9591
1993M3	89.5	68.36	75		334.47	124.7	150.7	7.0359
1993M4	100.5	78.87	93		380.6	125.5	149.9	6.7636
1993M5	110	93.69	111.5		451.3	125.8	149.8	6.6808
1993M6	121	83.17	119		470.06	125.5	149.7	6.7584
1993M7	134	97.99	149		529.69	125.3	149.2	7.1664
1993M8	149	108.03	160		579.77	124.2	149.5	7.3829
1993M9	147	112.81	143		594.73	123.8	149.1	7.2283
1993M10	132.5	93.69	137		540.74	124.6	149.9	7.1299
1993M11	150	97.51	150		590.72	124.5	150	7.3867
1993M12	140.5	98.47	135		547.52	124.1	149.3	7.4838
1994M1	144.5	100.38	141		562.09	124.5	149.6	7.5251
1994M2	156	106.12	146		605.98	124.8	150.4	7.4278
1994M3	148	102.29	140		581.83	124.9	150.4	7.4215
1994M4	156	93.21	138		576.63	125	151.2	7.277
1994M5	156	94.65	138.5		579.42	125.3	151.6	7.1511
1994M6	164	99.43	143		597.81	125.6	152	7.1276
1994M7	160.5	90.82	135		572.94	126	152.1	6.9678
1994M8	172	92.73	142		605.11	126.5	152.3	6.8796
1994M9	158	83.17	138		572.74	125.6	152	6.9066
1994M10	146.5	83.17	130		533.75	125.8	152.6	6.8115
1994M11	140	81.26	129		527.52	126.1	153.7	6.535

1994M12	158	81.26	143.5		573.67	126.2	153.7	6.8379
1995M1	162.5	86.04	160		594.24	126.6	155	6.764
1995M2	155	89.87	147.5	17.7	590.17	126.9	155.3	6.6673
1995M3	143.5	85.09	140	18.55	571.6	127.1	155.1	6.4706
1995M4	136	78.39	135	19.82	544.45	127.6	155.8	6.1555
1995M5	136	84.13	138	19.23	564.49	128.1	156	6.241
1995M6	127	79.35	140	19.95	565.44	128.2	155.8	6.3145
1995M7	139.5	78.39	137.5	21.19	583.88	128.2	155.3	6.1345
1995M8	149	88.91	144	22.23	610.4	128.1	155.5	6.117
1995M9	154	92.73	150	22.5	627.85	127.9	156.2	6.4
1995M10	140	92.26	136	20.72	626.54	128.7	155.7	,6.273
1995M11	130	86.04	125	20.5	572.16	128.7	156.1	6.2425
1995M12	129.5	87.95	118	21.07	600.81	129.1	156.5	6.36
1996M1	126	89.87	126	20.26	601.68	129.4	157.6	6.3181
1996M2	130	89.39	133	19.64	639.52	129.4	158	6.5166
1996M3	121	89.87	136	21.18	672.91	130.1	158.6	6.4211
1996M4	112	86.04	135	21.42	649.29	130.6	159.1	6.4434
1996M5	118	90.82	144	20.05	720.28	131.1	158.1	6.5841
1996M6	128	93.69	154	22.22	732.05	131.7	157.6	6.5271
1996M7	137.5	108.99	162.5	24.61	771.99	131.5	158.3	6.5011
1996M8	137.5	108.03	158	24.36	760.13	131.9	158.5	6.3635
1996M9	134.5	105.64	160	24.34	767.39	131.8	160.5	6.4401
1996M10	138	106.12	160	23.99	783.88	132.7	161.5	6.5025
1996M11	144	105.16	160	24.75	800.96	132.6	160.5	6.3846
1996M12	146.5	113.77	174	24.89	828.22	132.7	160.6	6.427
1997M1	156	129.06	177	23.8	864.02	132.6	161.3	6.3854
1997M2	146	133.84	180	23.67	928.68	132.2	160.7	6.5036
1997M3	142	127.15	180	21.06	898.7	132.2	160.2	6.8367
1997M4	143	121.41	180	19.95	894.61	131.6	159.9	6.718
1997M5	147	129.06	189	19.2	928.79	131.5	160.7	7.0828
1997M6	169	136.71	220	18.98	1034.95	131.3	160.8	7.1611
1997M7	174	150.1	230	21.91	1083.35	131	161.5	7.3283
1997M8	195	154	268	23.43	1230.21	131.3	162.3	7.7108
1997M9	201	162	270	25.22	1274.52	131.7	161.9	7.4873
1997M10	217	170	296	26.63	1371.98	131.8	162.3	7.1353
1997M11	208	162	345	26.75	1356.05	131.5	162.1	7.0628
1997M12	182	145	315	24.83	1245.91	131.4	161.3	7.2478
1998M1	174	150	310	20.34	1207.69	130.6	161.3	7.3643
1998M2	168	125	275	20.16	1147.46	130.5	161.8	7.5148
1998M3	165	125	275	19.02	1128.97	130.5	161.3	7.5683
1998M4	160	127	300	20.92	1216.06	130.7	162	7.6778
1998M5	161	122	290	20.28	1232.09	130.6	163.1	7.3948
1998M6	152	122	290	19.47	1193.32	130.4	162.3	7.5168
1998M7	148.5	117	260	19.47	1157.55	130.7	162.5	7.7268
1998M8	133.5	115	260	19.47	1025.64	130.3	162.4	7.6133
1998M9	101	98	200	19.47	697.63	130.6	163	7.7153
1998M10	104	98	170	19.47	680.7	131	162.7	7.3788
1998M11	110	105.5	200	19.47	803.35	130.7	162.2	7.3373
1998M12	90	90	195	19.47	641.87	131.3	161.7	7.4588
1999M1	91	89	200	19.47	657.6	131.7	162.2	7.6243

1999M2	106	96	190	19.47	732.37	131.1	162.5	7.5943
1999M3	115	91.5	172	19.47	666.52	131.6	163.4	7.9458
1999M4	106	88	190	19.47	736.14	132.2	164.9	7.721
1999M5	124	96.5	199	19.47	828.28	132.4	165.2	7.7931
1999M6	120	114	220	19.47	845.09	132.3	165.1	7.8725

Appendix 9: Publications from Thesis

Norwegian shipping: measuring foreign exchange risk

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The primary aim here is an attempt to measure the impact of foreign exchange movements on the operating results of the shipping industry. The issue arises from the imposition of a volatile foreign exchange market on a freight market structure which fixes revenues in US dollars. Despite attempts to shift costs into dollars, some other currency liabilities still remain, making exposure to exchange rate fluctuations inevitable. The contemporary experience of the Norwegian industry is used to analyse the cost structure in terms of currency denomination, the volatility in the real Kroner/US dollar exchange rate, and the sensitivity of the operating results to these fluctuations. This serves to highlight the commercial vulnerability of shipping companies. Exposure can be seen in a positive or negative light depending on the direction of movement in the exchange rate. Operating profits can rise and fall dramatically simply because of these exchange rate movements.

1. Introduction

Foreign exchange risk is just one of a number of risks facing the shipowner entrepreneur. It arises from the imposition of a volatile exchange market on a unique freight market structure. This structure effectively fixes revenues in US dollars, leaving a proportion of costs to be met in a variety of other currencies. Fluctuations in the rate of exchange between these currencies and the US dollar can therefore have a serious impact on shipowners' operating profit, and in turn, the value of their business. This paper attempts to measure the impact of this volatility on the operating results of the industry.

The issue is one of exchange rate volatility which does not conform to economic fundamentals, notably relative inflation in the respective countries. The problem has existed to varying degrees since the breakdown of the Bretton Woods agreement in the early 1970s, and was then recognized as an issue for the industry. Beth [1] wrote:

> 'The real issue for the shipping industry is not short term currency fluctuations containing ups and downs likewise, but the fixation to a given freight rate, printed in the US $, being also subject to market fluctuations indeed, but the commensurate value in national or home currency which is exposed to a medium fluctuation trend... What makes things complex is that each country is in a different position with regard to the dynamic value of its currency expressed in dollars as well as to its home rate of inflation. It is beyond question that just in a situation of overall market weakness shipping in high-cost nations with strong currencies may suffer most' (p. 2).

There are therefore two aspects to the problem. Firstly the cost structure in terms of currency denomination, and secondly the volatility of the real exchange rate. Both are instrumental in any attempt to measure the exposure. This paper examines the particular experience of Norwegian shipowners, using official statistics, company financial statements and the results of discussions with shipowners, shipbrokers, and financiers. The approach is not company specific, but is an analysis of the

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industry as a whole. The results illustrate the sensitivity of operating profit to movements in the real exchange rate, and serve to highlight the need for effective foreign exchange risk management for the whole industry. What is of note is that, although common to all companies, the issue is not perceived as a collective one. Each company manages risk individually to a greater or lesser extent, using short term hedging instruments. Long term measures are usually only taken when dealing with specific projects such as the building of a ship. Clearly there is a resource issue here. The larger companies have greater facilities for the management of foreign exchange risk and can therefore take a proactive approach. For the smaller companies, the gains and losses are not perceived to be sufficiently large to justify the cost of a formal strategy. The possible effect on operating profits as seen in the case of Norwegian shipping strongly suggests that this passive stance could be commercially damaging.

2. The Norwegian shipping industry

Norway plays a key role in world shipping, controlling 10% of the world fleet, around 1400 vessels, totalling 48 million dead-weight tons. The fleet provides for a diverse range of cargoes, crude oil, coal, cars, chemicals, gas, and cruise passengers. Chemical and gas tankers have become a particular specialism for Norwegian shipowners who control around 20% of the world fleet in the area [2].

In terms of the domestic economy, transport and communications accounted for 10.2% of Gross Domestic Product in 1993, with water transport accounting for 3.1%. In the same year, 15% of Norwegian exports worth 47 billion Norwegian Kroner came from shipping [3].

The situation has improved over the last 2 years with the introduction of a new shipping taxation system. The new regime replaced a corporate tax with a tonnage based model. Ships owned by the companies based in Norway can defer tax until a dividend becomes payable. This has led to both an increase in the number of ships registered under the NIS flag and an increase in the amount of profits reinvested rather than paid out as a dividend.

The industry has also become extremely important on the Oslo Stock Exchange. Over $1.2m has been raised in 1997 by companies seeking new marketable equity finance. Market capitalization for the sector has consequently increased to $18 billion from $9 billion at the start of the year. Maritime companies now account for 21% of the total market capitalization. Of the 210 companies now listed on the Exchange, 59 are shipping and offshore companies. These stocks have outperformed the all share index in 1997, with the shipping index up 68% [4] on the beginning of the year.

Table 1 shows the nominal operating results for the Norwegian registered, foreign-going fleet, 1990–1995. During this period, the industry has consistently achieved earnings in excess of NKr 30 billion. After a peak in 1991, there was a fall of 12%, but the position has steadily improved since 1993.

These results have been converted to Kroner. In so doing, they conceal the gains and losses arising from currency fluctuations. Each company faces varying degrees of risk depending on its particular cost structure. The type of business dictates part of this structure. For example, trading deep sea inevitably means most port dues are payable in currency other than dollars. The nationality of the seafarers in many cases dictates the currency denomination of the wage bill. Administrative and managerial expenses depend on the location of the head office which will mean a non dollar denominated liability.

Table 1. Operating results: Norwegian controlled, foreign-going fleet (millions Norwegian Kroner).

	Norwegian flag			Foreign flag			Total
	Operating earnings	Operating expenditure*	Operating results	Operating earnings	Operating expenditure*	Operating results	Operating results
1990	35 357	25 821	9 535	15 532	12 138	3 394	12 929
1991	37 323	26 881	10 444	16 662	13 452	3 209	13 653
1992	32 939	25 871	7 067	15 254	12 667	2 587	9 654
1993	34 674	27 011	7 663	15 563	12 819	2 744	10 407
1994	35 608	27 529	8 079	14 817	12 454	2 363	10 443
1995	34 183	25 850	8 333	unavailable			

*before depreciation.
Source: SSB Official Statistics of Norway.

The following sections explore the extent of the foreign exchange risk from the Norwegian perspective, by analysing the exchange rates themselves and the cost structure of the industry. First, however, there is an examination of the literature to determine an appropriate methodology for the measurement of the risk.

3. Measurement of foreign exchange risk: the literature

Economic exposure is concerned with the impact of an exchange rate change on future cash flow. It comprises transaction exposure and real ,operating exposure. Transaction exposure arises from possible gains or losses on foreign currency transactions already contracted for, but settled at a future date. Real foreign exchange exposure may be defined as the extent to which the present value of a firm is expected to change as a result of a given currency appreciation or depreciation.

Cornell and Shapiro [5] maintain that the measurement of operating exposure requires a long term perspective in which the firm's costs and price competitiveness will be affected by exchange rate changes. The measurement process is difficult, but can be achieved by either 'bottom-up' or 'top-down' estimates.

'Bottom-up' estimates require an understanding of both the structure of the markets and how the various competitors source inputs and sell products, and the degree of flexibility in changing markets, product mix, sourcing and technology. This can be achieved by surveys. Typically the questions should be:

(1) Who are the actual and major competitors?
(2) Who are the low cost producers?
(3) Who are the price leaders?
(4) What has happened in the past to profit margins when real exchange rates have become over or undervalued?
(5) What is the flexibility of the company to shift production to countries with undervalued currencies?

'Top-down' estimates rely upon an analytical comparison of the historical profitability of the company with the changes in profitability expected on the basis of changes in the real exchange rate. This assumes that the competitive position of the company is constant during the period of comparison and that the company has undergone no major structural changes at the level of aggregation under review. The

techniques examine the effect of real exchange rate movements on the proportion of exposed revenues.

This approach is supported by Hagemann [6] in his analysis of long term foreign exchange management. Investment and production commitments are such that foreign exchange risks may arise years before they are reflected in a company's accounting system. Companies should aim to minimize or eliminate such exposures before they become critical and costly to cover.

In the case of shipping companies, this involves calculating the net dollar revenues used to pay non-dollar costs and their change in value as a result of exchange rate movements.

Bennett [7], suggests that this type of analysis is often used by treasury managers. He specifically identifies three main measures, 'scenario analysis', 'effect of percentage movement', 'stress testing', and 'value at risk'.

Scenario analysis takes the level of exposure and translates it into the base currency at current market and forecast rates based on economic information. The potential foreign exchange gain or loss resulting from the unhedged position can then be calculated. The percentage movement simply examines the profit or loss arising from a given percentage movement in the exchange rate on the exposed cash flows. An extension of this analysis is provided by stress testing which considers the effect of sudden abnormal exchange rate movements on company survival. Value at risk performs a statistical analysis of past exchange rates, using standard deviation as the measure of volatility. The potential loss or value at risk is based on this level of volatility.

Kent and Shapiro [8] use a case study approach to assess the impact of foreign exchange risk. With the company under investigation, the focus is on cash flow as the primary determinant of corporate value. If the present value of a cash flows varies with exchange rate movements, so the value of the business changes. These cash flows will be unaffected by exchange rate movements if these are in line with relative inflation rates.

Their measurement involves regression analysis, whereby the cash flow stated in terms of the home currency is the dependent variable, and the nominal exchange rate movement is the independent variable.

$$CF_t = \alpha + \beta\, Exch_t + u_t \tag{1}$$

where CF_t is the cash flow of the business at time t, $Exch_t$ is the spot exchange rate at time t.

In this way, the extent to which exchange rate movements explain the changes in the cash flows can be measures using the usual statistical techniques, coefficient of determination etc. The analysis can further be extended to include any number of periods. It is possible that the exchange rate in the previous period, assuming monthly data, has an impact on the current cash flow. Thus the regression equation becomes:

$$CF_t = \alpha + \beta_1\ Exch_t + \beta_2\ Exch_{t-1} + \ldots + \beta_{n+1}\ Exch_{t-n} + u_t \tag{2}$$

In this analysis, cash flows are taken as:

> operating profit + depreciation ± changes in the domestic currency value of working capital, before deducting interest expense form capital expenditures, and taxes.

Other definitions were considered but this was thought to be the most pertinent on the assumption that the domestic value of replacement capital spending was independent of the exchange rate.

The effect of different currency denominations for financing costs could further be analysed using the above definition less interest expense. A comparison between the operating profit with the actual interest and the potential expense using another source of finance can then be performed using the same regression techniques.

This analysis hinges on the assumption that the historical sensitivity of cash flow to the movements in the exchange rate are a reasonable predictor of the future sensitivity. Furthermore, one or more of the variables may be non-stationary which may mean the use of co-integration techniques [9] to establish the existence of a long term relationship.

Establishing cash flows is often difficult. It may, however, be possible to examine the impact of exchange rate movements on cash flows indirectly using the share price. The rationale for this is given by the effect of cash flows on the value of the business. This stems from valuation based on the net present value of future cash flows.

$$\text{Value} = \frac{CF_{t+1}}{1+r} + \frac{CF_{t+2}}{(1+r)^2} + \ldots + \frac{CF_{t+n}}{(1+r)^n} \tag{3}$$

Cash flows here refer to free cash flows which are taken to be operating profit − taxes + depreciation − investments + changes in working capital. These flows may be discounted at the company's cost of capital (r).

Given that these cash flows lead to a valuation of the business, and exchange rate volatility affects these cash flows, it seems valid to examine the effect of exchange rate movements on the share price (SP_t). In performing a regression analysis, the variables and $Exch_t$ must be tested for stationarity using a unit root test, and made stationary by 'differencing', i.e. subtracting a lag of each variable. The 'differenced' series ΔCF_t and $\Delta Exch_t$, are stationary and can therefore be used to produce a model:

$$\Delta CF_t = \alpha + \beta \Delta Exch_t + u_t \tag{4}$$

This assumes that they are integrated of order one. In other words, only one lag of each variable is required.

The model can further be improved by taking account of short term dynamics as well as long term equilibrium, using the Error Correction Model [9].

This econometric approach should be explored, although it seems unlikely to produce conclusive results for the shipping industry in Norway. Many share price movements are linked to market perception, and where the market does not perceive the problem of exchange rate volatility, the effect on the share price is likely to be insignificant. This paper, therefore examines the situation from the practical treasury manager's standpoint, using accounting information for the industry as a whole. The method incorporates elements of the Cornell Shapiro 'top down' method, in analysing changes in profit on the basis of movements in the real rate. The sensitivity to changes in the rate are examined as in the 'percentage change' model. The change is based on the volatility of the real exchange rates as in the 'Value at Risk' analysis. The intention is to provide an overview of foreign exchange risk for the Norwegian industry using aggregate information collated by Official Statistics of Norway.

NKr/US$ Exchange Rate 1990-1997

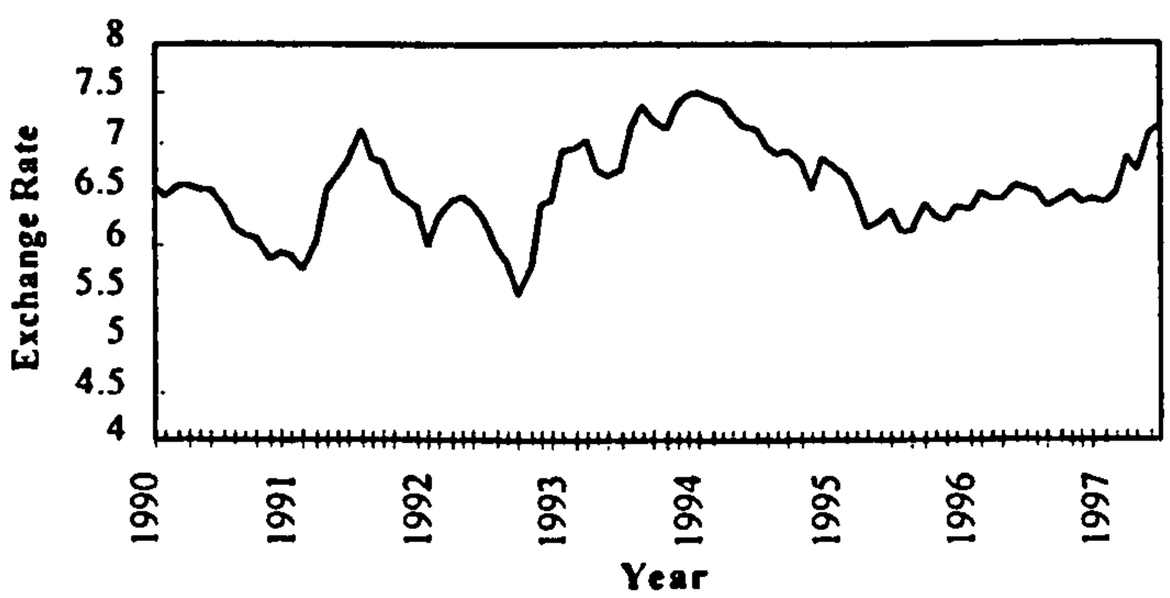

Figure 1.

Table 2. Nominal and real exchange rate volatility 1990–1996.

	Nominal rate			Real rate		
Year	Average	Std deviation	Coefficient of variation	Average	Std deviation	Coefficient of variation
1990	6.3084	0.2798	4.4%	5.0635	0.2513	5.0%
1991	6.4824	0.4208	6.5%	5.1887	0.3234	6.2%
1992	6.1429	0.3251	5.3%	4.9991	0.2514	5.0%
1993	7.0758	0.2666	3.8%	5.8883	0.2113	3.6%
1994	7.0724	0.3003	4.2%	5.8492	0.2686	4.6%
1995	6.3450	0.2041	3.2%	5.2133	0.1530	2.9%
1996	6.4524	0.0765	1.2%	5.3257	0.0795	1.5%

Source: Datastream.

4. Exchange rate volatility

As previously discussed, the fact that costs are denominated in a variety of currencies does not in itself create the problem. The exposure arises out of long term instability of the exchange rate. Figure 1 shows the volatility of the NKr/US$ exchange rate since 1990. This period has seen a fluctuation from 5.51NKr/US$ in September 1993 up to 7.53 NKr/US$ in January 1994. The volatility can be measured in terms of standard deviation around an average rate.

Figure 1 shows the volatility of the NKr/US$ nominal exchange rate. The average rate for this 7 year period is 6.57 NKr/US$, and the standard deviation is 0.4368NKr/US$. Table 2 shows the average rates and standard deviation for each of the 7 years together with the coefficient variation. The volatility varies form year to year. In 1991 there were wide fluctuations in the NKr/US$ exchange rate which continued into 1992. 1995 and 1996 saw greater stability but this will not necessarily continue.

It is not however the nominal rate, but the real rate which requires investigation. If the exchange rate moved according to cost differentials in the various countries, volatility would not be such an issue, since real rates would be maintained. This theoretical argument relies on the existence of constant purchasing power parity in the various countries.

Purchasing Power Parity originates from the law of one price, which states that an identical product or services sold in different markets should be the same price in these markets under the assumption that no 'friction' exists. This means that the exchange rate between two currencies can be expressed as the ratio of the price level in those countries. For example, the NKr/US$ exchange rate may be expressed as the ratio of the Norwegian price level to the US price level:

$$S = \frac{P^{N}}{P^{US}} \tag{5}$$

where S is the exchange rate between the NKr/US$ exchange rate, P^{N} is the price level in Norway, and P^{US} is the price level in the US.

Evidence suggests that the spot rate is not indicated by absolute purchasing power parity, but that the movement in the spot rate can be seen as the relative change in the prices between two countries over a period of time. In other words, any change in the differential rate of inflation between two countries will be offset by an equal but opposite change in the spot rate. Thus if inflation in Norway were 3% lower than in the US, relative purchasing power parity would predict an appreciation in the Kroner relative to the dollar of 3%.

Shipowners receiving dollars will use some of these dollars to pay their dollar costs and the rest will be exchanged in order to pay for non-dollar denominated costs. If purchasing power parity holds then the movement in the exchange rate will reflect relative movements in the inflation rates of the two countries such that the purchasing power remains the same. Thus if the dollar is depreciating against the Kroner, this must be because the inflation in the US is higher than inflation in Norway. Although a dollar will buy fewer Kroner, the fewer Kroner should buy the same amount of goods in Norway as before because inflation is lower.

Empirical work suggests that exchange rates do deviate from purchasing power parity [10]. This may be illustrated by examining the movement in real exchange rates. These are rates adjusted for inflation and should therefore be constant if purchasing power parity holds. Figure 2 shows the volatility of **real** NKr/US$ between 1990 and 1997. The real rates have been obtained by adjusting the nominal rates by the appropriate country producers price index.

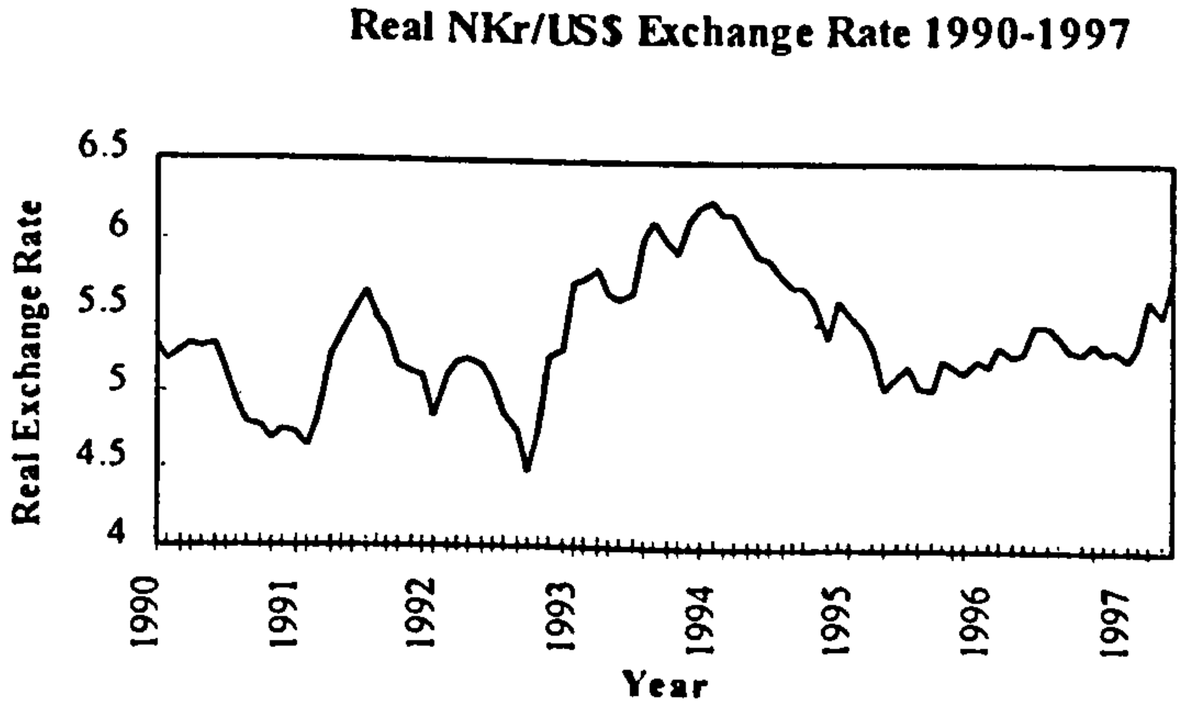

Figure 2.

Given that the theory of purchasing power parity requires a constant real rate of exchange, the diagram strongly suggests that purchasing power parity does not hold. This means that the dollar receipts when converted to another currency do not buy the same amount of goods and services. The volatility of the exchange rates is therefore much greater than the volatility of the prices. The average real rate for the period is 5.37 NKr/US$, and the standard deviation is 0.3977 NKr. Table 2 illustrates the annual situation during this period. The volatility of the real rate is almost as great as that of the nominal rate.

Illustrations of purchasing power parity using a price index as above are fraught with difficulties. The basket of goods is different from country to country, and there is some dispute as to which goods should be represented. However, even if purchasing power parity did hold it would still leave an exposure in the shipping industry, and indeed other industries, since there is no reason for costs and freight rates to move in line with a general index. The fact remains that in a dollar dominated industry, the volatility of the exchange rate can have a major impact on the operating profit where a large proportion of costs are denominated in other currencies. In order to assess the impact, the measures of volatility obtained in table 2 are applied to the exposed non-dollar costs derived in § 5.

5. Results

This paper attempts to measure the effects of exchange rate exposure for the Norwegian shipping industry as a whole using a combination of the 'top down', 'percentage change' and the 'value at risk' analysis discussed in § 3. The latest Official Statistics of Norway, for 1994 and 1995 detail the operating earnings and expenditure for Norwegian ships registered in Norwegian foreign going trade. Given that the vast majority of earnings are dollar denominated, the analysis focuses on operating expenditure. Each category is analysed in turn, to assess its currency denomination. This is based on discussions with shipowners and bankers, and calculation using other available statistics. Although the time series under consideration is short, the intention is to illustrate the more recent levels of exposure. It is also difficult to obtain accurate assessment of currency denominations, of costs dating back further, from discussion with those involved in the industry.

The non-dollar operating expenditure gives an indication of exposure. This is not the full extent of the problem as far as shipowners are concerned, since the operating profits are used to pay other non-dollar costs such as taxes and dividends. However, this analysis is confined to non dollar operating costs and their sensitivity to real exchange rate movements as established in § 4.

Table 3 shows the summary operating accounts and analysis of the operating expenditure for Norwegian flag, foreign going ships for 1994 and 1995. The expenditure is further analysed into currency denomination; Dollar, Kroner and other. The detail of currency denomination is discussed below:

Brokers' commission is charged in US dollars, no further analysis is required.

The majority of voyage expenditure comprises port dues, some of which have to be paid in non US dollar currencies, notably Dutch Guilders, Singapore dollars, Sterling, Deutschmarks, and Japanese Yen. The required currency therefore depends on the arrival of Norwegian registered vessels at foreign ports. Based on tonnage, the analysis of arrivals in ports is shown in table 4.

Based on discussions with shipowners, it was determined that European and Asian port dues are settled in the relevant domestic currency. Only figures for

Table 3. Operating account for Norwegian flag, foreign-going ships (millions NKr).

		Currency denomination (1995)				Currency denomination (1994)		
	Total	US$	NKr	Other	Total	US$	NKr	Other
Operating earnings	34 183				35 608			
Operating expenditure	25 846				27 533			
Operating profit	8 337				8 076			
Analysis of expenditure								
Brokers' commission	783	783			879	879		
Voyage expenditure	5 481	2 247		3 234	6 024	2 470		3 554
Bunkers	2 365	2 365			2 386	2 386		
Wages and social	4 166	2 041	2 125		4 397	2 198	2 199	
Repairs & maintenance	3 142	3 142			3 077	3 077		
Time charter hire	5 956	5 956			6 192	6 192		
Administration	1 756		1 756		1 781		1 781	
Other	2 197		2 197		2 797		2 797	
Total operating expenditure	25 846	16 534	6 078	3 234	27 533	17 202	6 777	3 554
Percentage of total expenditure	100%	64%	24%	12%	100%	62%	25%	13%

Source: Operating account (not currency denomination) SSB Official Statistics of Norway.

Table 4. Port dues based on arrivals at foreign ports 1994.

	Tonnage (1000 gross tons)	Percentage dollar	Percentage non-dollar
Europe	282 291		35
Africa	41 685	5	
North America	237 402	29	
South America	38 781	5	
Asia	200 199		24
Oceania	18 229	2	
Total	818 589	41	59

Source: SSB

1994 were available, therefore, these have also been used as the basis for the both the 1994 and 1995 analysis. Clearly there are changes from year to year but it is unlikely that they will have a significant effect on this analysis. The percentage of non-dollar, non-Kroner expenditure is around 12–13% which is consistent with information from the shipping companies.

Although it is sometimes necessary to use other currencies for bunkers, the dollar is the main currency of settlement and for this reason, these costs are assumed to all be in dollars.

Wages and social expenditure have been divided between US dollars and Kroner based on the number of Norwegian and foreign crew. The figures for 1995 based on information from the National Insurance Administration are 16 579 Norwegian crew and 16 035 foreign crew. The 1994 figures are 15 908 Norwegian and 15 924 foreign. It is assumed that the Norwegians are paid in Kroner and others are paid in US dollars. The currency split based on these figures is therefore 51% Kroner and 49% US dollars for 1995 and a 50 : 50 split for 1994.

Table 5. Sensitivity to changes in the exchange rate (all figures are expressed in millions).

	1995	1994
NKr denominated operating expenses	6078 NKr	6777 NKr
Expressed in US $ at average rate	1166 US$	1159 US$
±1 standard deviation in exchange rate per table 2		
1995 ± 0.1530 NKr (average (5.2133)	±178 NKr	
1995 ± 0.2686 NKr (average (5.8492)		±311 NKr

Repair and maintenance work can be in a variety of currencies, but as far as possible shipowners try to ensure that the majority of this work is paid for in US dollars. One hundred per cent is therefore an overestimate but any small percentage chosen for non-dollar expense would be purely arbitrary, and would not make a significant difference to the results. This analysis therefore assumes 100% US dollar denominated costs in this area.

Time charter hire costs are assumed to be 100% US dollars.

The administrative and management function is based at the headquarters of the shipping company, the majority of which will be in the home country. Thus, this is taken as being 100% Kroner.

The exact composition of the other expenses is not clear. However, examination of a number of financial statements reveal that this includes substantial restructuring costs which are likely to be denominated in Kroner.

Table 5 shows that in 1995, 6078 million NKr (1994—6777 million NKr) of operating expenditure is dependent on the $/NKr exchange rate. A further 3234 million NKr in 1995 (3554 million NKr in 1994) of operating expenditure is dependent on a variety of other exchange rates such as the $/Guilder, $/Yen, etc.

Given this cost structure, it is possible to measure the sensitivity of the operating costs to changes in the exchange rate. Table 5 concentrates on the NKr/US$ exposure, since the other currency denominations are not precisely known.

Table 5 uses the Kroner denominated expenditure from table 3 and shows the sensitivity of these costs to the volatility of the exchange rate in that particular year. In 1995, one standard deviation change in the rate represents a movement of 2.9%, and in 1994, 4.6%. It can be see that relatively small changes in the exchange rate can have a dramatic effect on costs, ±178 million Kroner in 1995 and ±311 million Kroner in 1994.

This exposure can work to both the advantage and disadvantage of the individual shipping companies. Larger companies have the necessary resource to take advantage of favourable rates which will give a competitive advantage. The impact of exchange rate volatility on the cost structure indicates a need for effective strategies for all companies in order to minimize the losses and maximize the potential gains.

6. Conclusion

The objective of this paper has been a first attempt to measure a problem which impacts on the whole of shipping. In the industry, foreign exchange exposure is often perceived as a risk over which little control can be exercised, and is thus largely ignored in the operational aspects of the business.

It would appear that the larger operators have attempted to develop strategies with varying degrees of success. What emerges, however, is the vulnerability of the smaller shipowners with their limited resource base.

Here, the discussion has concentrated on the Norwegian experience, but it nevertheless indicates the seriousness of the issue for the whole industry. Operating profits can rise and fall dramatically simply because of exchange rate movements. What is obvious is that exposure can be seen in a positive or negative light depending on the direction of movement in the exchange rate. Given that Norwegian shipowners cannot avoid exposure, they need an effective strategy to allow them to benefit from advantageous rates, as well as deal with the downside risk.

To ignore the problem is potentially a commercial error. By monitoring exchange rates and taking advantage of favourable rates, gains can be made, or losses minimized. Shipowners do not see themselves as speculators, particularly as far as the financial markets are concerned. However, this analysis highlights the need for a proactive approach which will not only ensure commercial advantage, but also secure an improved operating position.

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