A share selection framework for investors in the mining sector of the JSE (Ltd)

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Abstract

Shareholder wealth creation is a topic taught in MBA programmes.

This paper documents the development of a share selection framework in order to construct an alpha portfolio within the general mining sector of the JSE limited.

The relationship between fundamental analysis indicators, such as book value per share, earnings per share and intrinsic value, and the average annual share price is determined in order to build a linear regression model. The model is applied to the general mining sector to test its effectiveness. Criteria are set for each indicator to identify companies from this sector for inclusion in the final portfolio.

A portfolio’s risk is determined by the proportions of the individual securities, their variances, and their co-variances. Markowitz (1952) quantitatively demonstrated the benefits of diversification in order to reduce risk (volatility) and increase return. This theory was put to the test by comparing individual shares’ average volatilities against the diversified portfolio’s average volatilities for similar and/or improved returns.

A weighted average portfolio, with the lowest standard deviation, consisting of four shares identified from the selection framework, was constructed. The portfolio’s average annual growth rate was benchmarked against the JSE All Share Index average annual growth rate to evaluate returns over a ten year period. The research hypothesis, namely shareholder wealth creation in an alpha portfolio, was reached: the final portfolio outperformed the JSE All Share Index annual growth rate in seven out of the ten evaluated years.
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CHAPTER 1

SHAREHOLDER WEALTH CREATION IN THE GENERAL MINING SECTOR

1.1 Background

The JSE limited, originated more than 150 years ago, primarily to raise capital for the mining sector. In 2009 the general mining industry contributed 8.8% directly to the gross domestic product of South Africa and represented a third of the capitalisation of companies listed on the JSE limited. Coal, platinum and gold accounted for 71.2% of South Africa’s overall mineral sales in 2009 (Durrheim, 2010:3).

Investing in common stock, also called shares, securities or equities, is buying a part of a company listed on the stock exchange, in this case the JSE limited. As an equity owner, voting rights are obtained to take part in the election of board members of the company. Profits are also generated per security in the form of dividends, although all companies do not pay out dividends (Investopedia.com, 2011:1).

Investing in shares listed on the stock exchange entails a degree of risk. Risk in this case is defined as the probability to earn more or less than expected or required, in other words it refers to an uncertainty of returns. Risk related to equity can vary extensively and is typically subjected to the specific company’s performance. Two types of risks can be identified: unsystematic, or company specific risk and systematic, or market risk. Company specific risk can be eradicated through diversification, whereas systematic risk is the risk intrinsic to the entire market or market segment, and cannot be eluded (Megginson, Smart and Graham, 2010:177).

A market risk premium refers to the difference between equity returns of a market portfolio, and returns from safe or so-called 'risk free' investments. This premium is the minimum return that investors require above the return on risk free investments to make them willing to invest in a market portfolio. The risk free rate of return, the market risk premium and an adjustment for company volatility in relation to the
market, as measured by beta (see next paragraph), is generally used to set acceptable rates of returns for investment in a specific stock. In the case of a portfolio, a weighted average of the returns of the individual stock returns, will determine the portfolio return.

The beta of an asset is a standardised measure of the volatility of a security’s covariance with the overall portfolio (the market), a measure of systematic risk. This risk cannot be eliminated and can be seen as the only risk investors can be rewarded for bearing (Meggison et al., 2010:95). This study’s focus will be on unsystematic risk, and the reduction of volatility through diversification by means of a portfolio

It is generally accepted in financial literature that there is a delicate balance between risk and return. Usually, the more risky (volatile) the returns from a share, the higher the required rate of return. The standard deviation and coefficient of variation are measures of absolute returns and quantify the stand-alone risk of an investment. In a portfolio, risk reduction can be achieved, because fluctuations in return of one asset partially offset fluctuations in the return of another, when the returns from the assets are not 100% positively correlated.

Cilliers (2004:110) identified quantitative criteria in a five step model approach. The purpose of the model is to determine the investment potential of the individual securities based on the investment philosophy of Warren Buffet. In the study, Cilliers’ model criteria, as well as measures for the market in general, will be taken into account. Measures specifically related to the general mining industry, will be applied to evaluate which securities to select for inclusion in the final portfolio.

In this context it needs to be mentioned that in 1952 Markowitz (1952:78), the father of the modern portfolio theory, identified the importance of valuing securities in a group. The contribution by an individual security to the variance of the entire portfolio is the main focus of this theory (Rubenstein, 2002:3). Mean variance analysis identifies the most efficient portfolio: this is the combination of assets generating the expected return with a minimum risk (lower than individual securities); therefore the lowest volatilities, (betas) with the highest return.
1.2 Problem statement

The problem is that it is difficult for investors to identify a portfolio of common stock, within the general mining sector, to minimize risk and generate returns, preferably higher than the JSE All Share Index, as a benchmark to create shareholder wealth.

1.3 Study objectives

The focus of the study is to enable investors to generate wealth from investing in the general mining sector of the JSE limited.

1.3.1 Main objective

The primary objective of this study is to develop a framework that will enable investors to select a portfolio from the general mining sector with a positive alpha.

1.3.2 Sub objectives

i. To examine the applicability of Cilliers’ 2004 model in individual share selection as a first line screening tool, as well as variables specifically related to the general mining sector.

ii. To test Markowitz’s 1952 Mean Variance of Portfolio Choice Theory (MVP), in the final selection of the portfolio identification.

1.4 Research methodology

The literature study will firstly examine the general mining sector listed on the JSE limited followed by an investigation of the criteria identified for the screening framework. Finally, portfolio selection, to diversify risk and optimize returns, will be the focus.

The second part of this research project will be an empirical study. Five main indicators (book value per share; intrinsic value per Share; determination of a margin of safety; evaluation of profit margin of the company; and number of years to pay off debt), as per the model of Cilliers (2004:123) based on Warren Buffet’s investment
philosophy, as well as highly correlated measures specific to the general mining sector, will be tested as a first line screening tool in the portfolio selection of the companies listed in the general mining sector of the JSE limited. Multiple regression analysis will be used to identify the individual shares that correlate best with the various metrics over a twenty year period and build a framework for each of the years considered.

Markowitz’s 1952 mean variance of portfolio choice theory (MVP) will be applied in the final selection of the portfolio to determine the combination of the selected shares in the portfolio that results in the minimum variance portfolio. The portfolio average annual growth rate will be benchmarked against the JSE All Share Index (J203) average annual growth rate, to evaluate returns over a ten year period, to establish if the portfolio answers the research hypothesis, namely shareholder wealth creation in an alpha portfolio.

1.5 Scope of the study

This study will be conducted from the view of the individual investor, purchasing a portfolio of shares selected from the companies listed in the general mining sector on the JSE limited. Companies with less than 10 years data will be excluded to effectively evaluate variables.

1.6 Limitations of the study

This study only explores listed companies in the general mining sector on the JSE limited. Therefore other sectors and sub-sectors on the JSE limited are excluded, as well as unlisted companies and other security investments. Financial indicators with the highest correlation to average price per share in the general mining sector will be used to formulate a quantitative model for each year and develop the portfolio selection framework. Statistical confidence intervals of 95%, (p< 0.05), are set.

1.7 Layout of the study

A chapter outlay is provided to clarify what can be expected in the study.
Chapter 1

Chapter 1 provides an introduction to the research to be performed. It gives insight into the study that will be done. The impact of the general mining sector on the JSE limited is highlighted. The risk and return relationship of portfolio management is explained.

Chapter 2

Chapter 2 will consist of a literature study, which reports general theoretical aspects. Performance and importance of the general mining sector on the JSE limited will be considered. Established and contemporary theories on individual share investments will be investigated.

Chapter 3

Chapter 3 addresses the background on portfolio research models. The investment criteria will be examined. The company background of each company listed in the general mining sector of the JSE limited is provided.

Chapter 4

The empirical research of the study will be reported on in Chapter 4. This chapter will include the following sections:

- Research methods,
- Research sample,
- Statistical methods; and
- Report of findings
  - Summary output tables and figures
- Discussion/description of information in the output tables and figures.
Chapter 5

Chapter 5, the final chapter of the dissertation, will entail recommendations and conclusions on the research performed. Conclusions will be drawn from the empirical research performed in Chapter 4, and observations based on preceding research, reached. Recommendations for execution of a positive alpha portfolio selection will be made, followed by recommendations for further study.
CHAPTER 2

GENERAL THEORY: INDIVIDUAL SHARE SELECTION AND THE
GENERAL MINING SECTOR REVIEWED

2.1 Introduction

The first step in the creation of shareholder wealth is to build a deeper understanding of the causes and drivers of value in the market to assure sustainability of performance in a competitive environment. In order to do this, the market will be evaluated in a deductive approach by identifying global and local non-idiosyncratic factors. This will be followed by a view of the general mining sector’s recent performance. Common stock valuation models of risk and return will be examined.

2.1.1 The market

The South African economy experienced an extended period of deceleration in economic growth from 1970 to 1995. This trend was followed by a positive economic growth rate from 1995 to 2000 in real cumulative and per capita terms. The 2008 global recession led to a decline in the economic growth of South Africa. Productivity losses since 2000, due to the descending movement of real output per worker, as employment grew, is another contributing factor that leads to the questioning of the sustainability of South Africa’s growth recovery after the recession (Fedderke, 2010:1). Optimists still expect 3.4% economic growth to be reached in 2011 (Williams and Van Zyl, 2011:1).

There are several characteristics unique to South Africa that influences not only the economy, but also directly and indirectly, the general mining sector’s performance on the JSE limited. One such major contributor is the political uncertainty (Welch, 2011:23). Some of the top members of the governing party support the idea of nationalisation of the mining industry (Reuters, 2011:10). The African National Congress (ANC), the ruling party of South Africa, officially debated nationalisation of mining in the country after youth leader of the ANCYL, Julius Malema, called for this policy. South Africa’s unemployment rate is high, estimated at 24%, with a quarter of
the potentially economically active population unemployed. According to Susan Shabangu, Mineral Resource Minister of South Africa, Malema, informed by challenges of unemployment and poverty, said that the “country does not derive enough benefit from mining” (Casey, 2011:1). Nationalisation, however, poses a direct threat to investors (Reuters, 2011:10). Anglo America Plc, a London-based Company, is South Africa’s largest private employer. Cynthia Carol, CEO of Anglo America, described the idea of nationalisation as “the road to ruin” for South Africa, as mining companies will not invest unless they can be certain of secured assets (Casey, 2011:1).

The cost of doing business in South Africa is on the increase due to economy wide related events that affect business, such as: inflexible, costly, low skilled labour; high prevailing crime rates; electricity constraints; and rising electricity costs (25% per year for the next three years); inflation and interest rates (Fedderke, 2010:5).

Infrastructure investment, especially into rail transport systems, is essential to the mining industry (Durrheim, 2010:16). In this context one has to note that the global iron ore mining and steel fabrication are heavily dependent on Transnet’s freight rail to obtain growth and sustainability (PricewaterhouseCoopers, 2010:14).

Educational standards in mathematics and science are questioned in terms of international competitiveness, due to the fact that South Africa consistently ranked last in the testing of eighth graders, over the 1995-2003 periods, with a deteriorating score trend over the years. In 1995 a total of 37 countries participated in this testing, known as the TIMSS (Trends in International Mathematics and Science Studies), and 38 countries in 1999, although not all the same countries as in the previous year’s evaluation, and 46 countries participated in 2003. In 1995 Austria, Switzerland, France and Ireland took part in the TIMSS and performed very well, though they did not participate again. Countries such as South Africa, Macedonia, Jordan, Indonesia, Tunisia, Philippines, Marco and Chile filled the places of the above mentioned countries. In 1999 Scotland, Norway and Sweden missed the
TIMSS testing, although they were included in the other years (Dudaitė and Elijio, 2005:4).

South Africa shows a significant expenditure profile on human capital creation and in the health sector. Poor health outcomes are subscribed to high prevalence of HIV/AIDS and tuberculosis. These epidemics are reducing the availability of skilled-and-experienced-labour, total human capital and, in turn, increasing costs and decreasing productivity. Health and safety policies have a direct influence on the Mining Sector.

Other systematic (non-idiosyncratic) risk factors: property rights as a driver of capital accumulation, and government policies, are critical factors impacting the general mining sector performance on the JSE limited. As part of the Mineral Policies Act, the Mineral and Petroleum Resources Royalty Act was implemented on the first of March 2010, which added another expense and administrative load to the mining industry. Royalty taxes are a severance tax, charged to mining companies for the extraction of non-renewable mineral resources (Chamber of Mines, 2010:75).

### 2.1.2 Recent performance of the mining sector

South Africa has the world’s largest spring of mineral resources and was announced the world’s wealthiest country in terms of the value of in-ground mineral resources, by Citygroup Global Markets study in 2010 (Welch, 2011:4).

The 2009 recession led to a decline of 7.2% in the mining sector GDP value of South Africa - the fifth largest mining sector by GDP value in the world - with total income of R332 billion for 2009. This decline led to an accompanied retrenchment of twenty thousand people in the mining sector during this time period (Chamber of Mines, 2010:25).

As per the table below, derived from Statistics South Africa, it is noteworthy that the overall South African mining sector showed a decline of nearly 1% in real growth rates per annum over the past decade (1999 to 2009). While gold and diamond production are the main drivers of the decline in the overall mining sector, platinum
group metals (PGMs), iron ore and coal production grew positively. The top twenty mining countries in the world, in contrast to the South African mining sector, showed positive growth values and are estimated to continue this trend at an average real growth rate value of 5% per annum (Chamber of Mines, 2010:26).

Table 1: South African mineral production growth rates (Statistics South Africa, 2009:1)

<table>
<thead>
<tr>
<th></th>
<th>Total mining</th>
<th>Iron ore</th>
<th>Manganese</th>
<th>PGMs</th>
<th>Coal</th>
<th>Chrome</th>
<th>Diamonds</th>
<th>Gold</th>
</tr>
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<tr>
<td>1990-1999</td>
<td>-0.4</td>
<td>0.1</td>
<td>-0.3</td>
<td>7.1</td>
<td>2.3</td>
<td>5.4</td>
<td>1.3</td>
<td>-2.9</td>
</tr>
<tr>
<td>2000-2009</td>
<td>-0.5</td>
<td>6.5</td>
<td>4.9</td>
<td>2.6</td>
<td>1.2</td>
<td>-0.1</td>
<td>-0.2</td>
<td>-7.7</td>
</tr>
<tr>
<td>1990-2009</td>
<td>-0.6</td>
<td>3.3</td>
<td>2.3</td>
<td>4.8</td>
<td>1.8</td>
<td>2.6</td>
<td>-0.4</td>
<td>-5.3</td>
</tr>
<tr>
<td>2001-2009</td>
<td>-0.4</td>
<td>5.7</td>
<td>3.7</td>
<td>3.4</td>
<td>1.2</td>
<td>0.1</td>
<td>-3.1</td>
<td>-8</td>
</tr>
</tbody>
</table>

In contrast with the overall mining sector, coal mining is performing exceptionally well. One of the main contributing factors is the electricity crisis in South Africa which has resulted in coal being utilized to generate electricity. Another factor is that coal is an alternative fossil fuel energy source to oil. The global coal demand is rising as international oil prices are on the rise and events such as political instability in oil rich countries, for example Libya, prompted the recent spike in oil prices. Coal, as the leading mining industry in South Africa, had a total sales value of R65.4 billion, followed by PGMs at R58 billion and gold at R49 billion in 2009. These three minerals accounted for 71.2% of South Africa’s total mineral sales in 2009 (Durrheim, 2010:4).

To become a co-owner of a company by investing in the stock market, demands a thorough knowledge of a company’s operations and intrinsic value creation modalities. Equity valuation methodologies and theories form the basis to identify value creating investment opportunities.

2.2 Common stock valuation

Price is what you pay; value is what you get – Warren Buffet
Value creating investment selection could, therefore, be seen as an opportunity to gain superior value at a reasonable price. The market value of equity is determined by demand and supply on the open market where stocks are traded, this value may represent an under- or over-valuation of the share. Stock valuation methodologies and theories are applied to determine if equity is fairly priced.

Two types of common stock valuation models are eminent: absolute and relative valuation models. Absolute valuation models are based on fundamental analysis.

Fundamental analysis is defined as an evaluation method for securities, to determine the ‘fundamental’ value of the security from available information (about or from) the company. It can be seen as a predictive examination of related economic, financial and other quantitative and qualitative factors in an attempt to measure the securities’ intrinsic value. The aim of the examination is to generate a forecast for the securities’ market value and compare this value with the securities’ current market price to determine investment potential (Abad et al., 2004:231).

Typical models under the absolute valuation classification include: dividend discount model, discounted cash flow model, residual income models and asset based models (Ngunyen, 2011:1).

Relative valuation models in contrast do not solely focus on the company that is being examined; these models focus on the calculations of multiples or ratios which can be compared to similar companies or the industry in which the company under examination falls. The price to earnings multiples model is an example of a relative valuation model (Ngunyen, 2011:1).

2.3 Absolute common stock valuation models

The value of a share of common stock is the price that a buyer is prepared and able to pay from a willing and able seller, plus all expected dividend payments (total expected benefits from owning the share), discounted by a risk-adjusted rate. Companies can also distribute cash to shareholders by means of share repurchases (Megginsion et al., 2010:132). The equation is as follow:
Where:

\[ P_0 = \frac{D_1 + P_1}{1 + r} \]

...1

Where:

\( P_0 \) = current share price,

\( D_1 \) = expected dividend for the year,

\( P_1 \) = share selling price; and

\( r \) = required return on investment

2.3.1 Dividend Model

Williams’ dividend discount model (1938) determines the value of securities as the present value of the expected future cash dividends (Ross et al., 2008:513-515). A discount rate is used to discount forecasted dividends. The aim of the discount rate is to take the time value of money into consideration (Muradoglu, 1999:17). Researchers such as Walter (1956) and Black & Scholes (1974), established that the price of equities is influenced by a change in dividend policy and that the price of securities is a function of dividend policy (Farooq et al., 2010:143). This is the dividend discount model:

\[ P_0 = \frac{D_1}{(1 + r)^1} + \frac{D_2}{(1 + r)^2} + \frac{D_3}{(1 + r)^3} + \frac{D_4}{(1 + r)^4} + \frac{D_5}{(1 + r)^5} + \cdots \]

...2

Where:

The variables are the same as in the formula above.

In the financial literature, with reference to the dividend valuation approach, one normally finds that the zero growth model, the constant growth model and the uneven or variable cash flow model is discussed. These models can also be used for valuation purposes in practice.

2.3.1.1 Zero growth model

The zero growth model assumes an invariable dividend stream. Therefore, the dividend discount formula is reduced to the following equation:
\[ P_0 = \frac{D}{r} \]

Where:

The variables are the same as in the formula above.

According to this model the present value is equal to the constant dividend payment divided by the return on the investment. Therefore, the holding period of the security is irrelevant as stock valuation is based on dividends paid, not capital gains in the stock price. Variations in stock price can be subscribed to changes in the required return of equity (Megginson et al., 2010:133).

### 2.3.1.2 Constant growth model

The constant growth model, also known as the Gordon growth model, is based on the assumption of a constant growth \( g \) dividend stream and a constant discount rate. The amount of money the company retains for reinvestment and the rate of return the company earns on those investments, determine the company’s growth rate. In other words, the determinants of growth, \( g \) are the return on equity (ROE) and retention rate (RR), which is the profit retention ratio and equals \( 1 - \text{payout ratio} \). The constant growth model is generally only for mature companies with low to moderate growth rates (Megginson et al., 2010:134,137). The constant growth model equation is as follow:

\[ P_0 = \frac{D_1}{r - g} \]

Where:

\( P_0 \) = Current share price,
\( D_1 \) = Expected dividend for the year,
\( g \) = Constant growth rate; and
\( r \) = Required return on investment.

Researchers such as Kiley (2004:911), Aase (2008:293) and Booth (2003:507)
questioned the accuracy of this model. It is argued that the Gordon Growth Model does not consider the uncertainty in the growth rate itself. Return volatility is too high compared to the dividends' volatility. In other words, even the slightest change in growth rate, or required return, affects the denominator of this formula, resulting in major fluctuations in the estimated value of security prices.

### 2.3.1.2 Variable growth model

The variable growth model is applicable in growing companies. The model comprises two-stages. In the first stage the present value of dividends during the initial growth period of the company is calculated. The second stage represents the calculation of the present value of the stock price at the end of the initial growth period and which is referred to as the terminal value. To complete the calculation the present value of the dividend stream is added to the present value of the equity price at the end of the initial growth period. The variable growth model equation according to Megginson *et al.* (2010:135) is:

\[
P_0 = \frac{D_0 (1 + g_1)^1}{(1 + r)^1} + \frac{D_0 (1 + g_1)^2}{(1 + r)^2} + \ldots + \frac{D_0 (1 + g_1)^N}{(1 + r)^N} + \left( \frac{1}{(1 + r)^N} \times \frac{D_N + 1}{r - g_2} \right)
\]

Where:

- \(P_0\) = Current share price,
- \(D_0\) = Most recent dividend for the year,
- \(g_1\) = Initial (fast) growth rate,
- \(g_2\) = Constant growth rate of dividends,
- \(r\) = Required return on investment; and
- \(N\) = Number of years in the initial growth period.

(Megginson *et al.*, 2010:135).

### 2.3.2 Free cash flow model

The free cash flow approach is used to value equity, and considers the company as a whole. The free cash flow approach is a preferred valuation model in the financial
literature reviewed when a company does not pay out dividends. The main advantage of the method is that it is based on actual cash flow. Assumptions about cash distribution to shareholders are not needed (Megginson et al., 2010:140). Free cash flow can be calculated as follow:

\[ FCF = NOPAT - \Delta NOWC - \Delta FA \]

Where:
- \( FCF \) = Total free cash flow,
- \( NOPAT \) = Net operating profits after tax,
- \( \Delta NOWC \) = Change in the net operating working capital from year to year; and
- \( \Delta FA \) = Year to year change in fixed assets

Net operating profits after tax (NOPAT), the company’s earnings before interest and after corporate taxes are paid. NOPAT can be computed as follow:

\[ NOPAT = EBIT \times (1 - T) \]

Where:
- \( EBIT \) = Earnings before interest and taxes; and
- \( T \) = Corporate tax rate.

The change in net operating working capital (NOWC) is the difference between operating current assets and operating current liabilities from year to year (Megginson et al. 2010:34).

Once the total free cash flow of a company is determined, an appropriate discount rate, that represents all required rates of return of all investors, needs to be established. Risk varies for the types of investments in companies, for example common stock is riskier than preferred stock. Therefore, the assumption can be made that the required rate of return for common stock investors will be higher than preferred stock investors (Megginson et al., 2010:140).

A discount rate, after tax weighted average cost of capital (WACC), captures the
varying required returns of investors. The WACC is applied in the next step of the
calculation to compute a total company value. A company’s target debt ratio is used
in the calculation of WACC: it can be seen as the minimum rate of return at which a
company produces value for its investors (Megginson et al., 2010:141).

Miller (2008:1213) questions the appropriateness of the standard WACC calculation
of reward for stockholders and bondholders to cover the cost of capital accurately.
Bades (2009:1480) argues that the validity of the WACC is dependent on the usage
of the correct debt to equity value ratios, which is time-varying, unless a time-fixed
ratio is assumed.

2.3.3 Residual income valuation model

In his article, Plenborg (2002:305) highlights the conflicting findings of researchers
such as Ohlsen (1995) and Peasnell (1982) whom brought the latest developments
to Edwards and Bell’s (1961) accrual based valuation approach the, residual income
valuation model. The residual income valuation model (RI), derived from the dividend
discount model (DDM) is a variation on Steward’s (1991) economic value added
(EVA) approach. The equation is as follow:

\[
P_0 = BV_0 + \sum_{t=1}^{\infty} \frac{NI_t - k_e. BV_{t-1}}{(1 + k_e)^t}
\]

Where:

NI = Net income,
BV_0 = Book value of the equity at time 0,
k_e = Required rate of return; and
t = Time

(Plenborg, 2002:305)

In terms of financial ratios the RI formula can also be expressed as:

\[
P_0 = BV_0 + \sum_{t=1}^{\infty} \frac{(ROE_t - k_e)BV_{t-1}}{(1 + k_e)^t}
\]
Where:

ROE  = Return on Equity; and

The other variables are the same as in the formula above.

In his article, Plenborg (2002:305) highlights the conflicting findings of researchers such as Copland, Kotler & Murrin (1990) and Olson & Oswald (2000) regarding the superiority of either the Discounted Cash Flow (DCF) or RI approach, in company valuation from a user’s perspective. Comparison of the two valuation approaches is based on analytical attractiveness. Plenborg (2002:305) concluded in his findings that since both approaches are theoretically equivalent, equal company value estimates can be expected if these methods are applied correctly. Variation in values may be due to simplification of assumptions in practice. However the financial literature reviewed prefer the DCF approach, due to the fact that this method is unaltered by accounting methods (Sharma, 2010:204).

2.3.4 Book value

Book value is an accounting concept that refers to the carrying value on the balance sheet of the company’s equity.

\[
\text{Book value} = \text{Total Assets} - \text{Total Liabilities}
\]

Book value is based on historic-looking valuation approach. Essentially the book value of a company is the total sum left when a company sells all its assets and all its company obligations have been settled. A promising company with the ability to make earnings and growth on behalf of its owners will have a company value higher than the company’s book value (Megginson et al., 2010:143).

In order to evaluate companies in relation to other companies, book value per share can be used for a realistic comparison. book value per share can be calculated as follow:
Pourheydori (2008:16) found that book value has the smallest value relevance to security analysis valuation techniques compared to dividend and earnings valuation methods. Pourheydori (2008:16) assigned the low relevance of book value to share price security analysis valuation technique to the influence of high inflation rates.

2.3.5 Liquidation value

Liquidation value is the total sum left over after a company has sold all its assets and paid off all liabilities. Marketability of the company’s assets and depreciation charges assigned to fixed assets, will determine whether liquidation value will be more or less the same as book value (Megginson et al., 2010:143).

2.3.6 Intrinsic value per share

The intrinsic valuation model is a fundamental analysis method to determine the true value of a company or security. Intrinsic value calculations differ in the financial literature reviewed. Warren Buffet’s approach to the intrinsic value per share calculation, (as identified by Vick, 2001:124); will be applied in this study. The historic earnings per share’s average growth rate are determined over a ten year period. This discount rate is applied to the next year’s estimated earnings. Since this study is based on the South African mining industry, the R153 South African long term government bond will be used in the denominator of the intrinsic value per share calculation. The security attractiveness is expressed in terms of this rate in comparison to the bond. Thus, if the stock of the company trades for less than the discount value, it offers a more attractive price than the bond, due to the higher earnings yield. The calculation is as follow:

\[
\text{Intrinsic value per share} = \frac{\text{Estimated Earnings per share for next year}}{\text{Discount rate}}
\]

(Megginson et al., 2010:143).
Discount rate based on the RSA R153 government bond return is used for this study. The RSA R153 ten year average bond rate is 10.86.

![RSA R153 10 year bond rate](image)

**Figure 1: RSA R153 10 year bond rate (Trading Economics, 2010:1)**

The intrinsic value per share reflects the price at which the security should be traded at if it is properly priced in the market. Thus a lower intrinsic value per share offers a higher earnings yield and would be favoured by buyers.

The intrinsic valuation model is an income based model in contrast to modern valuation theory which is based on a free cash flow bases. Graham, Dodd and Cottle (1962, in Getry and Reilly, 2009:5) identified average future earnings power (estimated average over a future span of years), as the critical factor to determine a security’s Intrinsic value.

### 2.3.7 Market value of equity

A competitive marketplace is the determining factor in the price of securities – market value of equity is the term used to describe this share price valuation. Market value accounts for future growth potential in contrast with book value. Market value represents the price that investors are willing to pay for equity (Investopedia.com, 2011:1).

**Market value of equity**

\[
\text{Market value of equity} = \text{current stock price} \times \text{number of outstanding shares}
\]

...13
2.4 Relative valuation models

The relative valuation approach is based on the “law of one price, which states that two similar assets should sell for similar prices”. Companies or securities are simply compared; there is no search for a fundamental value as in the previous methods (Ngunyen, 2011:1). Information that is typically publicly available assists the ease of calculation and increases popularity of use especially for individual investors. The values obtained reflect industry trends, risk, as well as growth potential and do not comprise of a control premium (Weitzel, 2003:8).

In this study the succeeding investment valuation metrics will be discussed, price to earnings ratio, earnings per share data, price to cash flow ratio, price to book value, price to sales ratio, price to earnings to growth ratio, dividend yield, enterprise value multiple, as well as profit margin and number of years to pay off debt.

2.4.1 Price to earnings ratio

Current share price of the security relative to the company’s per share earnings is a share price ratio that is used to determine if individual securities are reasonably priced, known as the price to earnings ratio (P/E ratio). The amount an investor is willing to pay per unit of income of a company is reflected in the P/E ratio. Computation of this ratio is relatively simple and, therefore, widely used (Shen, 2000:24).

\[
\text{Price/Earnings Ratio} = \frac{\text{Stock Price per Share}}{\text{Earnings per Share (EPS)}}
\]

The earnings per share or price per share used in the ratio calculation can either reflect past values or expected earnings per share in share price values, in a futuristic approach. The company P/E ratio can be benchmarked against the P/E ratio for the industry, known as a normal P/E ratio. The P/E ratio of a company is often tied to the company’s growth prospects. Investors expect companies with higher P/E ratio to show more rapid company earnings’ growth. This perception can partially be explained by a modification of the constant growth model equation. Based on the assumption that a constant percentage of company’s earnings are
paid out as dividends, the fair or realistic P/E ratio for a company can be calculated, according to Megginson et al. (2010:144) as:

\[
\text{Realistic P/E} = \frac{P_0}{E_1} = \frac{d}{r - g}
\]

Where:
- \( P_0 \) = Current share price,
- \( E_1 \) = Annual earnings per share,
- \( d \) = Dividend payout,
- \( g \) = Constant growth rate; and
- \( r \) = Required return on return.

From the above equation it becomes clear that an increase in \( g \) or \( d \) causes a rise in the P/E ratio, as well as a decrease in the required rate of return. Therefore, high P/E ratios do not implicitly mean fast growth perspectives (Megginson et al., 2010:144).

The time period over which the earnings and share prices are calculated can influence P/E ratio measurements since either trailing (past) earnings or forecasted earnings can be used. The sum of trailing and forecasted earnings over a specific time frame known as the earnings multiple is a third variation which can be applied. Current average annual values are used most often in the calculation of the P/E ratio, although, daily, weekly or monthly averages of daily closing prices can also be used. Therefore, the corresponding earnings in the calculation can vary significantly. In the financial literature reviewed, sector comparison of companies P/E ratios are recommended for a realistic perspective of a company’s P/E ratio (Shen, 2000:24).

The P/E ratio is sensitive to corporate tax rate as well as the capital structure of the company. Higher P/E ratios will be evident in unlevered companies, and companies paying less tax, due to higher earnings (Shen, 2000:24).

2.4.2 Earnings per share ratio

Earnings per share (EPS) are the amount earned over a period, for example one
year, for every outstanding share of common stock. The actual EPS has a historical perspective and is known as trailing EPS. Leading EPS in contrast refers to estimates of earnings forecast for the next twelve months (Megginson et al., 2010: 31). The invert of the P/E ratio is the earnings per share ratio, which is equal to the dividend- to price ratio when the firm has no growth opportunities (Muradoglu, 1999: 20). On the other hand, maximizing profits translates into maximizing EPS and, therefore, value for share investors. However some short-run decisions can destroy long-run value of a company (Megginson et al., 2010:17).

2.4.3 Price to cash flow ratio

The price to cash flow (P/CF) ratio is comparable to the P/E ratio and can also be used to evaluate securities. Importantly, lower earnings than reported are possible, due to a number of non-cash charges in the income statement, therefore this approach is believed to be less exposed to manipulation by management (Investopedia.com, 2011:1). The P/CF ratio is used most often with mature or established companies when investors expect cash to be generated by the company. Once again, comparison with the industry or the market is recommended for a realistic perspective of the P/CF value of a company (Kennon, 2010:1).

\[
\text{Price/ Cash Flow Ratio} = \frac{Stock \ Price \ per \ Share}{Operating \ Cash \ Flow \ per \ Share}
\]

Note that free cash flow is sometimes used in this calculation as a variation. Financial literature seems to favour the free cash flow variation, since it is believed to represent business and economic conditions more accurately. The belief of a more accurate representation stems from the fact that free cash flow is adjusted, for example changes in working capital, amortization and depreciation (Kennon, 2010:1).

2.4.4 Price to sales ratio

Expected security value is attained in the valuation model of the security price to sales ratio by exploitation of the average security price of the industry to sales ratio and the expected sales of the next year (Wu and Wang, 2010:74).
The financial price to book value ratio is a similar valuation technique as the P/E ratio. Book value used in the calculation.

\[
\text{Price/Book Value Ratio} = \frac{\text{Stock Price per Share}}{\text{Shareholders' Equity per Share}}
\]

2.4.6 Price to earnings to growth ratio

The price to earnings to growth ratio (PEG) ratio compares P/E to estimated EPS growth projections (considers future earnings’ expectations). This is similar to the P/E ratio because under-or-over-valuation can be expressed. A PEG value of one is seen as a fair valuation of the current stock price. A PEG value less than one indicate under-valuation and more than one over-valuation of current share price. In the case of low growth projections this ratio has restricted applicability (Investopedia.com, 2011:1).

\[
\text{PEG Ratio} = \frac{\text{Price/Earnings (P/E) Ratio}}{\text{Earnings Per Share (EPS) Growth}}
\]

2.4.7 Dividend yield

The dividend yield is expressed as a percentage and can, therefore, be compared to an interest rate. In the calculation of the dividend yield, the security’s dividend per share for the latest four quarters is used, divided by the present price of the security. (Carlson, 2001:1).

\[
\text{Dividend Yield} = \frac{\text{Annual Dividend per Share}}{\text{Stock Price per Share}}
\]
2.4.8 Enterprise value multiple

The enterprise value to earnings before interest, taxes, depreciation and amortization (EV/EBITDA) is unaffected by diverse taxation rates and capital structure. This multiple allows for cross-border comparison within industries. In the case of highly leveraged companies, the equity value in the enterprise value calculation is very sensitive to Net Debt (Minjin'a, 2009: 53).

\[
Enterprise \text{ Value Multiple} = \frac{Enterprise \text{ Value}}{EBITDA}
\]

The value of the company equals the total of the market value of common equity (price multiplied by the amount of shares outstanding) and the net debt of the company (net debt value is lowered by shares outstanding). Net debt can be derived from the balance sheet; it is computed as the total debt minus cash and cash equivalents (Minjin'a, 2009: 53).

2.4.9 Profit margin ratio

This financial ratio is concerned with the company's profitability. Sustainability of profit margin and even growth is expected by shareholders, because share prices react sharply to unforeseen changes in this measurement (Megginson et al., 2010: 45).

\[
Net \text{ income profit margin} = \frac{Net \text{ income}}{Net \text{ sales}}
\]

The net income profit margin is the most widely used indicator to measure a company's efficiency due to the fact that all company expenses are taken into consideration (Megginson et al., 2010: 45).

The gross profit margin is another important company performance measure. Operating revenue (gross profit) is divided by the sales revenue and gives an indication of operational efficiency (Megginson et al., 2010: 45).
2.4.10 Number of years to pay off long-term debt

The number of years to pay off long-term debt can be viewed as a coverage ratio because focus is mainly on the income statement and concerned with the ability to generate adequate cash flow to pay off the principal (Megginson et al., 2010:44). A maximum of five years to pay off debt is set as criteria by Cilliers' (2004:112) and is calculated as follow:

\[
\text{Number of years to pay off long term debt} = \frac{\text{Long term debt}}{\text{Current annual profit}}
\]

2.5 Risk and return

Risk represents the marginal cost of investing while the marginal benefit of investing results in a return earned (either a gain or a loss). Share investments are riskier than bonds for two main reasons. Firstly share prices are fixed to the fortunes of companies, and secondly, unlike bonds, shares do not have a fixed date when the principal will be repaid. Investors investing in shares expect to be compensated for the time value of money (a risk free rate) as well as for the risk related to the company shares (risk premium), in comparison to the market risk premium. The market risk premium is the difference between the risk associated with the market and the risk of investing in a risk free bond (Muradoglu, 1999:3).

The capital asset pricing model (CAPM) can be used to illustrate the linear equilibrium relationship between the expected return (based on historical data) of a security and the perceived systematic risk. The CAPM utilizes an asset’s beta to explain the difference in returns across securities. The CAPM states that the expected return of a security (based on historical data) holds a linear equilibrium relationship with the perceived market risk. According to the CAPM, the expected return of a security equals the rate on a risk-free security plus a risk premium based on the security’s beta. If this expected return is lower than the required return then the investment should not be undertaken (Roodposhti and Amirhosseini, 2007: 2)

The effect of beta on the security market line (SML) can be explained by means of
the CAPM. Portfolio diversification is used to decrease nonidiosyncratic risk and increase shareholder value by combining riskier securities with a risk-free investment, such as a bond and using the market return as reference point. According to Megginson et al., (2010:209) the security market line plots the relationship between the expected return and risk as reflected by beta. In equilibrium, all assets lie on this line. When the security’s beta (risk measurement), lies above the SML, the expected return of the security or portfolio is too high and investors bid up price until expected return falls. On the other hand if the security’s beta lies below the SML, expected returns are too low, and investors sell stock to drive price until expected return rises.

Empirically the CAPM carried a lot of weight in the early years of the model, though flaws were discovered over time through testing. The main criticisms against this model are as follow:

(i) Rational investor expectations are assumed in predictions of the unobservable expected return.

(ii) The one-period nature of the CAPM, in other words, changes in time are not considered and the model does not specify the unit of time related to “one period”.

(iii) The risk-free rate assumed by the CAPM remains constant, in contrast to real world fluctuations over time.

(iv) The period over which bonds used as the proxy for the risk-free rate is not specified by CAPM.

(v) The CAPM assumes that “The Market” portfolio is measurable, and investors can hold such a portfolio, in reality however this assumption comprises a difficult problem (Megginson et al., 2010: 263).

Investors’ risk preference behaviour can be categorised into three distinct categories. Risk averse investors anticipate return for bearing risk, when the incremental risk increases greater return is expected. Risk neutral investors favour investments with higher return whether or not they represent greater risk; even the slightest premium
over other investments will be favoured. Risk seeking behaviour will typically bare
risk even though opportunity of negative average returns is at stake (Megginson et al., 2010: 163).

Indicators of investment risk that can be used to evaluate stocks are alpha (α), beta
(β), r-square (r²), standard deviation (σ), and the sharpe ratio. Beta is the most
common indicator used, representing the systematic risk. The standard deviation is a
measure of the volatility of the stock's price around its mean (Megginson et al.,
2010:166-217).

**Alpha**
The intercept of the security characteristic line (SCL) is known as the alpha
coefficient. By plotting the excess return (performance) of a specific security or
portfolio to the market portfolio returns, in every point in time, the regression line
known as the SCL can be obtained. The alpha coefficient permits for the possibility
of miss-pricing in the inclusion of the capital asset pricing model (Gilberto, Marcio
and Filidor, 2009:343).

![Figure 2: Alpha and the security characteristic line (Campbell,1997)](image)

Alpha uses a risk-adjusted basis to measure an investment’s performance. It
compares the risk-adjusted volatility (price risk) of a share to a benchmark index.
Alpha is commonly used to assess the performance of active portfolio managers, as
alpha is the excess return beyond the risk of the security. Active portfolio management refers to portfolio management, based on forecasting for security selection and/or the management of portfolios over time (market timing), in an attempt to outperform the market (or a benchmark index) in profit gains. Passive portfolio management opposes active portfolio management, and is founded on portfolio diversification (Grinold and Khan, 2005: 579).

**Beta**

Beta captures the systematic risk of a security in comparison to the market as a whole. In other words, the value of beta indicates volatility. Beta is calculated using regression analysis; it is the tendency of a security's price movements to respond to an overall market indicator, such as the All Share Index (ALSI), over the same time period (Munro, 2008:2). “The beta of an asset \( \beta_i \) equal the covariance of the asset's returns with the returns on the overall portfolio, divided by the portfolio variance.”

A positive beta, greater than one for example, indicates that the security's price will be more volatile than the market. A negative beta indicates that the security is negatively correlated with market movements (Megginson *et al.*, 2010:181). Negative betas decrease volatility of a portfolio if the portfolio is combined with positive betas.

Although beta is the most widely used measure of risk, it is still classified as a questionable measure of risk. Beta is based on historic volatility of price which does not accurately predict future investment performance. Therefore beta is seen in the financial literature reviewed as a weak measure of the risk-return-relationship at times because stock returns seem to be related to additional risk characteristics (Megginson *et al.*, 2010:182).

Farma and French (1992 in Grauer and Janmaat, 2010:465), also question beta as a measurement of risk, and demonstrate that beta differs across time. They attempt to discredit the capital asset pricing model. However, the Farma-French theory has also been challenged (Grauer and Janmaat, 2010:465). There may be other dimensions of risk such as economic developments, business fundamentals, and a securities price level, not captured by beta’s narrow focus on market prices.
**Coefficient of determination (r-square or \( R^2 \))**

The r-square value is a statistical measure representing the percentage of a share/portfolio’s movements that can be explained by the benchmark’s index movements, ranging from 0 – 100 (Yahoo, 2009:1).

**Standard deviation**

The standard deviation (\( \sigma \)) and coefficient of variation of annual returns can be utilized as measures of the stand-alone risk (the uncertainty of the return) of an asset or class. Usually, the higher the return, the higher the volatility. Standard deviation is also known as historical volatility and is used by investors as a measure of the amount of expected volatility, as well as to determine if the share price is under- or over-valued (Megginson et al., 2010:167). The normal distribution facilitates the interpretation of the standard deviation. One standard deviation consists of +/-68% of a variable’s spread around the mean, two standard deviations represent +/-95% of a variable’s distribution around the mean (figure 3).

![Figure 3: Normal distribution (Nursing planet, 2011:1)](image)

**The Sharpe ratio**

The sharpe ratio measures risk-adjusted performance by subtracting the risk free rate of return from the rate of return of a stock, and dividing this result by the stock’s standard deviation (volatility) of its return. The greater this ratio, the better is the risk-adjusted performance (Grinold and Khan, 2005:32).
\[
\text{Sharp ratio} = \frac{E[R - R_f]}{\sigma}
\]

Where:
ER = Expected portfolio return,
ERf = Risk free rate; and
\(\sigma\) = Portfolio standard deviation

**Margin of safety**
Determination of a margin of safety as proposed by Benjamin Graham (1973:527) is another risk protection strategy: protection against downside price risk. The margin of safety is dependent on the investor risk preference and can be quantified as the share intrinsic value minus the share price (Cilliers, 2004:112).

**Other risk measures**
Recent measures of risk used in portfolio optimisation have been proposed, such as momentum based risk measures, spectral/distortion risk measures and conditional drawdown, since mean variance is limited to Gaussian market returns. These risk measures propose a better fit to mathematical criteria set for a risk measure and, therefore, represent a more realistic dynamic market (Adam, Houkari and Laurent, 2008:1871).

**2.6 Sustainable growth**
Growth planning by companies can assist management in shareholder wealth creation. Growth from a company perspective is usually defined in terms of sales. Three popular measures, namely return on investment (ROI), economic value added (EVA), and growth in sales or assets will be described in this study (Megglinson et al., 2010:698).

**2.6.1 Return on investment**
Return on investment (ROI) refers to the company’s ability to utilise its assets to produce returns to common stockholders. Practical application of this value assists in the creation of company sustainable growth planning by management. A ROI
minimum hurdle rate is used to set a growth standard, in an attempt to increase ROI above the cost of capital and create shareholder value (Megginson et al., 2010:697). Due to the ease of implementation of administration associated with ROI, these techniques often become standard operating procedures within companies (Burns, 2000:3).

\[
ROI = \frac{\text{earnings available for common stockholders}}{\text{total investment}}
\]

2.6.2 Economic value added

Economic value added (EVA) is a variant of the Net Present Value Analysis. According to Carbaugh (2007:94) this value creation performance measure (a registered trademark of Stern Steward & Company) is based on economic profit. Economic profit considers both explicit and implicit cost; profit earned is expressed relative to a competitive rate of return (Carbaugh, 2007:94). Economic profit is directly linked to shareholder value, since the EVA value covers the cost of capital (Megginson et al., 2010:243). Shareholder wealth creation is taught in many MBA programmes as a tool to measure businesses. EVA is used to determine if management decisions are adding value to the company by creating shareholder wealth.

\[
EVA = \text{Cash flow} - \left( [(\text{Cost of Capital}) \times (\text{Invested capital})]\right)
\]

The value investments add for shareholders are determined by subtracting accounting profit from the investments' cash flow in the application of the EVA metric. EVA sets a performance benchmark for management in a specific time frame. Companies employing EVA in their planning process can use three techniques to increase EVA: increase operation profitability, invest capital in growth projects or liquidate activities that do not cover the total cost of capital (Bardia, 2008:41).

Research reports significant positive cash flow increases as well as an improvement in EBIDTA after EVA implementation, although the relationship between market price
and EVA is non-significant (Tortella and Brusco, 2003:286). The optimistic relationship between EVA and share price remains uncertain in the financial literature reviewed although the topic has been widely researched (Megginson et al., 2010:697).

2.6.3 Growth in sales

Growth in sales normally goes hand in hand with an increase in asset requirements, whether current or fixed assets (under the condition that assets are fully utilised and no excess capital exists). In turn growth in assets, according to the accounting equation, must equal growth in liabilities plus equity over time. Thus an increase in equity may imply an increase in retained earnings, leading to shareholder wealth creation (Megginson et al., 2010:698).

2.6.3.1 The sustainable growth model

The sustainable growth model was developed by Higgins in 1981 (Megginson et al., 2010:699) and is applied in the financial planning of companies. Taking into consideration the delicate balance of the accounting equation, financial objectives are weighted against operational performance to establish the optimal level of growth for a company (Megginson et al., 2010:699).

\[
g^* = \frac{m(1 - d)A}{\frac{A}{S} - m(1 - d)\frac{A}{E}}
\]

Where:
- \( g \) = growth
- \( m \) = Company profit margin,
- \( d \) = Dividend payouts,
- \( A/S \) = Invert of asset turnover; and
- \( A/E \) = Asset to Equity ratio
2.7 Conclusion

As has been demonstrated in this chapter, a variety of financial models exist. These models are not fully integrated, requiring a deeper understanding of their applicability to the general mining sector. The empirical study will focus on value creation as determined by these financial models.

The absolute valuation approaches aim to measure the securities intrinsic value in the predictive examination of all available quantitative and qualitative information. The dividend discount model and free cash flow valuation techniques are still very popular valuation tools despite the inherent flaws identified such as overvaluation. Although the dividend discount model and residual income model have been found to be similar in valuation effectiveness, the DDM seems to be the preferred valuation method due to the fact that is unaffected by accounting measures. The free cash flow model is based on actual cash flow, which is the major advantage of this method.

The relative valuation models allow for comparison of multiples or ratios between similar companies or within an industry. Generally these models allow for easier practical application which can be seen as a positive characteristic. Negatively on the other hand, relative valuation approaches are mostly affected by accounting measures.

The capital asset pricing model's validity is questioned in financial literature, because it provides an unstable risk measurement. However, the risk-return framework provided by the CAPM allows investors to quantify expected returns.
3.1 Introduction

One of the main goals of portfolio construction is to minimize investment risk to ensure minimal money losses through diversification. As Benjamin Graham (1973:12) explains “Taking a foolish risk can put you so deep in the hole that it’s virtually impossible to get out”. Rational portfolio investors seek to optimize security selection in order to appreciate capital.

3.2 Modern portfolio theory

Portfolio selection depends on the objectives of the investor. For example the balance within a portfolio between risky securities and relatively risk-free securities can differ. According to the modern portfolio theory (MPT), investors can expect higher returns from riskier investments.

Markowitz (1952:78) attempted to quantify the risk of a security. Risk minimization through proper diversification was demonstrated. Technical instruments to assist investors in the analysis and selection of an optimal portfolio were developed. This groundbreaking work of Markowitz laid the foundation of the MPT (Meggison et al., 2010:196).

In a portfolio, each security’s risk and expected return combination influences the variance of the entire portfolio. Markowitz’s (1952:78) Minimum Variance Portfolio (MVP) is the portfolio selection combination with the lowest standard deviation. An efficient portfolio is a portfolio set above the MVP on the upward portion of the elliptical distribution arch, where expected return is plotted on the y-axis and standard deviation on the x-axis. Efficient portfolio sets offer the highest expected return for the lowest level of volatility (Meggison et al., 2010:196).
Critique against Markowitz’s (1952:78) theory is mainly centred around two themes: firstly the assumption of variance as a correct measure of investment risks; secondly the adequateness of a joint elliptical distribution to represent all investment returns of security portfolios, are questioned by Jacob (1971:815). Markowitz (1959 in Swisher and Kasten, 2005:2) suggests using semi-variance accounting for asymmetrical distribution of risk.

According to Jacob (1971: 815) the following authors, William Sharp, John Linter and Jan Mossin extended Markowitz’s work through the development of the Capital Asset Pricing Model (CAPM).

The portfolio selection model of the CAPM is based on the following assumptions: decisions are made from a risk averse investor perspective; care is only given to systematic risk, because investors do have the option to diversify, and no rewards are offered for bearing unsystematic risk. Beta is the measurement for systematic risk and the only measurement that can be priced. A difference exists between portfolios. Efficient portfolios provide high expected returns while minimizing risk. In
equilibrium the market portfolio can be seen as efficient as presented by the SML (Megginson et al., 2010: 208).

Risk and return measures that do not always fit the realities of investment markets limit the MPT. The CAPM allows investors to better realise portfolio volatility. The SML constitutes share price equilibrium. Assets that propose expected returns above this line will be considered underpriced and assets below the SML overpriced. A portfolio with high-beta securities will move more than the market in an up-or-downward direction, and low-beta securities will move less relative to market movement (Markowitz, 2010: 3).

![Security Market Line](image)

**Figure 5: Security market line (Viswanath, 2001:1)**

A number of alternative portfolio construction models and theories exist that can be taken into consideration although these models will not be examined or used in this study.

### 3.3 Post modern portfolio theory

The post modern portfolio theory (PMPT) is an extension of the modern portfolio theory. Focus is placed on portfolio diversification to reduce investment risk with similar investment expected returns within the same portfolio. The PMPT does not
consider variance of portfolio expected return as an acceptable measure of investment risk and use a different approach to determine investment risk. The Sharp ratio is often the preferred instrument used in risk adjustments of returns (Patras, 2008:16).

The major critique centreing the Sharp ratio is the concern of the standard deviation using only volatility of excess return. The standard deviation (volatility) is a symmetric risk measure. Volatility misrepresents the portrayal of return dispersion if the return distribution is fat-tailed or negatively skewed (Culp and Heaton, 2010:91).

![Image: Figure 6: “Ideal” investment (Swisher and Kasten, 2005:5)]

### 3.3.1 Post-modern portfolio theory instruments

**Downside risk**

Swisher and Kasten (2005:1) define downside risk (DSR) as a perception of risk, based on an investor's minimal acceptable return (MAR), derived from downside frequency, mean downside deviation and downside magnitude.

DSR can be measured by utilizing downside risk semi-standard deviation (DSSD), a Value at Risk (VaR) or conditional value at risk (CVaR) approach (Culp and Heaton, 2010:91).
According to Swisher and Kasten (2005:1) Post modern portfolio theory optimises portfolios by optimising downside risk (DRO) versus returns instead of mean variance optimisation (MVO). They argue DRO superiority versus MVO based on three criteria: firstly, DRO is argued as a superior measure of risk versus standard deviation, since it is believed that DRO provides a more comprehensive description of the risk concept; secondly, financial assets do not necessarily follow a normal distribution pattern as they would in a perfect market and finally it seems as if DRO delivers better portfolios than MVO in a head-on portfolio comparison (Swisher and Kasten, 2005:1).
The sortino ratio (delineated below) can be seen as an addition of the Sharpe ratio (defined in Chapter 2) which uses DSR risk in the denominator.

**Sortino ratio**

The sortino ratio represents average excess return per unit of downside risk. This ratio can be used to measure fat-tailed or negatively skewed return distribution of an asset (Culp and Heaton, 2010:91).

\[
\text{Sortino ratio} = \frac{\bar{r} - rf}{DSR}
\]

Where:
- \(\bar{r}\) = Average return on an asset or portfolio,
- \(rf\) = Risk free rate; and
- DSR = Downside risk.

Another two popular asset pricing theories are the arbitrage pricing theory (Homsud et al., 2009:32) and the Farma and French Model (Megginson et al., 2010:216).

### 3.4 Arbitrage pricing theory (APT)

The ATP is a one-period asset pricing model developed by Stephan Ross 1976 for static portfolios (Homsud et al., 2009:32).

\[
R_i = a_i + \beta_{i1}II_{i1} + \beta_{i2}II_{i2} + \cdots + \beta_{iz}II_{iz} + e_i
\]

Where:
- \(R_i\) = return of the \(i^{th}\) equity is linearly related to a set of factors \(II_{ij}\) (\(j = 1,2,\ldots,z\)),
- \(\beta\) coefficients = sensitivity of the stock \(i\) to each factor; and
- \(e_i\) = random variable within a diversified economy with no arbitrage opportunity.
This theory can be seen as a substitute for the CAPM, providing a similar linear association between a security's expected return and its covariance with other factors (Patras, 2008: 9). In contrast with the CAPM theory making use of the market's expected return, the APT expected return is foreseen, subject to a risky assets expected return based on factor exposure and a risk premium of macro-economic factors and business conditions in a country. Although there is a weight linked to each factor, the theory does not specify the factors to be used in the computation, nor the means of determining a security's exposure to factors (Grinold and Khan, 2005:174).

3.5 Farma and French Model

Farma and French (1992, 1996, and 2002 in Megginson et al., 2010:216) identified a systematic relation between two factors, firm size and equity's book to market ratio with stock returns. The model is as follows:

\[
R_i - R_f = \alpha + \beta_{i1}(R_m - R_f) + \beta_{i2}(R_{small} - R_{big}) + \beta_{i3}(R_{high} - R_{low})
\]

Where:

\(R_i - R_f\) = Risk premium of a stock,
\(R_m - R_f\) = Risk premium on the market,
\(R_{small} - R_{big}\) = Additional return on small stocks compared to large stock,
\(R_{high} - R_{low}\) = Book to Market risk premium,
\(\beta_{i1}\) = Sensitivity of the stock \(i\) to the market factor,
\(\beta_{i2}\) = Securities sensitivity to the size factor; and
\(\beta_{i3}\) = Securities sensitivity to the book-to-market ratio.

The critics of Farma and French's Model (2004 in Megginson et al., 2010:216) question the low risk relationship associated with a low book-to-market ratio suggested by the theory. However the model opened up a new view to factors affecting asset returns. Multiple risk factors can be considered in the calculation of an expected return each with its own beta (Megginson et al., 2010:216).
3.6 Companies listed in the general mining sector of the JSE limited 31 December 2010 with a ten year historical data.

Shareholder wealth creation is dependent on company performance, it is therefore essential for investors to understand not only the business model but also to be knowledgeable about the industry and market within which the company operates, before they invest. The background information of individual general mining companies listed on the JSE limited on 31 December 2010, will now be discussed to create a better understanding of the companies in the general mining sector.

**Anglo American plc**

Anglo American plc (Anglo), JSE limited listing symbol, ANAAL, operates globally in mining activities, with a total of seven commodity subunits. Three of these units are managed from South Africa. Mining resources include PMGs, diamonds, copper, iron ore, nickel and coal. As measured at 11 January 2011, 42% of operating assets, 46% of revenue and 50% of operating profit for Anglo American was generated from South African business activities. Anglo American controlled 15% of JSE limited listed companies and South African investors held 34% of Anglo American shares (Anglo American plc, 2011:4).

**African Rainbow Minerals Limited**


ARM manganese mines are located in the Northern Cape Province of South Africa. The three ARM manganese mines include: Black Rock Mine, the largest known manganese source in the world, Nchwaning and Gloria Mines. Raw material is exported to Japanese and German customers via Port Elizabeth harbour. Locally Assmang-owned smelters are also supplied with manganese (African Rainbow Minerals Limited, 2010:5).

Iron ore open pit operations are run at Beeshoek Mine and Khumani Mine in the Northern Cape. Beeshoek ore is utilized locally while Khumani ore is railed to
Saldanha Bay from where it is exported (African Rainbow Minerals Limited, 2010:9).

Dwarsrivier Mine in Mpumalanga Province, South Africa, is a chromite mine owned by Assmang Limited and purchased from Goldfields Limited in 1998. Dwarsrivier Mine contains the world’s largest known PGMs, chromites and vanadium. ARM's mineral reserves increased by 3.86 million tonnes in 2010 compared to 2009 (African Rainbow Minerals Limited, 2010:13).

ARM platinum reserves are derived from four mine groups in South Africa, namely Nkomati Mine and Two Rivers, Modikwa and Kalplat Platinum Mines. ARM holds a 50% interest in Nkomati Mine operation in Mpumalanga province. Nkomati Mine resources include: copper, cobalt, PGMs and chromite. Two Rivers Platinum Mine operations are dually owned by ARM and Impala Platinum. ARM own 55% of this mine. Resources are similar to Nkomati Mine with PGMs, nickel, copper, cobalt and chrome. An 8.83 million tonne decrease in mineral reserves was measured from 2009 to 2010 due to mining depletion and reduction in the mining mineral area which included a multiple split reef. Despite the resource area changes, production at Two Rivers Platinum Mine increased from 2.96 Mt in 2009 to 2.92 Mt in 2010. Modikwa Platinum Mine's beneficial interests are 50% shared by ARM and Anglo Platinum. A 1.8 Mt production decrease was measured from 2009 to 2010 at this mine. ARM holds a 90% share of Kapla Platinum Projects in the North West Province. 137.36 Mt total mineral resources were measured at this mine in 2010 (African Rainbow Minerals Limited, 2010:15-25).

Goedgevonden Coal Mine operations, situated in Witbank, Gauteng, South Africa, contribute a 26% beneficial interest to ARM. Five seams of coal layers were identified which vary in quality. Low quality coal is utilised locally and is valued between 18 and 22 Mj/Kg whereas high quality steam coal is exported and has a value of greater than 27 Mj/kg (African Rainbow Minerals Limited, 2010:26).

ARM operational interests in Zambia include copper mines such as Konkola North Copper Project (a 50% interest) and Mwambashi Copper Project as well as an exploration division in search of base metals, PGMs, copper and coal. Namibian Otjikoto Gold Project's interest was sold for USD$26 million and these funds will be


ARM announced a 244% increase in the six month's headline earnings 31 December 2010 in comparison with corresponding six months of 2009, due to improvement in commodity markets. Coal exports from the Goedgevonden Coal mine increased by 367% and local chrome sales to Asmang increased by 116% (Van Staden, 2011:3).

**Assore Limited**

Assore Limited (Assore), JSE limited listing symbol ASR, is a ferroalloy producer and mining company with 50% beneficial interest in Assmang Limited. 52.28% of ASR is owned by Oresteel Investment. Mining resources include iron, manganese and chrome ore. ASR’s resources from Dwarsrivier, Khumati, Gloria and Nchwaning mines have an expected lifespan of 30 years. ASR announced a 313.2% increase in headline earnings for the six month period to 31 December 2010 compared to the same period in 2009. According to the company, the main change in earnings can be subscribed to an increased iron ore demand. Although increased sales volumes of manganese have been reported for this period, Desmon Sacco Assore chairman believes that the manganese and chrome demand will remain balanced (Williams, 2011:1–2).

**BHP Billiton plc**

BHP Billiton plc (BHPBill), JSE limited listing symbol BIBLT, operates within nine business sectors in over 25 countries with headquarters in Melbourne, Australia. Business sectors are as follow: petroleum, aluminium, base metals and uranium, diamonds and specialty products, stainless steel materials, iron ore, manganese, metallurgical coal and energy coal. The BHP Billiton Limited group and the BHP Billiton plc group merged in 2001 and is therefore “the world’s largest diversified natural resources company” (BHP Billiton, 2010:20). The BHP Billiton Limited group
and the BHP Billiton plc group keep separate stock exchange listings and hold primary listings on the Australian Securities Exchange and the London Stock Exchange respectively. BHP Billiton plc has a secondary listing on the JSE limited in South Africa (BHP Billiton, 2010:20).

**Merafe Resources Limited**

The core operations of Merafe Resources Limited (Merafe), JSE limited listing symbol, MRF, are the production and sale of ferrochrome. The Xstrata-Merafe Chrome Venture jointly own assets in six mines and a total of twenty furnaces at five establishments (Merafe Resources Limited, 2011:2).

**Miranda Minerals Holding Limited**

Miranda Minerals Holdings Limited (Miranda) JSE limited listing symbol, MMH, explores and extract minerals. Miranda’s main assets in South Africa include: Rozynene Bosch base metals and a silver deposit in the Northern Cape, Sterkfontein and Fraaiuizicht alluvial platinum, Lydenburg andalusite, Schagen and Schoongelegen gold, as well as Nooitgedacht coal deposits in Mpumalanga, Turffontein and Blaauwbank diamond deposits near Ventersdorp in North West Province and Kromdraai’s fluorspar in Gauteng (Miranda Minerals Holdings, 2011:4,6,11).

In terms of Black Economic Empowerment requirements, 20.8% of Miranda’s shares belong to Realeboga (Pty) Limited.

**Mvelaphanda Resources Limited**

Mvelaphanda Resources Limited (Mvela), JSE limited listing symbol, MVL, is a broad-based empowerment company. The group have significant assets in mineral and metals in South Africa. The company’s major assets include stakes in Northam Platinum and Trans Hex (Elisa Communications Corp, 2010:3).

**Petmin Limited**

Petmin Limited (Petmin), JSE llimited listing symbol, PET, key commodity mining and processing activities include silica, anthracite and iron ore mining and marketing.
The business segments, as per geographical area in South Africa, are as follows: Mpumalanga Province - Veremo Holdings (Pty) Ltd and SamQuarz (Pty) Ltd, Kwazulu-Natal Province - Tendele Coal Mining (Pty) Ltd including the Somkhele Anthracite Mine and Petmin Logistics (Pty) Ltd (Mathews, 2010:4–13).

**Sallies Limited**

Sallies Limited (Sallies), JSE limited listing symbol, SAL, has been listed on the JSE limited since 1904. Originally Sallies was a gold mining company. Over the years its main producing and marketing activities refocused on acidgrade fluorspar (acidspar). Acidspar is used to produce hydrofluoric acid (HF) found in products such as refrigerant gases, fluoroplastics and aluminium tri-fluoride. The product is mainly exported (Meier, 2010:b,4–6).

Sallies acquired Witkop Fluorspar Mine in the North West Province of South Africa in 1990 and the Buffalo Fluorspar Mine in the Limpopo Province in 2006. Buffalo Florospar's production was stopped in 2008 due to high levels of phosphorous content in the fluorspar. Witkop's mining activities were also been placed on hold due to unfavourable market conditions in 2009 (Meier, 2010: b,4–6).

**Sentula Mining Limited**

Sentula Mining Limited (Sentula), JSE limited listing symbol, SNU, is not only involved in opencast mining, drilling and exploration, but diversified outsourced mining services are also provided to the South African coal Mining Sector. Sentula operates in 16 African countries. South African activities are focused around coal and anthracite mining. Three of Sentula’s five coal mining projects are based in South Africa. Main Board JSE limited listing of Sentula has been active since 1993 (Sentula Mining Limited, 2010:2).

Opencast mining companies owned by Sentula include Megacube, Benicon Opencast Mining and Classic Challenge Trading. JEF Drill and Blast is Sentula’s overburden drilling and blasting division. The equipment, spares and engineering division includes two subdivisions, namely Benicon Sales and Caston. Geosearch international is Sentula’s exploration drilling company and Ritchie crane hire is a
mobile crane hiring division. Coal mining beneficial interests include: Nkomati Anthracite (SA), Sentula Exploration (SA) (formerly Merafe Coal), Mabapa Mining (SA), Jonah Coal/Aquila Resources – Asenjo Energy and, lastly, Jonah Coal Indongo (Zambia) (Sentula Mining Limited, 2010:4).
CHAPTER 4

INVESTORS’ SHARE SELECTION FRAMEWORK AND ALPHA PORTFOLIOS

4.1 Introduction

Research involves the scientific process of gathering information and knowledge in an objective fashion in order to answer a research problem (Thomas and Nelson, 2001:3).

4.2 Research methods

The literature study examined the population sample, followed by an investigation of investment selection criteria and portfolio selection to diversify risk and optimise investment returns. Specific selection criteria considered to be investigated from the literature study include the following chosen valuation indicators:

1. Free cash flow
2. Intrinsic value
3. Economic value added (EVA)
4. Margin of safety
5. Price/earnings ratio
6. Years to pay off dept
7. Price/book Value
8. Price/cash flow
9. Net profit margin
10. Hamada beta
11. Return on invested capital
12. Annual Change in Sales and;
13. Book value per share.

The scientific research process was followed in this study. Firstly the research problem was identified namely: How to assist investors to identify a portfolio of common stock within the general mining sector, to minimize risk and generate returns, preferably higher than the JSE All Share Index, as a benchmark to create shareholder wealth.

The population sample was selected, namely the general mining sector of the JSE limited and limitations were set.

Quantitative analysis of secondary numerical data obtained from McGregor BFA Ltd was used in this study to answer the research objectives:

1. To develop a framework that enables investors to select a portfolio from the general mining sector that is outperforming the JSE All Share Index (J203) average annual growth rate.

2. To examine the applicability of Cilliers’ model (Cilliers, 2004:142) in share selection as a first line screening tool, as well as variables specifically related to the general mining sector.

3. To test Markowitz’s Mean Variance of Portfolio (MVP) choice (Markowitz 1952:77-91), in the final selection of the portfolio identification.

Factors identified as the most important criteria to consider were used to recognise individual shares for inclusion in the portfolio. Criteria were set for each indicator within the various factors. The shares that met the research sample criteria were evaluated against the indicators’ criteria within each factor, by means of a matrix chart (presented in Appendix A, table 8). Companies meeting the most criteria (at least 50%) were included in a portfolio. The criteria were as follows:
Table 2: Evaluation criteria for the correlating factors (Own compilation)

<table>
<thead>
<tr>
<th>Performance measures:</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Change in Sales</td>
<td>A consistent year-to-year sales record are expected, compare Sales Growth with market capitalisation Evaluation: An upward trend in Sales Growth.</td>
</tr>
<tr>
<td>Book value per share</td>
<td>A positive trend in book value per share and Average book value per share growth of the company must outperform the general mining sector average growth (112.05) over this 20 year period.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Earnings &amp; Profit measures:</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earnings per share</td>
<td>The company’s EPS average must outperform the General Mining EPS sector average 1991-2010 (this value were calculated as 488.30)</td>
</tr>
<tr>
<td>Gross Profit margin</td>
<td>The company average above 3.812, the average of the general mining sector annual gross profit margin for all companies over the twenty year period. Preferably a stable gross profit margin year on year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value creators:</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free cash flow</td>
<td>A positive free cash flow value for each year</td>
</tr>
<tr>
<td>Intrinsic value per Share</td>
<td>A low intrinsic value per Share indicating a higher Earnings Yield in comparison to a discount rate (RSA R153 bond). Lower values over time signals higher Earnings Yield potential and therefore a downward trend in this value is set as the criteria in this study.</td>
</tr>
<tr>
<td>economic value added</td>
<td>EVA shows how much value will be added to the capital employed each year, thus a positive trend is expected</td>
</tr>
</tbody>
</table>

Graphs were drawn for trend-line evaluation of indicators’ criteria, where needed, over the 10 year period of the companies that were evaluated (Appendix A, figures 14–17).

Four companies passed the screening criteria and were included in the portfolios. Due to the availability of data, a common ten year time period for these four identified companies was used, 1999 to 2009 for the portfolio effectiveness evaluation.
Diverse weighted averages of each of the identified companies were included in various portfolios. Markowitz’s Mean Variance of Portfolio (MVP) choice (Markowitz 1952:77-91) was applied to identify an optimal portfolio (lowest standard deviation relative to the highest expected return) from the selection of portfolios with different weights assigned to each share.

The final selected portfolio was benchmarked against the JSE All Share Index (J203) average annual growth rate for alpha portfolio evaluation.

4.3 Research sample

The population of this study consisted of the listed companies in the general mining sector of the JSE limited from 1991 to 31 December 2010.

Table 3: Companies listed in the general mining sector 1991-2010 (McGregor BFA Limited, 2011)

<table>
<thead>
<tr>
<th>Company Name</th>
<th>JSE Name</th>
<th>Item No</th>
<th>Years listed in sample</th>
<th>Total Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSOLUTE HOLDINGS LIMITED</td>
<td>ABSOLUTE</td>
<td>ABO</td>
<td>2009</td>
<td>1</td>
</tr>
<tr>
<td>ANGLO AMERICAN PLC</td>
<td>ANGLO</td>
<td>AGL</td>
<td>1991-2010</td>
<td>20</td>
</tr>
<tr>
<td>AFRICAN RAINBOW MINERALS LIMITED</td>
<td>ARM</td>
<td>ARI</td>
<td>1991-2010</td>
<td>20</td>
</tr>
<tr>
<td>ASSORE LIMITED</td>
<td>ASSORE</td>
<td>ASR</td>
<td>1991-2010</td>
<td>20</td>
</tr>
<tr>
<td>BHP BILLITON PLC</td>
<td>BHPBILL</td>
<td>BIL</td>
<td>1997-2010</td>
<td>14</td>
</tr>
<tr>
<td>CHROMETCO LIMITED</td>
<td>CHROMETCO</td>
<td>CMO</td>
<td>2006-2010</td>
<td>5</td>
</tr>
<tr>
<td>COAL OF AFRICA LIMITED</td>
<td>COAL</td>
<td>CZA</td>
<td>2007-2010</td>
<td>4</td>
</tr>
<tr>
<td>EXXARO RESOURCES LIMITED</td>
<td>EXXARO</td>
<td>EXX</td>
<td>2002-2010</td>
<td>9</td>
</tr>
<tr>
<td>KUMBA IRON ORE LIMITED</td>
<td>KUMBA</td>
<td>KIO</td>
<td>2006-2008</td>
<td>2</td>
</tr>
<tr>
<td>FIRESTONE ENERGY LIMITED</td>
<td>FIRESTONE</td>
<td>FSE</td>
<td>2009-2010</td>
<td>2</td>
</tr>
<tr>
<td>INFRASORS HOLDINGS LIMITED</td>
<td>INFRASORS</td>
<td>IRA</td>
<td>2009-2010</td>
<td>2</td>
</tr>
<tr>
<td>MIRANDA MINERAL HOLDINGS LIMITED</td>
<td>MIRANDA</td>
<td>MMH</td>
<td>2001-2010</td>
<td>10</td>
</tr>
<tr>
<td>MERAFE RESOURCES LIMITED</td>
<td>MERAFE</td>
<td>MRF</td>
<td>1991-2010</td>
<td>20</td>
</tr>
<tr>
<td>METOREX LIMITED</td>
<td>METOREX</td>
<td>MTX</td>
<td>1991-2010</td>
<td>20</td>
</tr>
<tr>
<td>MATODZI RESOURCES LIMITED</td>
<td>MATODZI</td>
<td>MTZ</td>
<td>1991-2007</td>
<td>17</td>
</tr>
<tr>
<td>MVELAPHANDA RESOURCES LIMITED</td>
<td>MVELA RES</td>
<td>MVL</td>
<td>1991-2010</td>
<td>20</td>
</tr>
<tr>
<td>PETMIN LIMITED</td>
<td>PETMIN</td>
<td>PET</td>
<td>1991-2010</td>
<td>20</td>
</tr>
<tr>
<td>SALLIES LIMITED</td>
<td>SALLIES</td>
<td>SAL</td>
<td>1991-2010</td>
<td>20</td>
</tr>
<tr>
<td>SA MINERAL RESOURCES CORP LIMITED</td>
<td>SAMROCSS</td>
<td>SAM</td>
<td>1995-2007</td>
<td>13</td>
</tr>
<tr>
<td>SEPHAKU HOLDINGS LIMITED</td>
<td>SEPHAKU</td>
<td>SEP</td>
<td>2009-2010</td>
<td>2</td>
</tr>
<tr>
<td>SENTULA MINING LIMITED</td>
<td>SENTULA</td>
<td>SNU</td>
<td>1993-2010</td>
<td>17</td>
</tr>
<tr>
<td>URANIUM ONE INC</td>
<td>UROKE</td>
<td>UUU</td>
<td>2005-2010</td>
<td>6</td>
</tr>
<tr>
<td>WHITE WATER RESOURCES LIMITED</td>
<td>WHTWATER</td>
<td>WWR</td>
<td>2010</td>
<td>1</td>
</tr>
</tbody>
</table>
The research sample limitations:

- Companies listed on the JSE limited on 31 December 2010 were included in the literature study sample in Chapter 3 to develop an understanding of these companies in the general mining sector.

- All companies listed in this sector on the JSE limited from 1991–2010 were included in the framework development of the research, depending on data availability.

- The framework was tested with the companies that consisted of at least 10 years of data over the twenty year period of 1991–2010.

- Companies that met above 50% of the criteria set in the framework were included in the final portfolio.

- Due to the availability of data, a common time period for the identified companies was selected, namely 1998–2009, for the construction and testing of the various portfolios against the benchmark.

4.4 Statistical methods

Data (Financial and Annual Reports) pertaining to the general mining sector, listed on the JSE limited, from 1991 to 2010 obtained from McGregor BFA Ltd were gathered and sorted. Absolute and relative share valuation indicators were chosen and calculations were tabulated.

StatSoft, Inc. (2011) STATISTICA-data analysis software system, Version 10. was used for statistical analysis (Ellis, 2011).

Correlation analyses between each metric and the average share price of the general mining sector were used to determine the relevance of the specific indicators. The stepwise regression analysis was performed. Scatter-plots were drawn to evaluate linearity. Independence, normality and equal variance were also assessed to comply with the four assumptions of regression (Levine et al., 2008: 530–532).
Principal component analysis was used to combine highly correlated variables (above 0.5 statistical correlations, as per criteria) into a single factor in order to reduce the number of variables and classify the variables. Seven factors were identified from the Principal Components Analysis as per table 4.

<table>
<thead>
<tr>
<th>Valuation indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factor 1</strong> Value creators</td>
</tr>
<tr>
<td><strong>Factor 2</strong> Safety measures</td>
</tr>
<tr>
<td><strong>Factor 3</strong> Price ratios</td>
</tr>
<tr>
<td><strong>Factor 4</strong> Risk-Return measures</td>
</tr>
<tr>
<td><strong>Factor 5</strong> Performance measures</td>
</tr>
<tr>
<td><strong>Factor 6</strong> Earnings and Profit</td>
</tr>
<tr>
<td><strong>Factor 7</strong> Dividend yield</td>
</tr>
</tbody>
</table>

The following factors; Safety measures, Price ratios, Risk-Return measures and Dividend yield could not be used due to the positive/negative correlation variance throughout the different years.

Linear regression demonstrated three consistent factors; Factor 6: Earnings and Profit, Factor 5: Performance Measures and Factor 1: Value Creators.

Multiple linear regression equations per year were drawn. The adjusted $r^2$ was used in consideration of the multiple regression models because it reflects both the number of independent variables and the sample size. F-tests were performed to determine the value of each model. A 5% level of significance was used, thus 95% confidence interval. Multiple linear regression models were applied to the companies listed in the general mining sector of the JSE limited that consisted of at least ten years’ data.

### 4.5 Report and findings

Each company in the general mining sector with more than ten years of data was evaluated in the share selection framework. The share selection framework contains criteria for the individual components within each factor that were highly correlated.
with the average annual share price and can be reported as follow:

**Performance Measures:**

**Annual change in sales:**
A consistent growing year-to-year sales record are expected, sales growth expressed as a growth percentage can be compared with market capitalisation.

*Calculation:* This year’s sales divided by the previous year’s sales minus one.

*Evaluation criteria:* An upward trend in sales growth.

**Book value per share:**
The book value of a company is the total sum left when a company sell all its assets and all company obligations have been settled.

*Calculation:* The book value per share can be calculated by dividing the company book value by the number of shares outstanding (Megginson et al., 2010:143).

*Evaluation:* A positive trend in book value per share. Average book value per share growth of the company must outperform the general mining sector average growth (112.05) over this 20 year period set as the criteria in this research.

**Profit and Earnings**

**Earnings per share**
Return per share is the measurement for shareholder wealth creation.

*Calculation:* Earnings per share can be calculated over a specific time frame, for example annual earnings divided by the number of shares outstanding.

*Evaluation criteria:* The individual company’s annual EPS average should compare favourably with the general mining sector’s annual EPS average. In this study the criteria for inclusion is an EPS average above the General Mining EPS Sector average 1991–2010, this value was calculated as 488.30.

**Gross profit margin**
“In general the Gross Profit Percentage measures a company’s ability to charge premium prices and produce goods and services at low cost” (Libby, Libby and Short, 2009:289).
Calculation: Gross Profit divided by Sales usually calculated on annual figures, expressed in percentage (Libby, Libby and Short, 2009:289).

Evaluation criteria: The company’s annual average gross profit margin must be above 3.81%, the average of the general mining sector’s annual gross profit margin average for all companies over the twenty year period. Preferably a stable gross profit margin year on year is expected.

Value Creators:

Free cash flow
Free cash flow is often used to evaluate a company’s ability to peruse long term investment opportunities. Free cash flow is based on Actual cash Flow of a company. The company is viewed as a total entity. A positive free cash flow indicates availability for additional expenditures and reflects a company’s financial flexibility. Free cash flow is often used to pay out dividends to shareholders, or repurchase the company’s own share to increase earnings per share (Libby, Libby and Short, 2009: 671).

Calculation: Free cash flow equals the Net Operating Profit After Tax, minus the Change in Net Operating Working Capital minus the Change in Fixed Assets.

Evaluation criteria: A positive free cash flow value for each year the company was listed in this research time frame 1991–2010.

Intrinsic value per share
The intrinsic value per share reflects the price at which the security ought to sell if it is appropriately priced in the market. Thus a lower intrinsic value per share offers a higher earnings yield and would be favoured (Vick, 2001:124).

Calculation: The intrinsic value is calculated by dividing the estimated earnings per share for the next year by a discount rate. In this study the RSA R153 Government Bond return is used as the discount rate.

Evaluation criteria: A lower intrinsic value per Share is favoured since it offers a higher earnings yield. Lower values over time would be to the advantage of the shareholder in wealth creation. In this study a downward trend is the criteria set for this indicator, expressing growth in Earnings Yield over time.
**Economic value added**

Economic value added is the profit earned after the cost of capital is covered. The value investments add for shareholders are determined by subtracting accounting profit from the investments' cash flow in the application of the EVA metric.

*Calculation:* Economic value added is the cash flow of the company minus the product of the cost of capital and invested capital (Megginson et al., 2010:243).

*Evaluation criteria:* EVA shows how much value will be added to the capital employed each year, thus a positive trend is expected

### 4.5.1 Summary and output tables and figures

Table 5 presents the multiple linear regression models for each year. These models consist of various factors which hold a correlation with the average annual share price of the companies in the general mining sector in the specific year. These factors are made up by various share valuation metrics, as described in the share selection framework.

Table 5: Multiple linear regression models for each year (Ellis, 2011:1)

<table>
<thead>
<tr>
<th>Year</th>
<th>Model: $Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>$Y_i = 535.9835 + 0.5297 F5 - 0.4059 F6 + 0.0006 F1$</td>
</tr>
<tr>
<td>1992</td>
<td>$Y_i = 193.2200 + 0.2336 F5 + 35.1297 F6 - 0.0013 F1$</td>
</tr>
<tr>
<td>1993</td>
<td>$Y_i = -301.635 + 0.564 F5 + 34.825 F6 - 0.0011 F1$</td>
</tr>
<tr>
<td>1994</td>
<td>$Y_i = -518.806 - 1.219 F5 + 35.433 F6$</td>
</tr>
<tr>
<td>1995</td>
<td>$Y_i = 197.1064 + 2.2970 F5 + 11.0822 F6 + 0.0002 F1$</td>
</tr>
<tr>
<td>1996</td>
<td>$Y_i = 114.3759 + 8.1529 F5 - 29.4463 F6 + 0.0002 F1$</td>
</tr>
<tr>
<td>1997</td>
<td>$Y_i = 1383.168 + 1.249 F5 + 8.488 F6$</td>
</tr>
<tr>
<td>1998</td>
<td>$Y_i = 64.44086 - 1.73793 F5 + 26.19034 F6 + 0.0001 F1$</td>
</tr>
<tr>
<td>1999</td>
<td>$Y_i = 171.1425 - 1.3119 F5 + 56.4538 F6 - 0.0003 F1$</td>
</tr>
<tr>
<td>2000</td>
<td>$Y_i = 86.48615 + 1.35626 F5 + 12.28165 F6 + 0.00006 F1$</td>
</tr>
<tr>
<td>2001</td>
<td>$Y_i = 91.44289 + 2.24115 F5 + 5.06125 F6 - 0.00002 F1$</td>
</tr>
<tr>
<td>2002</td>
<td>$Y_i = 609.0109 - 0.8936 F5 + 9.8160 F6 + 0.0004 F1$</td>
</tr>
<tr>
<td>2003</td>
<td>$Y_i = 186.6976 - 0.8686 F5 + 36.2079 F6$</td>
</tr>
<tr>
<td>2004</td>
<td>$Y_i = 27.562855 + 2.35387 F5 + 11.54221 F6 + 0.00006 F1$</td>
</tr>
<tr>
<td>2005</td>
<td>$Y_i = 235.6521 + 1.0524 F5 + 5.9445 F6 + 0.0002 F1$</td>
</tr>
<tr>
<td>2006</td>
<td>$Y_i = 1144.702 + 3.844 F5 - 2.941 F6$</td>
</tr>
<tr>
<td>2007</td>
<td>$Y_i = 3004.993 + 0.371 F5 + 9.956 F6$</td>
</tr>
<tr>
<td>2008</td>
<td>$Y_i = 3331.303 + 2.051 F5 + 7.133 F6$</td>
</tr>
<tr>
<td>2009</td>
<td>$Y_i = 38.34554 + 3.92456 F5 + 4.20919 F6 + 0.00014 F1$</td>
</tr>
<tr>
<td>2010</td>
<td>$Y_i = -261.515 + 7.130 F5 + 8.061 F6$</td>
</tr>
</tbody>
</table>
4.6 Discussion of information in the output tables and figures

From Table 5, it can be seen that Factors 5 and 6 are present in all twenty years multiple linear regression models. Factor 1 is only present in fourteen years' multiple linear regression models, nevertheless, is still an important measure which is taken into account in the share selection framework. Therefore, Performance indicators as well as Earnings and Profit metrics, can be seen as the most important criteria in the selection of shares in the general mining sector when considering inclusion within the portfolio.

Table 6 present the statistical findings of the empirical study. The variation of change in average share price is explained by the overall regression model for each year, as indicated by the adjusted $r^2$.
The share selection and multiple linear regression frameworks were applied to the chosen companies, as indicated in Table 3. Four companies met above 50% of the share selection framework criteria (Table 2); African Rainbow Minerals Limited, Assore Limited, BHP Limited plc and Sentula Mining Limited. These companies are included in the construction of the final portfolios.

The multiple regression models’ fit on the four selected companies for portfolio construction are presented in Figures 9–12.

A fairly accurate multiple linear regression model fit for African Rainbow Minerals Limited was obtained. The group boasts constant annual sales growth over the twenty year period. Average earnings per share from 1991 to 2010 of 562.1 cents can be reported. The highest earnings per share, 1906 cents, were reached in 2008 before the recession. From Table 6, a statistically significant (above 99.5%) variation of the change in average share price is explained by the overall regression model. ARM data for 2010 was not available. The average capital gain from 1999 to 2009 was 20.33%, with a standard deviation of 187.74 and coefficient of variation of 9.24.
Assore limited display a very accurate model fit. The multiple linear regression model presented undervaluation in only two years, 2006 and 2008. The overall model fit is reflected in the coefficient of determination, $R^2$ values of 0.9998 is reached in 2000, whereas the lowest model fit was in 2006 (table 6). Although a slight upward trend in Sales growth is present, the company’s book value per share declined over time. Average capital gains 1999 -2009 was 27.13% and volatility of returns represented by the standard deviation of 217.37 and coefficient of variation of 8.01.
BHPBill met the most criteria in the selection model. The group’s historic values reflect strong profit margins, increase in earnings and book value per share, sales growth as well as efficient EVA growth and free cash flow from 1991 to 2009. Among the four selected companies, BHPBill showed the most promising capital gains from 1999 to 2009, 30.94% in relation to the volatility. A standard deviation of 109.31 and coefficient of variation of 3.53 were delivered.

![Figure 12: SNU: actual vs. predicted annual share price (Own compilation)](image)

The group’s intrinsic value per Share increased over the twenty year period signalling a lower earnings’ yield over time, yet the performance measures (book value per share and sales growth) show favourable trends. Historic growth of EVA value is another constructive measurement for Sentula Mining Limited. Although Sentula reported the highest capital gains (53.00%) among the four selected shares from 1999 to 2009, it was also the most volatile share, as is noticed in its standard deviation of 266.20 and coefficient of variation of 5.02.

Five portfolios were arbitrarily constructed representing the random percentage of the selected shares; African Rainbow Minerals Limited, Assore Limited, BHPBill Limited plc and Sentula Mining Limited. The portfolio with the lowest standard deviation was chosen, in application of Markowitz’s (1952) MVP.
Table 7: Portfolio Selection (Ellis, 2011:1)

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Average Capital Gains 1999-2009 (ACG)</th>
<th>Standard Deviation (SD)</th>
<th>Coefficient of variation</th>
<th>Beta</th>
<th>SD/ACG %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio 1: 25% of each company ARI,ARS,BHP,SNU</td>
<td>32.85%</td>
<td>5.73</td>
<td>0.17</td>
<td>-0.82</td>
<td>17.44%</td>
</tr>
<tr>
<td>Portfolio 2: 16.67%ARI,16.67%ARS, 50%BHP,16.67%SNU</td>
<td>32.22%</td>
<td>5.68</td>
<td>0.18</td>
<td>-0.76</td>
<td>17.63%</td>
</tr>
<tr>
<td>Portfolio 3: 23%ARI,23%.ARS, 30%BHP,23%SNU</td>
<td>32.39%</td>
<td>5.69</td>
<td>0.18</td>
<td>-0.80</td>
<td>17.57%</td>
</tr>
<tr>
<td>Portfolio 4: 30%ARI30%ARS, 10%BHP,30%SNU</td>
<td>33.23%</td>
<td>5.76</td>
<td>0.17</td>
<td>-0.86</td>
<td>17.33%</td>
</tr>
<tr>
<td>Portfolio 5: 28.3%ARI,28.3%ARS, 15%BHP,28.3%SNU</td>
<td>33.07%</td>
<td>5.75</td>
<td>0.17</td>
<td>-0.85</td>
<td>17.39%</td>
</tr>
</tbody>
</table>

Portfolio 2 was chosen as the final portfolio for investment. This portfolio displayed the lowest standard deviation of 5.68. The standard deviations of the portfolios were compared to the average capital gains and Portfolio 2 represented the highest capital gains in relation to the standard deviation of 17.63%. The portfolio capital gains' 1999 to 2009 average was 32.22% coefficient of variation of 0.18.

The final portfolio annual growth rates were benchmarked against the JSE All Share Index (J203) average annual growth rate as displayed in Figure 13. The portfolio annual growth rates outperformed the JSE All Share annual growth rates in seven of the ten years (Figure 13).
A satisfying portfolio offering higher growth rates as the JSE All Share Index in seven out of ten years was reached.
CHAPTER 5

RECOMMENDATIONS AND CONCLUSIONS

5.1 Introduction

Chapter 1 focused on information pertaining to the stock exchange and specifically
the general mining sector listed on the JSE limited. Share investment risk and return
trade-off were explained as well as the importance of valuing securities as a group.
The research problem, objectives, methodology, scope and limitations were set.
Lastly a chapter by chapter layout was given.

Chapter 2 presented a deeper understanding of the causes and drivers of value in
the market. The South African general mining market was explored. Finally stock
selection and valuation techniques were researched in the literature study.

In Chapter 3 portfolio construction was discussed. Companies listed on the JSE
general mining sector, as at 31 December 2010, were placed under the lens.

Shareholder wealth creation through an alpha portfolio was the focus of the empirical
study presented in Chapter 4. This chapter consisted of the research methods,
sample, statistical methods and the reports and findings.

5.2 Conclusion

In this study a share selection framework for the general mining sector of the JSE
limited was introduced. This approach is analytical and able to identify individual
securities for the construction of an alpha portfolio.

To illustrate the frameworks’ ability in share selection, the multiple linear regression
models for each year were put to the test. Head-on actual vs. predicted average
share prices were compared over a ten year period with a statistically significant
level of 0.05. However the framework is still based on a historical perspective prone
to errors in prediction.
This study has several limitations, the sample used in this study suffered from a lack of data for some companies. Firms that did not make the final sample criteria in the empirical test were eliminated, biasing the results in disfavour of the hypothesis.

A weighted average portfolio, with the lowest standard deviation, consisting of four shares recognised from the security selection framework, was benchmarked against the JSE All Share (J203) Index. In support of Markowitz’s (1952) modern portfolio theory, the volatility of individual shares was tested against the portfolio’s volatility.

Findings presented in this study suggest that the developed share selection framework proved to be effective. In conclusion, it is believed that this study made three primary contributions;

Firstly an effective screening framework for share selection within the general mining sector of the JSE limited was developed.

Secondly diversification effectiveness through portfolio construction was proved.

Finally the portfolio success came to light in the comparison with annual market returns outperforming the JSE All Share index in seven out of ten years in the annual growth rate comparison.

The study objectives were reached and an alpha portfolio promising shareholder wealth creation was presented.

5.3 Recommendations

An analysis of the applicability of the quantitative criteria identified in this study, in various international markets and across various sectors, is recommended.
Bibliography


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### Table 8: Evaluation of Companies against criteria matrix (Own compilation)

<table>
<thead>
<tr>
<th></th>
<th>Factor 5</th>
<th>Factor 6</th>
<th>Factor 1</th>
<th>Total criteria passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANGLO AGL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARM ARI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASSORE ASR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHPBILL BHP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIRANDA MMH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MERAFE MRF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>METOREX MTX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATODZI MTZ</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVELA RES MVL</td>
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<td></td>
</tr>
<tr>
<td>SAMROC SAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SENTULA SNU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graphs were used to evaluate each company against the criteria set for the various indicators in the study. An example of four African Rainbow Minerals' graphs:
Figure 14: ARM: Average Annual change in sales (Own compilation)

Figure 15: ARM: Average annual EVA values (Own compilation)

Figure 16: ARM: Average annual book value per share (Own compilation)
Figure 17: ARM: Annual intrinsic value (Own compilation)