A TEST OF A TWO-FACTOR ‘MARKET AND OIL’ PRICING MODEL

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Abstract

In this paper we employ a GMM-based approach to test the restrictions imposed by a two-factor ‘market and oil’ pricing model when a risk-free asset is assumed to exist. We examine the Australian market which has several interesting features including self-sufficiency in relation to oil, a large concentration of natural resource companies, susceptibility to the 'Dutch disease' and a diverse industry base. We extend previous literature by examining industry sector equity returns as different industry groups are likely to have different exposures to an oil factor, particularly in Australia. In the formal tests, we find evidence in favour of the model, particularly for industrial sector industries. The preferred model includes a domestic portfolio proxy for market returns in addition to the oil price factor and we find evidence of a positive market risk premium as well as a significantly priced oil factor.

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1. INTRODUCTION

Asset pricing is probably one of the most controversial topics in the literature.[1] There have been many attempts to move out of the single factor-CAPM framework with varying degrees of success (eg. Chen, Roll and Ross (1986); Chen (1991); Fama and French (1993)). In the context of a multi-factor model, several researchers have investigated the potential role of an oil price factor. This literature is well represented by Chen, Roll and Ross (1986); Hamao (1989); Kaneko and Lee (1995); Ferson and Harvey (1995); Al-Mudaf and Goodwin (1993) and Jones and Kaul (1996). These papers suggest that the role of an oil factor in asset pricing is somewhat unclear.

Chen, Roll and Ross (1986) is often regarded as a seminal paper that uses economic variables to test multi-factor asset pricing models. Using a US dataset, Chen et al could not support the role of an oil factor. While Hamao (1989) generally confirmed this finding for a Japanese sample, Kaneko and Lee (1995) find support for a Japanese oil factor using a more recent time period. Further, in an international setting, Ferson and Harvey (1995) reject the hypothesis that an oil-price risk beta is equal across their sample of eighteen countries. Accordingly, they use this finding to justify the inclusion of the oil factor in a series of asset pricing tests. Similarly, Jones and Kaul (1996) use an APT-type model in which fundamental variables are augmented by an oil price change variable and find support for an oil based factor. Al-Mudhaf and Goodwin (1993) use a sample of oil companies listed on the NYSE over the period 1970 to 1978, and find that a significant *ex ante* oil risk premia existed in the period immediately following the OPEC oil price shock of 1973.

The role of oil in the economy is significant. Casual evidence suggests that international capital markets are highly sensitive to oil price shocks. For instance, two examples are the substantial stock market reactions to the OPEC oil price hikes of 1973-1974 and 1979-1980 and

[1] For instance, Fama's (1991) review of market efficiency points to a number of unresolved controversies surrounding asset pricing and the associated empirical tests.

to the Iraqi occupation of Kuwait in 1990. Energy expenditures as a proportion of GNP are typically high in all nations, especially the OECD countries. As one example, in the USA over the last 20 years, energy expenditure has amounted to around 10% of GDP on average per year, with petroleum products accounting for over half of this expenditure, although the percentage has generally been declining over the last decade.

The focus of this paper is on the Australian market. Over the period 1983 to 1996, Australia has largely been self-sufficient for petroleum products with Australian imports of refined petroleum products averaging 2,890 million litres per year and exports averaging 3,007 million litres per year. However, the net external trade has typically been less than 2% of domestic consumption. Over the same period, annual domestic production averaged 39,705 million litres.[2]

The advantage of examining the Australian market is three-fold. First, as noted above, the Australian economy is relatively self-sufficient for petroleum products. Over the period 1983-1996, Australian imports of refined petroleum products averaged 2,890 million litres per year while exports averaged 3,007 million litres per year. Over the same period, annual domestic production averaged 39,705 million litres. Net external trade has typically been less than 2% of domestic consumption. The evidence reviewed above indicates that the sensitivity of stock prices to an oil factor varies across markets. An examination of the Australian market adds further to this evidence. By comparing the results to those of other studies, some insight can be gained as to where differences may lie.

Second, Australia is a unique country given its vast geographic size and relatively small and diverse population. The remoteness of the country means that the costs of transportation and freight potentially constitute a major component of the costs of many Australian companies and hence the price of oil is likely to have an impact on these costs. Industries with a relatively high proportion of

[2] The source of these statistics is *ABARE Commodity Statistics*, 1996 December, p. 314.

their costs devoted to oil-based inputs, such as Transport, are expected to have a negative sensitivity. Conversely, in the absence of offsetting effects, we would expect a positive oil return sensitivity in oil and oil-related industries, in which oil directly impacts the revenue side of the income statement. However, in general, the impact of oil price changes on equity prices will depend on the ability of firms to pass on the effect to customers through changing prices.[3]

Third, the Australian stock market has a relatively high concentration of natural resources companies compared to many other markets and some industries derive considerable revenue from oil and oil-related products and hence changes in oil prices will affect the profitability of these industries. For instance, resource sector listings averaged 31% as a proportion of listed stocks over the period 1974-93 peaking at 41% in 1991.[4] Previous work has concentrated on aggregate market returns. However, we argue that aggregate analysis is inappropriate considering the diverse nature of the Australian market and the possibility for differential effects to be manifested across industry groups.

The analysis by industry sectors in this paper is an extension on previous work. A priori, it may be argued that a self-sufficient economy in respect of a product would be relatively insulated from external price shocks in that product. However, such an argument is probably too simplistic. As noted above, industries reliant on transportation costs may experience opposing effects to those industries involved in the production of oil and oil-related products.

The importance of recognising the potential for differential industry effects is also reflected in economic theory through the work of Gregory (1976), Corden (1984) and others on the so-called theory of the 'Dutch disease'. In this theory, the emergence of a new export sector may result from

[3] Also note that firms can protect themselves against adverse movements in the oil price through hedging using derivative instruments. The extent to which hedging occurs makes any sensitivity to oil price changes harder to detect. Moreover, given the growth in derivative products and the improved understanding of risk management by corporate treasurers, we expect hedging practices to have become more common over time.

[4] Figures are sourced from Annual Reports of Stock Exchange of Melbourne (1974-1988) and the Australian Stock Exchange Yearbook 1994 (1989-1993).

a boom in mineral or energy prices shifting the foreign exchange supply curve to the right. The resultant excess foreign exchange supply induces a contraction in the outputs of other competing industry sectors. Foreign exchange intervention in such circumstances through devaluation leads to either higher inflation or an accumulation of foreign exchange reserves. The Dutch disease highlights the sectoral dependence in an economy and how the price of output of each sector relative to that of other sectors determines the allocation of resources. The Dutch disease is often cited in the context of mineral and energy booms, such as the natural gas discoveries by the Dutch in the 1960s, the North Sea oil discovery in Britain in the 1970s and the mineral booms in Australia in the late 1960s. Again, the significant natural resource sector in the Australian economy makes it susceptible to the Dutch disease.

The aim of this paper is to conduct an examination of the priced sensitivity of returns on Australian industry sector portfolios to an oil factor. The test is conducted using a two-factor, beta pricing model. The next section outlines the empirical method while section three presents the results. The paper is concluded in section four.

2. EMPIRICAL METHOD

2.1 Generalised Method of Moments (GMM) Framework

In conducting asset pricing tests of the two-factor model, we begin by assuming that the factor generating process is adequately described by a market and oil price factor specification as follows (Al-Mudhaf and Goodwin 1993):

$$R_{it} = E(R_i) + \beta_i [R_{mt} - E(R_m)] + \gamma_i [OILR_t - E(OILR)] + e_{it} \qquad \ldots (1)$$

where R_{it} is the return on the ith asset or portfolio in month t, R_{mt} is the return on the market index in month t and $OILR_t$ is the return on the oil price in month t expressed in Australian dollars.

Assuming that a risk-free asset exists, an exact two-factor version of the Ross (1976) APT is:[5]

$$E(r_i) = \beta_i E(r_m) + \gamma_i E(r_{oil}) \qquad \text{. . . (2)}$$

for i=1,2,...,N; where $E(r_i)$ is the expected excess return for asset i; $E(r_m)$ is the expected excess return on the market portfolio and $E(r_{oil})$ is the expected excess return on oil.

The empirical application of the model takes the following form:

$$r_{it} = ß_i r_{mt} + ?_i r_{oil,t} + e_{it} \qquad \text{. . . (3)}$$

for i = 1, 2, ... , N; where r_{it} is the excess return on the ith asset in month t, r_{mt} is the excess return on a value-weighted market index and $r_{oil,t}$ is the return on oil in excess of the risk-free rate.

The asset pricing model in (2) imposes a zero intercept condition on its empirical counterpart in (3) across all equations. In this paper, this hypothesis is tested using the generalised method of moments (GMM) approach of MacKinlay and Richardson (1991). In the case of the empirical model of (3) with the intercept restricted to be equal to zero, there are 3N sample moment equations. The GMM involves an evaluation of the 3N sample moments, with 2N unknown parameters. Hence, N over-identifying restrictions exist.

The modeling framework above uses the excess oil return as a mimicking portfolio for oil risk, which is theoretically justified if oil can be directly and costlessly traded as a security in investors' portfolios. However, this imposes the assumption that the risk premium for oil risk is $E(r_{oil})$, and does not provide a direct test of the hypothesis that the oil risk premium is zero. To address this issue, a modified version of the test is investigated in which the system of equations is augmented by a mean equation for each of the market and oil price factor returns and the risk premia are directly parameterised. This provides us with the facility to directly estimate (and test the

[5] This model could alternatively be interpreted as a version of the intertemporal capital asset pricing model (ICAPM), whereby the oil price factor takes on the role of a hedging factor.

significance of) the premium for market and oil risk.[6] Specifically, the empirical specification of this modified test becomes:

$$r_{it} = ß_i(?_m + ?_t) + ?_i(?_{oil} + ?_t) + e_{it} \qquad \text{. . . (4) [i = 1, 2, ..., N]}$$

$$r_{mt} = \mu_m + ?_t \qquad \text{. . . (5)}$$

$$r_{oil,t} = \mu_{oil} + ?_t \qquad \text{. . . (6)}$$

In the context of this system of equations, the basic GMM test procedure is modified slightly – we now have 3N+2 equations and 2N+4 unknown parameters to estimate. Accordingly, the GMM test of the over-identifying restrictions is chi-square with N-2 degrees of freedom. Specifically, the GMM test statistic is formally defined as:[7]

$$\text{GMM} = (T\text{-}N\text{-}1)^* \, g_T(\hat{\phi})' \cdot S_T^{-1} \cdot g_T(\hat{\phi}) \qquad \text{. . . (7)}$$

where $g_T(\hat{\phi}) = \frac{1}{T}\sum_{t=1}^{T} f_t(\hat{\phi})$, is the empirical moment condition vector,

$f_t(\hat{\phi}) = [\hat{e}_{1t}\ \hat{e}_{1t}r_{mt}\ \hat{e}_{1t}r_{oil,t}\ ......\ \hat{e}_{Nt}\ \hat{e}_{Nt}r_{mt}\ \hat{e}_{Nt}r_{oil,t}\ \hat{?}_t\ \hat{?}_t]'$; and,

(ϕ) is the vector of estimated coefficients (= $\{\hat{ß}_i, \hat{?}_i, \hat{?}_m, \hat{?}_{oil}, \hat{\mu}_m, \hat{\mu}_{oil}\}$) across the system of equations.

In addition, we can test the hypothesis that each expected premium is zero (ie. H_0: $\lambda_m = 0$ and H_0: $\lambda_{oil} = 0$). As this extended framework permits a more powerful test, this approach is followed herein. The estimation technique employs heteroskedasticity and autocorrelation consistent covariance matrices and uses an iterated procedure following Ferson and Foerster (1994).

2.2 Using the Kalman Filter to Model the Expected Premium of the Hedge Portfolio

As an extension of the previous analysis, we can investigate the time-variation in the expected oil premium over our sample period. However, a complication is that a proxy hedge portfolio

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[6] A previous example of this type of test can be found in Ferson and Harvey (1994). We would like to thank an anonymous referee for suggesting this extended analysis.

[7] This represents the small-sample adjusted version following MacKinlay and Richardson (1991).

comprising traded assets needs to be formed and the risk premium of that portfolio analysed. While the literature offers a variety of alternative techniques to do this, we follow the general approach of Breeden, Gibbons and Litzenberger (1989) and obtain the maximally correlated portfolio (MCP) using restricted OLS regression techniques. Specifically, a regression is estimated in which the excess return on crude oil is regressed against the excess returns on the industry portfolios in our study. The regression is restricted to have no intercept and to contain just those industries that produce statistically significant coefficients wherein the sum of coefficient estimates is equal to unity.

Briefly, the outcome of the MCP analysis is as follows. Three industries were found to contribute significantly to the MCP – Oil and Gas (not surprisingly); Other Metals; and Paper and Packaging. The coefficients from the regression can be interpreted as portfolio weightings and when applied to the constituent three industry returns produce the return on the proxy hedge portfolio for oil. The correlation between the MCP and the oil price excess return was 0.378.

To investigate the time-variation in the expected oil premium reflected in the MCP, a state-space representation using the Kalman Filter is used. The Kalman Filter is a popular approach used in similar situations in the literature. Examples of this approach applied to the task of extracting a time-varying expected inflation series include Hamilton (1985), Burmeister, Wall and Hamilton (1985), Cheung (1993) and Faff and Heaney (1999). Cheung's approach is the simplest version and is applied here.

The Kalman filter resolves a "signal extraction" problem; that is, we wish to decompose the observed oil return into two components (1) the expected oil premium - the "signal" and (2) the forecasting error (ε_t) - the "noise". The Kalman filter can be applied to this problem, once an appropriate specification for the signal component is determined. Following Cheung (1993) the random walk is adopted and the model can then formally be defined as:

$$r_{hp,t} = \lambda_{hp,t} + \varepsilon_t$$

$$\lambda_{hp,t} = \lambda_{hp,t-1} + \eta_t \qquad ...(8)$$

where $r_{hp,t}$ = excess return on hedge portfolio in period t
$\lambda_{hp,t}$ = expected oil premium in period t
ε_t ,η_t = white noise error terms

3. RESULTS

The data comprise monthly continuously compounded returns on 24 Australian industry portfolios over the period from July 1983 to March 1996. Two non-overlapping subperiods - July 1983 to October 1989 and November 1989 to March 1996 – are also analysed to examine the robustness of the results. Given the inclusion of the crash of October 1987 in our sample, we assess the sensitivity of our analysis to this extreme observation – that is, in those subperiods in which the crash occurs, the analysis is performed both including and excluding this observation. Likewise, our full sample period includes the period around the latter half of 1990 through to early 1991 when Iraq invaded Kuwait and the Gulf War ensued. This had a dramatic effect both on the world's equity and oil markets. Consequently, it is appropriate that some sensitivity analysis is conducted relative to this major event. To this end, we can identify the key dates that encapsulate the Gulf War crisis following Bradford and Robison (1997). The action that initiated the crisis was the invasion of Kuwait by Iraq on 2 August 1990, which in turn lead to the start of the air war on 17 January 1991. The Gulf war subsequently ended on 28 February 1991. Accordingly, we quarantine the months August 1990 through to February 1991 as the 'Gulf War' months and the analysis is run both including and excluding these observations.

The industries are partitioned into a natural resources group (comprising 5 industries) and an industrials group (comprising 19 industries). The natural resources group can be thought of as net producers of oil and oil-related products and hence a positive relationship with the oil factor is expected. Conversely, the industrials group are likely to be net users of oil and oil-related products and hence a negative relationship with the oil factor is expected.[8]

The stock return data are sourced from the Price Relatives File of the Centre for Research in Finance (CRIF) at the Australian Graduate School of Management. Two alternative proxies for the market portfolio are used, namely, (1) a value-weighted domestic index supplied by CRIF; and (2) a value-weighted global index supplied by Morgan Stanley Capital International. Oil prices (sourced from Equinet) are proxied by the US dollar price per barrel of West Texas Intermediate crude oil. This measure is widely regarded and quoted as the international benchmark.[9] A number of previous studies have used this measure as an oil price proxy including Ferson and Harvey (1995) and Foster (1996). The oil price observations are sampled monthly over the same period as the stock returns, July 1983 to March 1996.

First, consider a set of basic descriptive statistics for the excess oil returns series, as reported in Table 1. The table reveals mean, median, maximum, minimum, standard deviation, skewness and kurtosis values for various sample periods. Regardless of the period chosen, the basic descriptive statistics are similar. Of greatest interest is the finding of a negative mean excess oil return, which in part reflect periods of general declines in the price of oil. However, as shown in the final row of the table, the hypothesis of a zero mean excess oil return cannot be rejected in any case.

[TABLE 1 ABOUT HERE]

[8]We note that this classification may still be distorted by individual industry effects as even the natural resources group is likely to suffer from increased transportation costs. However, further sub-sector groupings would involve a considerable amount of subjective ex-ante judgement as to those industries that are net producers and those that are net users. Nevertheless, the two sector grouping is an improvement over previous tests.

[9] There are various oil price indicators such as Crude Oil Light Sweet, Heating Oil, Brent Crude and West Texas Crude. The latter is chosen here given its common quotation in international markets. The contract can be traded in the spot market and is quoted in US dollars per barrel.

Table 2 reports the results of the GMM tests of the restrictions in the two-factor specification given by equations (6), (7) and (8). In Panel A, the tests are performed using returns on a value-weighted domestic market index, whereas in Panel B, returns on a global market index are utilised. Several key features are evident from the table. First, it can be seen that in most cases the p-values exceed 0.5 and as such the consistent result revealed in Table 2 is that the null model cannot be rejected. This is the case for both panels in the table, regardless of whether the domestic or the world market index is employed as the market factor. For example, the smallest p-value is 0.080 for the overall sample period, benchmarked against the world market factor, in the resource sector.

Second, and following on from the first point, support for the two-factor model is true and not sensitive to the time period, the crash of October 1987, the period surrounding the Gulf War or the industry sector. If anything, the model is more strongly supported for the industrials sector (which generally have higher p-values) than for the resources sector. Nevertheless, the restriction placed on the model is consistently not rejected.

[TABLE 2 ABOUT HERE]

Third, as a partial qualification to the strong support indicated above, we observe a lack of statistical significance for the risk premia estimates when examining the resources sector. This is particularly so when the global market factor is utilised, since in this case none of the risk premia are significant. Fourth, we find considerably more evidence of statistically significant risk premia in the case of the industrial sector. However, in the cases where a domestic market factor is used, it is only in the subperiod 1983 to 1989 (excluding the crash) and in the full sample period (excluding the crash and the gulf war) that the market risk premium is significantly positive. Furthermore in Panel A for the industrial sector, while the oil risk premium is found to be statistically significant in every case, it is somewhat disconcerting to observe a change in sign from the first subperiod (negative) to the second (positive). Thus, in the absence of a credible argument for why the risk premia should behave this way, the overall worth of the two-factor model must be questioned in this setting. Interestingly for the combined sample, denoted as the 'all industries' case in Panel A of Table 2, the message seems more positive – particularly when the Crash and Gulf War months are excluded. In this case not only does the GMM test lead to a non-rejection of the two factor model but both risk premia are positive and statistically significant.

Fifth, the counterpart results for the international version of the model (Panel B) for the industrial sector are somewhat different. Here we find that on only two occasions out of 6 cases, is the market risk premium not significantly positive. Further, the oil price risk premium is statistically significant in only two cases, in the latter subperiod. Notably, these significantly positive oil risk premia match the results in Panel A concerning the domestic market counterpart.

As a final word, the results of this analysis need to be interpreted with caution. It would be inappropriate to conclude that, on the basis of these limited tests, the two-factor 'market-oil' model should be universally embraced. What it does suggest however, is that further investigation of this type of model is worthy of more detailed scrutiny. In particular, further analysis is warranted of whether the change in sign of significant premia has an economic rationale or is just a statistical aberration.

As suggested earlier, after addressing our formal asset pricing tests it is of some interest to investigate the time-variation in the expected oil premium (as reflected by the MCP) over our sample period. A state-space representation using the Kalman Filter with a random walk process was estimated according to (8). The plot of the time-varying expected oil premium produced by this estimation over the period June 1984 to March 1996 is provided in Figure 1.[10] The figure reveals a period of volatility between 1984 and 1988. In the early part of the sample, the risk premium is positive, however from 1985 the series largely remains negative. From about 1989 the oil premium shows a gradual upward trend – starting at around –1.3 % climbing to about –0.5 % by early 1996.

[FIGURE 1 ABOUT HERE]

4. CONCLUSION

The investigation of multi-factor asset pricing models is becoming increasingly popular. This paper extends the literature by examining the asset pricing implications of an 'oil-market' two-factor model in the stock market. This analysis was undertaken using a sample of Australian industry sector returns over the period 1983 to 1996. A GMM-based approach was used to test the restrictions imposed by the two-factor model when a risk-free asset is assumed to exist.

The major finding of our study is that the two-factor model has support, particularly for industrial sector industries. Specifically, the preferred version of this model is one that includes a domestic portfolio proxy for market returns in addition to the oil price factor. For this model we find evidence of a positive market risk premium as well as a significantly priced oil factor in the full period. However, in subperiod analysis the support is weaker.

Interestingly, our results cast some doubt over the applicability of the model to the resources sector. The lack of support when using resources sector industries is notable since it is consistent with the well documented difficulty of explaining resource sector pricing in Australia [see, for example, Ball and Brown (1980); Ball (1986); Dolan (1997); and Ord (1998)]. This remains an elusive issue worthy of further research. Furthermore, while our results provide evidence in favour of the model, further research is required to explore the potential economic role of an oil price factor in a multifactor setting.

[10] It should be noted that the first 12 observations of this series are not plotted due to a start-up value problem

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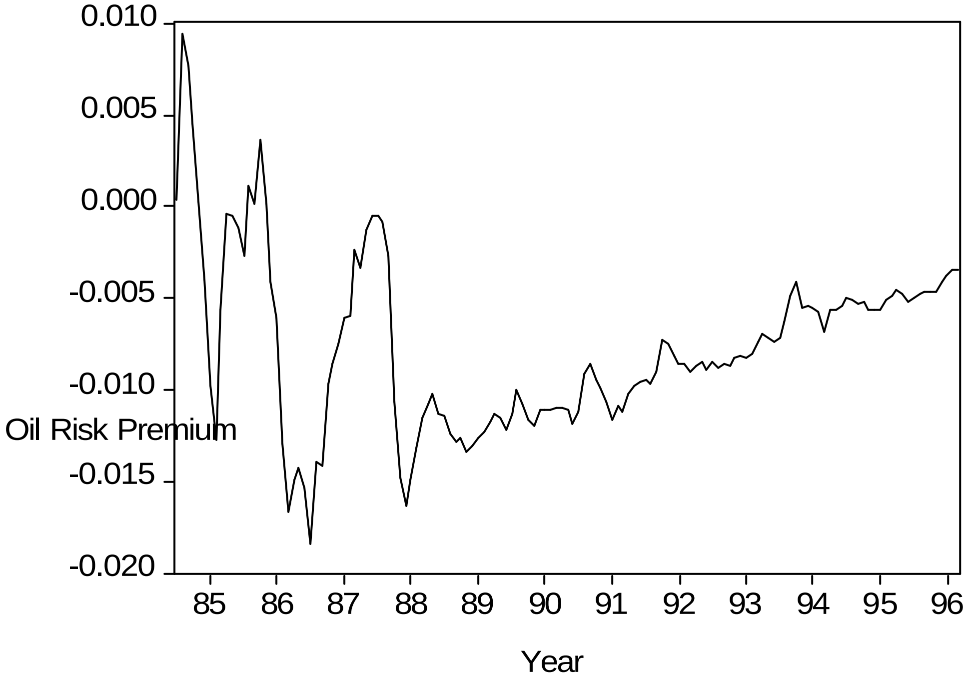

Figure 1: Plot of Time Varying Oil Risk Premium (Random Walk Kalman Filter)

TABLE 1: SOME DESCRIPTIVE STATISTICS FOR EXCESS OIL RETURNS

	Sample Periods					
	1983/07 to 1989/10	1983/07 to 1989/10 (ex-C)[a]	1989/11 to 1996/03	1989/11 to 1996/03 (ex-Gulf War)[b]	1983/07 to 1996/03	1983/07 to 1996/03 (ex-C & ex-Gulf War)[a b]
Mean	-0.0136	-0.0146	-0.0057	-0.0043	-0.0096	-0.0097
Median	-0.0040	-0.0067	-0.0057	-0.0032	-0.0057	-0.0053
Maximum	0.3201	0.3201	0.3439	0.1797	0.3439	0.3201
Minimum	-0.4184	-0.4184	-0.3013	-0.1606	-0.4184	-0.4184
Std. Dev.	0.1066	0.1069	0.0892	0.0633	0.0980	0.0884
Skewness	-0.7107	-0.6897	0.4222	-0.0946	-0.3123	-0.7232
Kurtosis	6.5419	6.5206	6.5953	3.0725	6.8493	7.6511
H_0: Mean = 0	-1.109[c] (0.271)	-1.184 (0.240)	-0.558 (0.579)	-0.572 (0.569)	-1.211 (0.228)	-1.314 (0.191)

a Sample period excludes the month of October 1987.

b Sample period excludes the months of August 1990 to February 1991 around the Gulf War crisis.

c This is the t-statistic and the associated p-value is contained in parentheses below the coefficient estimate.

TABLE 2: GMM TESTS OF A TWO-FACTOR MODEL USING A MARKET FACTOR AND AN OIL PRICE FACTOR

This table presents the results of testing the two-factor model in the system of regressions:

$$r_{it} = ß_i(?_m + ?_t) + ?_i(?_{oil} + ?_t) + e_{it} \;...\;(4)\;[i = 1, 2, ..., N];\; r_{mt} = \mu_m + ?_t \;...\;(5);\; r_{oil,t} = \mu_{oil} + ?_t \;...\;(6)$$

Test Period	Resources Sector Industries					Industrial Sector Industries					All Industries				
Panel A: Domestic Market Factor															
	GMM[a]	λ_m[b]	λ_{oil}[b]	μ_m[b]	μ_{oil}[b]	GMM[a]	λ_m[b]	λ_{oil}[b]	μ_m[b]	μ_{oil}[b]	GMM[a]	λ_m[b]	λ_{oil}[b]	μ_m[b]	μ_{oil}[b]
1983/07 to 1989/10	3.840 (0.279)	0.00266 (0.32)	-0.04407 (-1.45)	0.00154 (0.20)	-0.00682 (-0.53)	10.466 (0.883)	-0.00025 (-0.04)	-0.08930 (-5.50)	-0.00409 (-0.64)	-0.03445 (-4.44)	-	-	-	-	-
1983/07 to 1989/10 (Crash excluded) [c]	3.350 (0.341)	0.00947 (1.66)	-0.04202 (-1.45)	0.01069 (2.15)	-0.01166 (-0.89)	11.013[f] (0.856)	0.02535 (5.24)	-0.11155 (-7.06)	0.01891 (4.54)	-0.05361 (-7.83)	-	-	-	-	-
1989/11 to 1996/03	0.661 (0.882)	0.00249 (0.50)	0.00321 (0.18)	0.00118 (0.28)	-0.00656 (-0.57)	10.264 (0.892)	-0.00134 (-0.46)	0.02985 (2.45)	0.00021 (0.08)	0.00515 (0.55)	-	-	-	-	-
1989/11 to 1996/03 (Gulf War excluded) [d]	1.180 (0.758)	0.00413 (0.90)	-0.00188 (-0.11)	0.00230 (0.58)	-0.00407 (-0.53)	6.879 (0.985)	-0.00287 (-1.14)	0.10267 (6.01)	-0.00580 (-2.49)	0.00203 (0.39)	-	-	-	-	-
1983/07 to 1996/03	4.928 (0.177)	0.00468 (1.08)	-0.01273 (-0.76)	0.00362 (0.83)	-0.00837 (-0.96)	10.563 (0.878)	-0.00222 (-0.51)	-0.05643 (-4.08)	-0.00205 (-0.51)	-0.01562 (-2.12)	14.879 (0.867)	0.00234 (0.83)	-0.01169 (-1.62)	0.00213 (0.75)	-0.01487 (-2.07)
1983/07 to 1996/03 (Crash and Gulf War excluded) [c d]	3.629 (0.304)	0.00750 (2.04)	-0.01541 (-1.00)	0.00709 (2.17)	-0.00734 (-0.94)	13.848 (0.678)	0.01115 (3.17)	0.03895 (3.68)	0.01022 (3.20)	0.00110 (0.19)	17.343 (0.744)	0.00958 (3.08)	0.01664 (2.57)	0.00881 (2.89)	-0.00348 (-0.69)
Panel B: World Market Factor															
1983/07 to 1989/10	3.833 (0.280)	-0.00533 (-0.29)	-0.04319 (-1.35)	0.00449 (0.80)	-0.00685 (-0.53)	8.483 (0.955)	0.09647 (4.35)	0.00339 (0.20)	0.01059 (2.88)	-0.02127 (-2.75)	-	-	-	-	-
1983/07 to 1989/10 (Crash excluded)[c]	0.457 (0.928)	-0.21191 (-1.12)	-0.07512 (-0.59)	0.00884 (1.81)	-0.01933 (-1.72)	9.148[f] (0.935)	0.09171 (3.42)	0.00230 (0.12)	0.01426 (4.09)	-0.02238 (-2.94)	-	-	-	-	-
1989/11 to 1994/12	2.665 (0.446)	-0.00198 (-0.11)	0.00981 (0.56)	-0.00061 (-0.12)	-0.00853 (-0.61)	8.720 (0.949)	0.00572 (1.15)	0.05164 (5.06)	-0.00504 (-1.28)	0.01873 (2.05)	-	-	-	-	-
1989/11 to 1994/12 (Gulf War excluded) [d]	1.684 (0.640)	0.00049 (0.04)	0.00615 (0.46)	-0.00105 (-0.29)	-0.00693 (-0.78)	11.763[e] (0.814)	-0.00079 (-0.24)	0.04783 (9.67)	-0.00495 (-1.64)	0.00862 (1.69)	-	-	-	-	-
1983/07 to 1994/12	6.750 (0.080)	-0.00256 (-0.26)	-0.02850 (-1.43)	0.00205 (0.54)	-0.01230 (-1.29)	9.817 (0.911)	0.01757 (3.07)	-0.00038 (-0.03)	0.00792 (2.54)	-0.01251 (-1.51)	13.705 (0.912)	-0.01584 (-3.93)	-0.05394 (-5.13)	0.00293 (1.05)	-0.02376 (-3.30)
1983/07 to 1994/12 (Crash and Gulf War excluded) [c d]	2.327[f] (0.507)	-0.44692 (-0.48)	-0.11256 (-0.40)	0.00538 (1.48)	-0.01478 (-1.92)	12.833 (0.747)	0.02678 (4.02)	-0.00516 (-0.44)	0.01074 (3.69)	-0.01837 (-2.55)	14.743[f] (0.873)	0.02603 (4.81)	-0.01066 (-1.14)	0.01087 (3.95)	-0.01891 (-2.69)
Degrees of Freedom	3					17					22				

a The generalised method of moments test statistic (GMM) testing that the two-factor model holds, is distributed as a chi-square with the degrees of freedom indicated at the bottom of the column. The statistic has had the small sample adjustment applied following MacKinlay and Richardson (1991). The associated p-value is contained in parentheses below the statistic.

b The associated t-statistic is contained in parenthesis below the coefficient estimate.

c The observation 1987:10 is excluded

d The observations1990:08 to 1991:02 are excluded

e Due to model convergence problems, this test statistic is based on the exclusion of 1987/10 and 1987/11.

f Due to model convergence problems, this test statistic is based on adding the period 1989:07 to 1989:10 to the beginning of this subperiod.