AUSTRALAN COAL COMPANY RISK FACTORS: COAL AND OIL PRICES

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ABSTRACT

Examination of panel data on listed coal companies on the Australian exchange over January 1999 to February 2010 suggests that market return, interest rate premium, foreign exchange rate risk, and coal price returns are statistically significant in determining the excess return on coal companies' stock. Coal price return and oil price return increases have statistically significant positive effects on coal company stock returns. A one per cent rise in coal price raises coal company returns by between 0.15% and 0.17%. A one per cent rise in oil price raises coal company returns by between 0.06% and 0.08%. The sensitivity of stock prices to oil price shocks suggest a role for investment in stocks that rise when energy prices increase in a well balanced portfolio and in pursuing profitable investment strategies.

JEL: G12; G15; Q4

KEYWORDS: Coal Stock Price; Coal Price; Oil Price

INTRODUCTION

Energy companies are very dominant in the stock markets of the developed countries. In the literature close attention has been paid to the effect of oil prices on the stock prices of oil and gas companies. Sadorsky (2001) and Boyer and Filion (2007) find that positive oil price shocks significantly raise stocks returns for Canadian oil and gas companies and El-Sharif *et al*. (2005) find a similar result for UK oil and gas companies. In contrast to work identifying the risk factors of oil and gas companies and evaluating the effect of energy prices on the stock returns of oil and gas companies, relatively little similar work has appeared on coal companies despite the importance of coal as a source of energy. Coal provides over 23 percent of global primary energy needs (compared to 36% for oil) and accounts for producing 39 percent of the world's electricity industry.

In this paper, we examine the risk factors of Australian coal company stock returns. We pool the stock return data on coal companies listed on the Australian stock exchange. Coal price returns strongly influence coal stock returns. Oil price returns also significantly influence stock return of coal companies. A one per cent rise in coal (oil) price raises coal company returns by between 0.15% and 0.17% (between 0.06% and 0.08%). Market return, interest rate premium, and foreign exchange rate risk are statistically significant in determining the excess return on coal companies' stock. The beta coefficient of market return is significantly greater than 1 confirming that firms in the primary energy sector are more risky than the market. The depreciation of Australian dollar has a negative impact on the return of coal companies, a result similar to that found by comparable country studies for oil and gas companies.
The remainder of the paper is organized as follows. Section 2 discusses the risk factors and the models of coal company returns to be estimated in our study. Section 3 describes the data and the variables. Section 4 presents the results of the research and section 5 concludes the study.

LITERATURE REVIEW

Studies on the determinants of returns of coal companies in Australia or other countries is comparatively sparse compared to the number of studies on Australian mining and other companies and on oil and companies for other countries. In addition to the studies already mentioned, Dayanandan and Donker (2011) and Mohanty and Nandha (2011) report that oil price increases have a positive and statistically significant impact on oil and gas companies in North America and the U.S., respectively. Ramos and Veiga (2011) find that the returns of the oil and gas sector in 34 countries are significantly impacted by oil price returns.

In the production and the trade of coal, Australia has a significant role. Australia ranks fourth in the world in proven coal reserves after the US, Russia and China, and ranks third in the world in coal production after China and the US. Australian is the world's largest coal exporter and accounts for around a third of world coal trade. An authoritative overview of the Australian coal industry is provided by Barnett (1994). Work on determinants of coal trade in the Pacific area includes contributions by Ekawan *et al*. (2006) and Barnett (2002). Colley (1997) analyses the influence of Japanese investment in the Australian coal industry and concludes that profit is only one of the objectives of such investment. Warell (2006) find that the market is globally integrated for coal. Li (2010) argues that a fully developed spot market in steam coal is well advanced. Li et al. (2010) find a stable long run cointegrating relationship between price series for coal in Europe and Japan.

An early study by Ball and Brown (1980) on the performance Australian mining industry found that mining equities were relatively risky and that company was unrelated to rate of return and significantly negatively correlated with standard deviation of rate of return. Ratti and Hasan (2013) report that increases in oil price return (volatility) raise (lower) returns in the Australian energy sector. Khoo (1994) examines the sensitivity of stock returns of mining companies in Australia to exchange rate movements. Di Iorio and Faff (2000) study the effect of exchange rates on Australian stocks. Faff and Chan (1998) evaluate the pricing behaviour of Australian gold industry stocks using a multifactor model. Faff and Brailsford (1999) study the effect of oil prices on various industrial sectors of the Australian stock market.

DATA AND METHODOLOGY

The Multifactor Model

To identify important determinants of coal companies stock returns we apply a multi-factor arbitrage pricing theory model to panel data. We follow Sadorsky (2001), Boyer and Filion (2007), and Nandha and Faff (2008) and use a multifactor market model to study the impact of oil prices on stock returns. In the model, we assume that the return of coal companies is associated with market return, foreign exchange return, an interest rate premium, and oil and coal price returns. The basic model is given by

$$r_{i,t} = \alpha_i + \beta_m r_{m,t} + \beta_i i_t + \beta_{fx} fx_t + \beta_c r_{c,t} + \mu_{i,t} \quad (1)$$

where $r_{i,t}$ represents the excess return of coal company *i* at time *t*, $r_{m,t}$ is the market excess return, i_t is the interest rate premium given by difference between long-term interest rate and the short-term interest rate, fx_t is the foreign exchange return, $r_{c,t}$ is the coal price return, α is a constant, and $\mu_{i,t}$ is an error term. Excess returns for coal companies and the market are by subtracting the risk free rate of return from return of coal companies and the market. The model is estimated with generalized least squares (GLS) panel data technique. The GLS procedure is an efficient method for controlling heteroscedasticity and autocorrelation present in the data.

Australian coal companies export over three quarters of their output. Thus, foreign exchange rate risk might well be important for coal companies. Studies show that oil and gas companies are sensitive to foreign exchange risk. Over 40% of Australian coal exports go to Japan, the Japanese yen to Australian dollar exchange rate and Japanese industrial production will be considered as potential important influences on stock returns for Australian coal companies.

Interest rate plays a very crucial for the coal companies. The literature identifies that interest rate is significant for the return of the mining companies and oil and gas and gold companies. Sadorsky (2001) and Boyer and Filion (2007) find the interest rate factor significant in stock returns of oil and gas companies. Changes in the interest rate can directly affect investment decisions and have implications for the cost of indebtedness. Coal companies are capital intensive. The interest rate and the stance of monetary policy are important variables in influencing returns to such companies.

Oil price returns orthogonal to coal price returns will be included in the regression equation (1) to determine whether oil price has an impact on the returns to coal companies that is not captured by coal price alone. Higher oil price might be perceived as indicative of higher future coal prices and thus higher stock prices for coal companies. Oil price shocks might also influence stock prices through affecting expected cash flows and/or discount rates. Oil price shocks can affect corporate cash flow since oil is an input in production. Oil price shocks can affect the discount rate for cash flow by influencing the expected rate of inflation and the expected real interest rate. The corporate investment decision can be affected directly by changes in the latter and by changes in stock price relative to book value. The regression of oil price returns on coal price returns is given by

$$r_{o,t} = \phi + \varphi r_{c,t} + \varepsilon_t \tag{2}$$

Here, $r_{o,t}$ refers to oil price return at time t and ε_t is a random term capturing influence on oil price returns not captured in coal price return. The estimated residual from equation (2), $r_{o,t}^{orth}$, oil price return orthogonal to coal price return at time t, will be introduced into the multifactor model in equation (1).
The model inclusive of orthogonal oil price return is given by

$$r_{i,t} = \alpha_i + \beta_m r_{m,t} + \beta_i i_t + \beta_{fx} fx_t + \beta_c r_{c,t} + \beta_o r_{o,t}^{orth} + \mu_{i,t} \tag{3}$$

If the β_o is statistically significant in equation (3), then oil price return provides information for coal stock returns beyond that conveyed by coal price return.
The volatility of energy price returns has also been considered as an influence on firm level investment and on stock returns (Park and Ratti (2008) and Yoon and Ratti (2011)). A model that captures the effects of energy price volatility is given by:

$$r_{i,t} = \alpha_i + \beta_m r_{m,t} + \beta_i i_t + \beta_{fx} fx_t + \beta_c r_{c,t} + \beta_o r_{o,t}^{orth} + \beta_c^{vol} \sigma_{c,t}^2 + \beta_o^{vol} \sigma_{o,t}^2 + \mu_{i,t} \tag{4}$$

where volatility in coal price return is given by $\sigma_{c,t}^2$ and volatility in oil price return is given by $\sigma_{o,t}^2$. The volatilities in coal and oil price returns are obtained as the conditional variance obtained from estimating univariate GARCH (1, 1) processes.

<u>Data and Variables</u>

We identify coal companies from Coal Stock Directory provided by the Investor Ideas. These are companies active in the mining, processing, and marketing of coal in Australia. Companies listed after January 2005 are not included. We have stock return data on 20 coal companies in Australia. Our sample consists of monthly data covering the period of January 1999 to February 2010. All data unless otherwise stated are from DataStream.

The variables in the paper are: $r_{i,t}$ - the excess return of coal company *i* at time *t*, $r_{m,t}$ - the market excess return, i_t - is the interest rate premium, fx_t - the foreign exchange return, $r_{c,t}$ - coal price return, $r_{o,t}$ - oil price return, $r_{o,t}^{orth}$ - orthogonalized oil price return, $\sigma_{c,t}^2$ - coal price return volatility, $\sigma_{o,t}^2$ - oil price return volatility.

The excess return series for coal company stock is given by natural log difference of current month's closing price from previous month's closing price minus the monthly return on the Australian 30-day dealer bill rate. The Australian stock market excess return is given by natural log difference of current month's S&P/ASX 200 index closing price from previous month's closing price minus the monthly return on Australian 30 day dealer bill rate.

For foreign exchange rate returns three variables will be utilized. These are foreign exchange rate returns given by the fractional changes in the Australian dollar/US dollar exchange rate, in the trade-weighted index for the Australian dollar, and in the Australian dollar/Japanese yen exchange rate, respectively. We use changes in interest rate premium for interest rate risk. The interest rate premium is calculated as the difference between the 10-year Australian Government bond yield and the 30-day dealer bill rate. The 10-year Australian Government bond yield, the Australian 30-day dealer bill rate and the trade-weighted index for the Australian dollar are obtained from the Reserve Bank of Australia.

The price of coal is the free on board Australian dollar price per metric tonne. The price of oil is future price (Australian dollar) of Brent crude. The coal (oil) price return is given by the fractional change in the monthly data for coal (oil) price.

A generalized autoregressive conditional heteroskedasticity (GARCH) model is used to generate measures of conditional variance to serve as approximations for oil and coal return volatility. Univariate GARCH models have wide application in modelling volatility in oil prices (Lee *et al*. (1995)). Kang *et al*. (2008) use various GARCH models to calculate the volatility of crude oil price. Narayan and Narayan (2007) use an EGARCH model to calculate oil price volatility across various sub samples. Sadorsky (2006) studies the appropriateness of various statistical models to capture oil price volatility and conclude that univariate GARCH model outperforms multivariate models in modelling of oil price volatility.
We estimate the GARCH (1, 1) model given by:

$$\begin{aligned} r_{j,t} &= \gamma + \varepsilon_t \\ \varepsilon_t &\approx N\left(0, \sigma_t^2\right), \\ \sigma_t^2 &= \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \end{aligned} \tag{5}$$

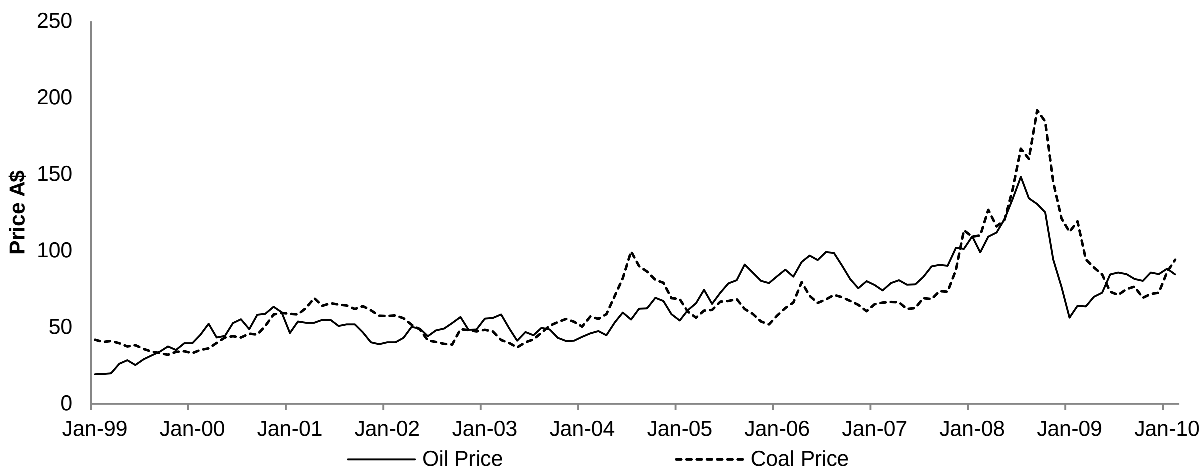
where $r_{j,t}$ is the coal (oil) return at time t, γ is a constant, and ε_t is an error term. The volatility in coal (oil) price return is captured by σ_t^2 in equation (5). Coal price return volatility, $\sigma_{c,t}^2$ and oil price return volatility, $\sigma_{o,t}^2$, over 1999:1-2010:2 are estimated, respectively, to be (standard errors are in parenthesis):

$$\begin{aligned} \sigma_{c,t}^2 &= 0.001 + 0.0591\varepsilon_{t-1}^2 + 0.9330\sigma_{t-1}^2 \\ &\quad (0.0050) \quad (0.0261) \qquad (0.0350) \end{aligned}$$

$$\sigma_{o,t}^2 = 0.0018 + 0.1525\varepsilon_{t-1}^2 + 0.6947\sigma_{t-1}^2$$
$$(0.0025)\quad(0.0129)\qquad(0.0712)$$

Coal and oil prices are shown in Figure 1. The energy prices do track one another with oil price showing larger swings. The positive co-movement in coal and oil returns is confirmed in the correlation matrix in Table 2. In Table 2 there are positive correlations between coal and oil returns on the one hand and increased returns in the Australian market and the interest rate premium on the other. The magnitude of the correlation coefficients is not so large as to indicate a problem with multicollinearity in the variables.

Figure 1: Coal and Oil Price in Australian dollars



This figure shows coal and oil prices in Australian dollars from January 1999 to February 2010.

Table 1 contains summary statistics on the variable used in the regression equations. Mean excess returns for coal company stocks have been greater than that for the market overall over 1999 to 2010. Over the period the mean coal and oil returns are positive and the latter is larger than the former. The volatility in oil returns is greater than that in coal returns in the monthly data.

Table 1: Summary Statistics of the Variables

Variable	Mean	Std. Dev	Min	Max
$r_{i,t}$	0.0085	0.1813	-0.9293	0.9373
$r_{m,t}$	0.0039	0.0447	-0.2016	0.1159
i_t	0.0011	0.0487	-0.0874	0.1638
fx_t	-0.0027	0.0393	-0.0874	0.1638
jpy_t	0.0011	0.0495	-0.3138	0.1039
$r_{c,t}$	0.0111	0.0793	-0.2939	0.2472
$r_{o,t}$	0.0152	0.1130	-0.3530	0.2847
twi_t	0.0022	0.0281	-0.1374	0.0608

Notes: The table reports summary statistics of the variables $r_{i,t}$ *-the excess return of coal company,* $r_{m,t}$ *- the market excess return,* i_t *-the interest rate premium given by difference between long-term interest rate and the short-term interest rate,* $r_{c,t}$ *-the coal price return,* $r_{o,t}$ *- the oil price return. Three different exchange rates:* fx_t *-the Australian dollar/US dollar rate (A$/US$),* twi_t *-the trade weighted index of the Australian dollar (weighted foreign currencies/A$), and* jpy_t *is the Australian dollar/Japanese yen (A$/J¥) rate.*

Table 2: Correlation Matrix of the Variables

	$r_{m,t}$	fx_t	i_t	$r_{c,t}$	$r_{o,t}$	jpy_t	twi_t
$r_{m\ t}$	1.0000						
fx_t	-0.5189	1.0000					
i_t	0.1836	-0.2263	1.0000				
$r_{c.t}$	0.0460	-0.1072	0.2644	1.0000			
$r_{o.t}$	0.3690	-0.3106	0.4025	0.2466	1.0000		
jpy_t	0.5089	-0.6785	0.2706	0.1288	0.2195	1.0000	
twi_t	0.5067	-0.7190	0.2418	-0.0003	0.2767	0.7797	1.0000

Notes: This table reports correlation matrix of the variables: $r_{i,t}$ -the excess return of coal company, $r_{m,t}$ - the market excess return, i_t -the interest rate premium given by difference between long-term interest rate and the short-term interest rate, $r_{c,t}$ -the coal price return, $r_{o,t}$ - the oil price return. Three different exchange rates: fx_t -the Australian dollar/US dollar rate (A\$/US\$), twi_t -the trade weighted index of the Australian dollar (weighted foreign currencies/A\$), and jpy_t is the Australian dollar/Japanese yen (A\$/J¥) rate.

RESULTS

The results from our GLS panel data estimation of equation (1) are reported in Table 3. In all regressions market excess return, the interest rate premium, foreign exchange return, and coal price return are statistically significant. The Wald test statistic for panel data indicates the models are statistically significant. The coefficient of market return in each equation in Table 3 is significantly greater than 1 in all equations, suggesting that the equity of coal companies is more risky than the market return. A one-tailed test of the null hypothesis that the coefficient of market return is less than one is rejected at the 1% level of confidence in 3 cases, at the 5% level of confidence in 2 cases, and at the 10% level of confidence in 1 case in Table 3. This result for coal companies is consistent with results reported for oil companies by Al-Mudhaf and Goodwin (1993), Faff and Brailsford (1999) and Sadorsky (2001) that the beta coefficients for oil companies are greater than one. The interest rate premium is significant at 1% level in all the regressions in Table 3. A larger value for the interest rate premium (a lower short-term interest rate relative to the long-term interest rate) indicates easier monetary policy and this is associated with an increase in returns for coal companies.

Three different exchange rates are used; the Australian dollar/US dollar rate (A$/US$), the trade weighted index of the Australian dollar (twi) and the Australian dollar/Japanese yen (A$/J¥) rate. The statistically significant negative coefficient estimate for fx in column 1 in Table 3 implies that depreciation of Australian dollar against the US dollar has negative impact on the return of coal companies in Australia. This result is consistent with the results of Sadorsky (2001), Boyer, and Fillion (2007) in which the foreign currency exposure of energy companies is negative when the domestic currency depreciates. The result for the trade-weighted index of the Australian dollar (twi) in column 2 is similar to that for the Australian dollar/US dollar rate in column 1. A fall in trade-weighted index of the Australian dollar implies a devaluation of the Australian dollar relative to the main trading partners. Thus, in column 2 in Table 3 an increase in twi implies an increase in coal stock returns.

Since Australian coal companies export heavily to Japan, the foreign exchange rate of Australian dollar against the Japanese yen and Japan's industrial production are introduced as variables in the regression. Results are reported in columns 3 and 4. The foreign exchange rate of Australian dollar against Japanese yen is statistically significant and Japanese industrial production is not significant for Australian coal companies. The sign of the coefficient β_{jpy} is positive, which implies that when Australia dollar depreciates against the yen, the return of Australian coal companies increases. This result is explicable in that the correlations reported in Table 2 imply that depreciation of the Australian dollar against the US dollar is negatively associated with depreciation of the Australian dollar against the Japanese yen.

Table 3: Coal Company Stock Returns: January 1999-February 2010

Coefficients	1	2	3	4	5	6
α	0.0006	0.0006	0.0015	0.0013	0.0009	0.0009
	(0.0034)	(0.0034)	(0.0038)	(0.0034)	(0.0034)	(0.0034)
β_m	1.1691***	1.2674***	1.2048***	1.2261***	1.1334***	1.1315***
	(0.0873)	(0.0868)	(0.0866)	(0.0886)	(0.0752)	(0.0903)
β_i	0.2731**	0.2730**	0.2531***	0.2756***	0.2444***	0.2228**
	(0.0826)	(0.0754)	(0.0752)	(0.0777)	(0.0752)	(0.0791)
$\beta_{fx(A\$/US\$)}$	-0.4576***				-0.3440**	-0.4417***
	(0.1006)				(0.1202)	(0.1010)
β_{twi}		0.3345**				
		(0.1412)				
$\beta_{jpy(A\$/JY)}$			0.3090***	0.2854***	0.1465	
			(0.0889)	(0.0802)	(0.0957)	
β_c	0.1628***	0.1823***	0.1625***	0.1672***	0.1595***	0.1700***
	(0.0430)	(0.0432)	(0.0431)	(0.0432)	(0.0477)	(0.0433)
β_{ip}				0.1880		
				(0.1646)		
β_o						0.0602*
						(0.0034)
Wald χ^2	442.44	424.78	435.60	436.96	445.42	443.74
Prob>χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
# Obs.	2434	2434	2434	2434	2434	2434

The table reports the results using the following multifactor regression equation $r_{i,t} = \alpha_i + \beta_m r_{m,t} + \beta_i i_t + \beta_{fx} fx_t + \beta_c r_{c,t} + \beta_o r_{o,t}^{orth} + \mu_{i,t}$ *where* $r_{i,t}$ *-the excess return of coal company,* $r_{m,t}$ *- the market excess return,* i_t *-the interest rate premium given by difference between long-term interest rate and the short-term interest rate,* $r_{c,t}$ *-the coal price return,* $r_{o,t}$ *- the oil price return. Three different exchange rates:* fx_t *-the Australian dollar/US dollar rate (A$/US$),* twi_t *-the trade weighted index of the Australian dollar (weighted foreign currencies/A$), and* jpy_t *is the Australian dollar/Japanese yen (A$/J¥) rate. Data are monthly and the model is estimated using GLS panel data model. ***Significant at 1%, **significant at 5%, and *significant at 10% level.*

In column five of Table 3 results are reported for both the Australian dollar/US dollar rate (A$/US$) and the Australian dollar/Japanese yen (A$/J¥) rate as variables in the regression equation. The A$/US$ is statistically significant and the A$/J¥ is not statistically significant. In what follows we will work with the Australian dollar/US dollar rate as the variable capturing foreign exchange rate risk.

Coal and Oil Price Returns

The coal price return is statistically significant at 1% level in determining the excess return on coal companies in Australia in all the regressions in Table 3. The significant effect of coal price return on the excess return of coal companies is robust to inclusion of an oil price return variable (that is orthogonal to coal price returns). In column 6 of Table 3, orthogonalized oil price return, $r_{o,t}^{orth}$, is statistically significant at the 1% level. This implies that oil price return increases not reflected in coal price returns also have a positive effect on coal company stock returns.

The coal price return variable refers to returns in Australian dollars. Although coal contracts are expressed in US dollars, coal price returns have been expressed in terms of Australian dollars since we examine Australian coal companies. If the regressions in Table 3 were re-estimated with coal price returns expressed in US dollars, for regressions including both exchange rate risk (measured by A$/US$) and coal price return, the coefficient on the coal price variable (β_c) would be unchanged (at 0.1700 in column 6), but the estimated coefficient on the exchange rate risk variable would be become -0.2717 (the sum of -0.4417 and 0.1700 the estimated values of β_{fx} and β_c in column 6). Given the coefficients in Table 3, stock return increases would still be associated with appreciation of the domestic currency, but less so than when coal rice returns are in terms of the Australian dollar. The reduction will be greater if oil price return is also expressed in US dollars rather Australian dollars, and bring results with regard to exchange rate more into line what would be expected if effective hedging policies were in place.

Coal and Oil Price Returns Volatility

Coal return volatility and oil return volatility are constructed by the conditional volatility in GARCH (1, 1) processes in equation (5). In Table 4, results from estimating equation (4) are reported.

Table 4: Coal Company Stock Returns and Coal and Oil Price Volatility: January 1999-February 2010

Coefficients	Model-1	Model-2	Model-3	Model-4	Model-5
α	-0.0066 (0.0061)	-0.0071 (0.0061)	-0.00911 (0.0077)	-0.0188** (0.0093)	0.0170** (0.0094)
β_m	1.1200*** (0.0898)	1.1613*** (0.0923)	1.1472*** (0.0911)	1.2127*** (0.0905)	1.1789*** (0.0931)
β_i	0.2712*** (0.0749)	0.2295*** (0.0792)	0.2285*** (0.0792)	0.3363*** (0.0726)	0.2357*** (0.0793)
$\beta_{fx(A\$/US\$)}$	-0.4495*** (0.1008)	-0.4315*** (0.1012)	-0.4669*** (0.1028)	-0.4989*** (0.1022)	-0.4576*** (0.1029)
β_c	0.1577*** (0.0431)	0.1652*** (0.0434)	0.1652*** (0.0434)		0.1574*** (0.0437)
β_c^{vol}	0.5104 (0.8700)	0.2967* (0.1508)		1.6029* (0.8703)	1.4221* (0.8465)
β_o		0.0654** (0.0358)	0.0779** (0.0397)		0.0607* (0.0360)
β_o^{vol}			1.1820*** (0.6701)	1.0187* (0.5735)	0.8427* (0.4012)
Wald χ^2	444.67	446.47	445.65	432.65	448.72
Prob>χ^2	0.0000	0.0000	0.000	0.0000	0.0000
Observations	2434	2434	2434	2434	2434

The table reports the results using the following multifactor regression equation : $r_{i,t} = \alpha_i + \beta_m r_{m,t} + \beta_i i_t + \beta_{fx} fx_t + \beta_c r_{c,t} + \beta_o r_{o,t}^{orth} + \beta_c^{vol} \sigma_{c,t}^2 + \beta_o^{vol} \sigma_{o,t}^2 + \mu_{i,t}$ *where* $r_{i,t}$ *-the excess return of coal company,* $r_{m,t}$ *- the market excess return,* i_t *-the interest rate premium given by difference between long-term interest rate and the short-term interest rate,* $r_{c,t}$ *-the coal price return,* $r_{o,t}$ *- the oil price return,* fx_t *-the Australian dollar/US dollar rate (A$/US$),* $\sigma_{c,t}^2$ *- coal price return volatility,* $\sigma_{o,t}^2$ *- oil price return volatility. Data are monthly and the model is estimated using GLS panel data model. ***Significant at 1%, **significant at 5%, and *significant at 10% level of significance.*

The results in Table 4 indicate that the statistical significance of coal and oil price returns in explaining coal company returns are robust to the inclusion of the volatility measures. Coal and oil price return volatility have positive effects on coal company returns. These effects are statistically significant at 10% level of significance in column (5).

CONCLUDING COMMENTS

A number of studies identify the risk factors of oil and gas companies and evaluate the effect of energy prices on the stock price of oil and gas companies. Despite the importance of coal as a source of energy, relatively little work has appeared on coal companies. Companies in Australian's coal sector account for about a third of coal trade. We examine panel stock return data on listed coal companies on the Australian stock exchange over 1999 to 2010. A multifactor market model is used to estimate the expected excess returns to coal company stock prices in Australia.

Market return, interest rate premium, foreign exchange rate risk, and coal and oil price return are statistically significant in determining the excess return on coal companies' stock in Australia. The beta coefficient of market return is significantly greater than 1 in line with results for oil and gas companies confirming results that firms in the primary energy sector are more risky than the market. The depreciation of Australian dollar against either the US dollar or a trade weighted value of the Australian dollar has a negative impact on the return of coal companies in Australia, a result similar to that found by comparable country studies for oil and gas companies.

The significant effect of coal price return on the excess return of coal companies is robust to inclusion of an oil return variable. Oil price return increases have a statistically significant positive effect on coal company stock returns. A one per cent rise in coal price raises coal company returns by between 0.15% and 0.17%. A one per cent rise in oil price raises coal company returns by between 0.06% and 0.08%. The sensitivity of stock price indices to oil price shocks suggest a role in a well-balanced portfolio (and for pursuit of profitable investment strategies) for investment in stocks that rise when oil price increases.
In this paper, we consider the various risk factors of coal companies in Australia. The exposure of coal companies in other countries to these risk factors might be different. Therefore, this analysis can be extended to other countries. To estimate oil and coal return volatility, we use GARCH methodology. Future research might consider other measures of the energy return volatility. Furthermore, future research might consider Global Financial Crisis (GFC) in 2008 to check the robustness of the risk factors of this study.

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