Equity pricing in the mining sector: Evidence from NYSE and LSE

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Abstract: The study examines the Capital Asset Pricing Model (CAPM) for the mining sector using weekly stock returns from 27 companies traded on the New York Stock Exchange (NYSE) or on the London Stock Exchange (LSE) for the period of December 2008 to December 2010. The results support the use of the CAPM for the allocation of risk to companies. Most companies involved in precious metals (particularly gold), which have a beta value less than unity (Table 1), have been actuated as shelter values during the financial crisis. Values of R^2 do not shown very explanatory power of fitted models ($R^2 < 70$ %). Estimated coefficients beta are not sufficient to determine the expected returns on securities but the results of the tests conducted on sample data for the period analysed do not appear to clearly reject the CAPM.

1. Introduction

Estimation of expected returns or cost of equity for individual stocks is central to many financial decisions such as those relating to portfolio management, capital budgeting, and performance evaluation. The main alternative available for this purpose is a single-factor capital asset pricing model (CAPM) developed by Sharpe [1], Lintner [2] and Mossin [3].

Firms have two sources of capital: debt and equity. Driven largely by a firm's default risk, the cost of debt for a firm is reflected by market interest rate on recently issued bonds. Pricing equity is not as straightforward and can be a source of debate. The CAPM is the most generalized tool to estimate beta values and therefore the cost of equity [4,5,6, between others].

The global mining sector is fiercely competitive and consequently, firms are under constant pressure to operate in the most efficient manner. There are few studies that apply investment data to obtain asset pricing models in companies engaged in natural resources (forestry, mining, fisheries). A recently study [7] uses CAPM model in North American stock markets to predict equity pricing in the forestry sector. This approach is used for mining sector in this study. A critical aspect to maintaining competitiveness is the ability to source capital. In fact, [8,9] argued that exploiting mining resources is one of the most capital-intensive endeavors. Additionally, given the long investment horizons associated with many mining-based assets, management decisions and resource valuation tend to be very sensitive to capital costs.

Despite its widespread use, the CAPM has not received empirical support in several studies [10,11,12]. In an attempt to alleviate these shortcomings, several competing multifactor models have been developed. Even though the criticism about CAPM, this method has the following advantages: 1) As the CAPM states in his formula, we can find what investors are looking for from particular stocks. To do this, only values we need are a risk-free rate of return, market return and beta; sensitivity of the stock's return to the return on the market portfolio. 2) We can also use the CAPM to find the discount rate for a new project [13]. 3) Finally the use of CAPM model is consistent with risk diversification in shaping financial portfolios [5].

The main objective of this paper is to perform CAPM, for individual mining stocks. The second is to get the value of the beta estimate for several mining companies and finally to compare the results from the companies belonging to the mining sector against other sectors.

2. Methodology and Data

2.1 The CAPM

Derived from the portfolio theory [14], the Sharpe-Lintner-Mossin CAPM is specified as

$$\mathrm{E}(R_i) = R_t + \beta_i \left[E(R_m - R_f) \right], i = 1,\ldots,N \quad (1)$$

where R_i is the required rate of return on asset *i*, R_f is the risk-free rate of return, β_i is the systematic or non-diversifiable risk of asset *i*, and R_m is the expected return on the market portfolio.

Eq. (1) represents a "security market line" (SML) having an intercept (alpha) equal to the risk-free rate and a slope (beta) equal to the excess return on the market portfolio.

The CAPM rests on eight assumptions [15] which are: 1) Operating costs are zero, 2) Capital assets can be diversified infinitely 3) No income (or corporation) tax 4) There is full competition (individual purchase-sale do not affect the prices), 5) Investors make decisions according to the expected returns and standard deviations of these returns, 6) Infinite open sales is possible (lending and borrowing at risk free interest rate is possible), 7) Investors have homogenous expectations about the expected returns, standard deviations and correlation coefficients, 8) All capital assets can be marketed.

These assumptions plus that security returns are normally distributed, result in beta being the correct risk measure. Because the risk of an individual security is considered only in relation to other securities in the portfolio, all investors will choose to hold the market portfolio.

2.2 Methodology

The CAPM have been estimated using a time series of returns by the following classical regression model:

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it}, i = 1,\ldots,T \quad (2)$$

where r_{it} and r_{mt} represent excess returns for asset *i* and the market at time *t*, respectively and T (total number of weeks since October 24, 2008 to October 22, 2010, in this case).

Eq. (2) have been estimated by ordinary least squares (OLS) for each asset *i*.

2.3 Data

The CAPM method is applied to a sample of returns for mining-related firms that are publicly traded on the New York Stock Exchange (NYSE) or on the London Stock Exchange (LSE). Since a group of these firms have assets that are predominately mines and the returns are based on actual transactions, by using individual securities, as opposed to portfolios, the analysis should yield a more accurate reading of the systematic risk associated with such investments.

To limit the possibility of shifting model parameters, analysis was limited to a 2-year period (October 24, 2008 to October 22, 2010). This restricted the study to those firms where continuous pricing data over this period were available, then the selection reaches a sample of 27 firms. Weekly closing prices on Friday (P) were recovered from google [16].

Returns were then calculated as

$$R_{it} = \ln(\frac{P_t}{P_{t-1}}) \quad (3)$$

This left a time series of 107 return observations for each firm beginning October, 24 2008. The weekly equivalent of the yield on a 1-month US Treasury bill was treated as the risk-free rate and the value-weighted returns on all NYSE stocks were used as the return on the market portfolio. For those firms listed on the LSE, the corresponding weekly return on the Pound-Us dollar exchange rate (r_e) (GBP/US$) was recovered from the Bank of England's web site to be used in the model to estimate exchange rate risk [17].

It has used the website of Professor Damodaran [18] to compare with other sectors.

3. Results

The regressions models adjusted are shown in Table 1

Table 1. Description and results of firms included in the asset pricing model.

Ticker (exchange)	Main Product	β	p-v	R^2 %	p-v (Durbin-Watson test)	α	p-v	p-value (Box-Pierce test)
AAL (Lse)	Diversified	1,7000	0,0000	51,86	<0,01	0,0000	> 0,1	0,31
ABX (Nyse)	Gold	0,6700	0,0200	9,72	0,03	0,0000	> 0,1	0,15
AEM (Nyse)	Gold	1,0637	0,0034	14,10	0,017	0,0200	> 0,1	0,23
ANTO (Lse)	Copper	1,2813	0,0092	11,30	> 0,1	0,0500	0,08	

AU (Nyse)	Gold	0,6900	0,0063	12,36	0,17	0,0000	0,1	
AUY (Nyse)	Gold	1,0486	0,0035	14,03	0,35	0,0080	> 0,1	
BHP (Nyse)	Diversified	1,4324	0,0000	57,20	0,36	0,0170	0,01<p< 0,1	
BTU (Nyse)	Coal	1,3827	0,0000	34,15	0,17	0,0063	0,1	
BVN (Nyse)	Gold	0,9559	0,0037	13,88	0,007	0,0000	> 0,1	0,33
CCJ (Nyse)	Uranium	1,4952	0,0000	48,00	0,25	0,0000	> 0,1	
CNX (Nyse)	Coal	1,4608	0,0000	32,77	0,24	0,0000	> 0,1	
EGO (Nyse)	Gold	0,6909	0,0223	8,80	0,38	0,0200	> 0,1	
FCX (Nyse)	Copper	2,0129	0,0000	51,70	0,12	0,0130	0,1	
FQM (Lse)	Copper	1,8227	0,0000	31,37	> 0,1	0,0200	> 0,1	
GG (Nyse)	Gold	0,8122	0,0113	10,72	0,01	0,0000	> 0,1	0,31
IAG (Nyse)	Gold	0,6928	0,0534	6,40	0,05	0,0100	>0,1	0,42
IVN (Nyse)	Copper	1,9575	0,0000	26,13	0,07	0,0200	> 0,1	0,06
KGC (Nyse)	Gold	0,8178	0,0099	11,10	0,07	0,0000	> 0,1	0,91
NEM (Nyse)	Gold	0,5741	0,0186	9,33	0,14	0,0000	> 0,1	
POT (Nyse)	Phosphates	1,2712	0,0000	28,12	0,12	0,0300	0,07	
RTI (Nyse)	Titanium	1,5869	0,0000	33,10	0,053	0,0000	> 0,1	0,51
RTP (Nyse)	Diversified	1,5102	0,0000	34,10	0,07	0,0000	> 0,1	0,21
SLW (Nyse)	Silver	1,8476	0,0000	30,10	0,48	0,0000	> 0,1	
TCK (Nyse)	Diversified	3,5314	0,0000	69,22	0,006	0,0000	> 0,1	0,3
TIE (Nyse)	Titanium	1,4889	0,0000	31,20	0,21	0,0000	> 0,1	
VED (Lse)	Diversified	2,2119	0,0000	52,10	0,45	0,0150	> 0,1	
XTA (Lse)	Diversified	1,7768	0,0000	39,10	0,07	0,0000	> 0,1	0,78

β_i coefficients are all significant (p-value < 0.1). The α_i coefficients usually get zero (p-value > 0.1). The residuals, ε_{it}, are independent. This is verified in all cases with the Durbin-Watson test cause the p-values are p>0.1. In cases where p-values are < 0.0, it has tested the serial correlation of the residuals with the Box-Pierce test. Estimated with a greater number of autocorrelations, resulting p-values greater than 0.01, thus admitting the independence of the residuals also in this cases. There is only one exception for IVN. This case would be tested with analysis techniques for dependent data.

R^2 not exceed 70%, so a great part of variance is not explained by this model.

Table 2 shows the results with the general data of each sector recovered from Damodaran's website [18].

Table 2. Comparison of results with sector data from Damodaran's website.

Sector	*Number firms This study*	$\overline{\beta}$ this study	*Number firms Damodaran*	$\overline{\beta}$ Damodaran
Biotechnology			119	1,24

Building Materials			46	0,90
Chemical (Diversified)			30	1,43
Coal	2	1,42	25	1,45
Metals & Mining (Div.)	14	1,79	68	1,26
Natural Gas (Div.)			32	0,99
Paper/Forest Products			36	1,04
Petroleum (Integrated)			23	1,12
Power			67	0,74
Precious Metals	11	0,90	73	1,16
Steel (General)			19	1,43
Total Market	**27**	**1,40**	**5857**	**0,93**

The initial part of the methodology for testing the CAPM required the estimation of betas for individual sample stocks by using observations on weekly returns for a sequence of dates. The range of estimated individual beta has the minimum value of 0.5741 and the maximum value of 3.5314 (Table 1). Majority of the estimated beta coefficients are statistically significant at a 95% level.

4. Discussion and Conclusions

The results support the use of the CAPM for the allocation of risk to companies. Thus most companies involved in precious metals (particularly gold), which have a beta value less than unity (Table 1), have been actuated as shelter values [19] during the financial crisis (study period December 2008 to December 2010).

The intercept term (α) is interpreted as the difference between the time series return of the asset and that predicted by the fitted model. In 26 of the 27 companies analyzed in this paper, the intercept term (α) is zero (Table 1), which implies that the model describes well the behaviour of these companies. These results are similar to those of other authors who have studied companies engaged in natural resources [7].

Our findings are similar to that of Damodaran [18] even though our sample of data is fewer than his. Table 2 shows the results for beta and we conclude that the mining sector is riskier than others which have a fewer than one beta value.

The R^2 is a goodness-of-fit measure interpreted as the fraction of uncertainty explained by the fitted models, in this case, the explanatory power of the model is limited ($R^2 < 70$ %). In the light of above findings, it can be concluded that beta is not sufficient to determine the expected returns on securities and more research is needed, using other methods to explain the behaviour of stock returns. Nevertheless the results of the tests conducted on sample data for the period of December 2008 to December 2010 do not appear to clearly reject the CAPM. The empirical findings of this paper would be useful to financial analysts in mining sector. Further research on the combinations of market factors, macroeconomic factors and firms' specific factors can be carried out to solve the CAPM puzzle.

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