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Value Creation in Mining: an Analysis of South Africa's Platinum Industry

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A research report submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration

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Abstract

The superiority of economic over accounting metrics is established and an analysis of the value created by platinum mining companies since 1994 is made. The link between growth and market value is shown to depend on earning an incremental return on invested capital (ROIC) that exceeds the weighted average cost of capital. The competitive advantage gained through capital budgeting is analysed using a ROIC tree to disaggregate ROIC into its component ratios, showing that firms' performance is differentiated through capital turnover rather than operating margin. The impact on value creation of the Mining Charter, of the Mineral and Petroleum Resources Development Act, and of the proposed Royalty on mineral production is assessed through a survey of executives and analysts to the industry, revealing cautious optimism that negative impacts will be both temporary and manageable, but that considerable uncertainty surrounds the value of old order mineral rights under the new order. Through a hypothetical example, Real Options Valuation is shown to be an appropriate methodology to quantify the value of old order rights, should expropriation necessitate claims for compensation.

Declaration

I declare that this research project is my own, unaided work. It is submitted in partial fulfilment of the requirements of the degree of Master of Business Administration for the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University.

Christopher Antony Jacobs

Date

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This research could not have been completed without the fundamental data upon which much of the report rests. For the published accounting data on South African firms, I would like to thank Professor Leon Brümmer of McGregor BFA, and Messrs Sean Barry and Anthony Marsh of Anglo Platinum for providing other valuable data.

For guiding this project through to completion, grateful thanks are due to my supervisor, Mr Stephan Foster.

Finally, for their patience and understanding, often ill-deserved, I thank my wife, Sheila and children, Daniel and Rebecca. Let the games begin.

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Glossary of Terms & Abbreviations

Item	Description
APV	Advanced Present Value
BCR	Benefit/Cost Ratio = NPV of project cash flow / NPV of capital investment
BEE	Black Economic Empowerment
Beta (β)	Covariance of a share or portfolio with the market
CAPM	Capital Asset Pricing Model
Concentrator	Facility for beneficiating ore prior to shipping to a smelter.
DCF	Discounted Cash Flow method of valuation
Dividend Yield (DY)	Dividends per share / Market price of equity
DPP	Discounted Payback Period
EBITA	Earnings before interest, tax and amortisation of goodwill
Economic Profit	Invested capital x {ROIC – WACC}
EVA ®	Economic Value Added ® Stern Stewart Company. See Economic Profit
HDSA	Historically Disadvantaged South Africans
Invested Capital (IC)	Net working capital plus net PPE plus net other operating assets (*excludes* non-operating assets, excess cash & equivalents)
IRR	Internal Rate of Return
MPRDA /MPRDB	Mineral and Petroleum Resources Development Act /Bill
MVA®	Market Value Added ® Stern Stewart Company
NAP	North American Palladium – a mining company based in Canada
NOPLAT	Net Operating Profit less Adjusted Taxes
NPV	Net Present Value
PGM	Platinum Group Metals – platinum(Pt) palladium(Pd) rhodium(Rh) ruthenium(Ru) osmium(Os) and iridium(Ir)
PI	Profitability index. Same as BCR (q.v.)
PP	Payback Period
PPE	Property, Plant and Equipment
RoE	Return on Equity
ROCE	Return on Capital Employed
ROIC	Return on Invested Capital = NOPLAT / IC
RONIC	Return on New Invested Capital = incremental ROIC
ROV	Real Options Valuation
Scorecard	Scorecard for the Broad Based Socio-Economic Empowerment Charter for the South African Mining Industry
SGR	Sustainable Growth Rate
Tolling	Treatment of concentrates by a refiner on behalf of a third party
WACC	Weighted Average Cost of Capital

Chapter 1: Introduction

1.1 Background

1.1.1 The Market

Platinum is truly a precious metal. Far less abundant in the Earth's crust than gold, it is prized not only for the beauty and durability it lends to jewellery, but also for its ability to catalyse chemical reactions without itself being consumed. This has led to rapidly increasing demand for platinum and the associated platinum group metals ('PGM's) – principally palladium and rhodium, along with minor metals ruthenium, osmium and iridium – as catalysts in the refining of petrochemicals and in 'autocatalysts' for cleaning noxious gasses from vehicle exhausts.

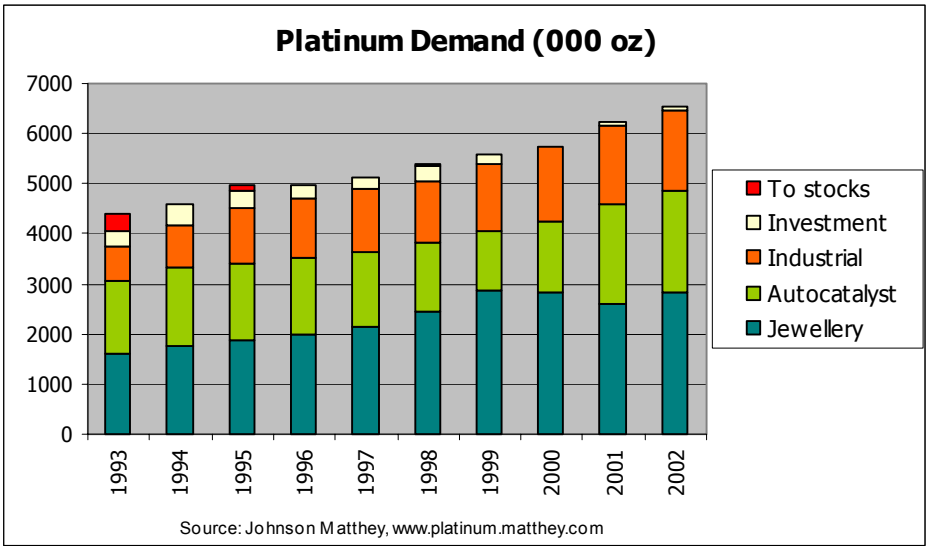


Figure 1 Platinum market growth 1993-2002

PGM's are also finding new, high-tech applications such as in data storage devices. Possibly the greatest potential growth market, though, is in fuel cells which convert hydrogen into electrical power and emit only water vapour. Fuel

cells have the potential to power everything from mobile phones and laptop computers to cars and even homes.

Jewellery demand, too, has been increasing. Japanese demand grew rapidly during the 1990's and although sales have fallen back slightly, it remains an important market. In China, marketing campaigns have been hugely successful in promoting platinum over gold jewellery amongst the emerging professional class, and Chinese jewellery demand has grown rapidly to over a million ounces per year. In the West, platinum is replacing gold as the metal of choice amongst affluent, younger buyers.

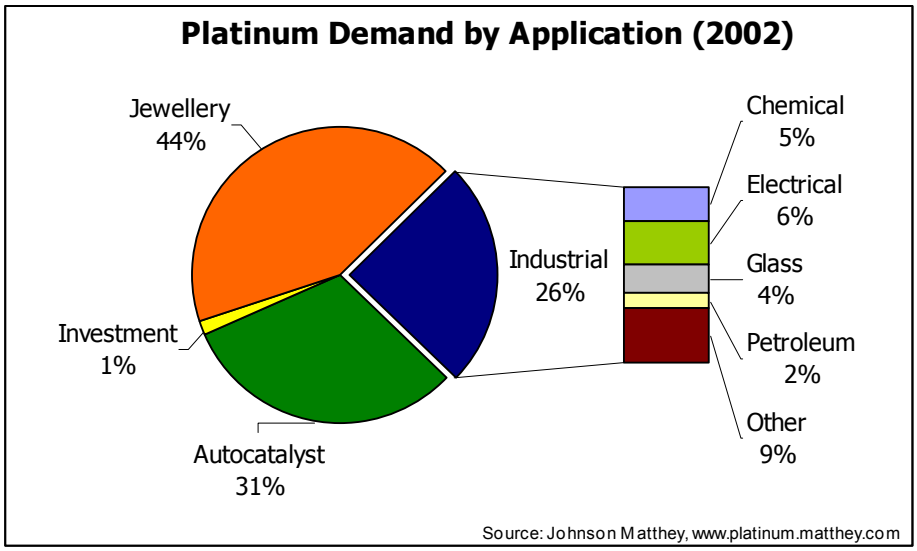


Figure 2 Platinum Demand by Application

1.1.2 Industry Structure

Almost six million ounces of new platinum were mined in 2002, of which South Africa produced seventy five percent, while Russia produced fifteen percent and North America just seven percent (see Figure 2). Much of the PGM production from both Russia and North America is a by-product of nickel mining and is comprised mostly of palladium with lesser amounts of platinum and other PGMs, whereas in South Africa the industry is dominated by primary PGM producers

exploiting platinum-rich ores from the rim of the Bushveld igneous complex. In 2002, the industry employed 111 720 people on 17 mines in South Africa (Chamber of Mines, 2003). The country is home to almost all of the major platinum producers, and while there are a number of new entrants from the United Kingdom and Canada which are not addressed by this study, all six major locally (South African) registered platinum producers are included in the scope of this research.

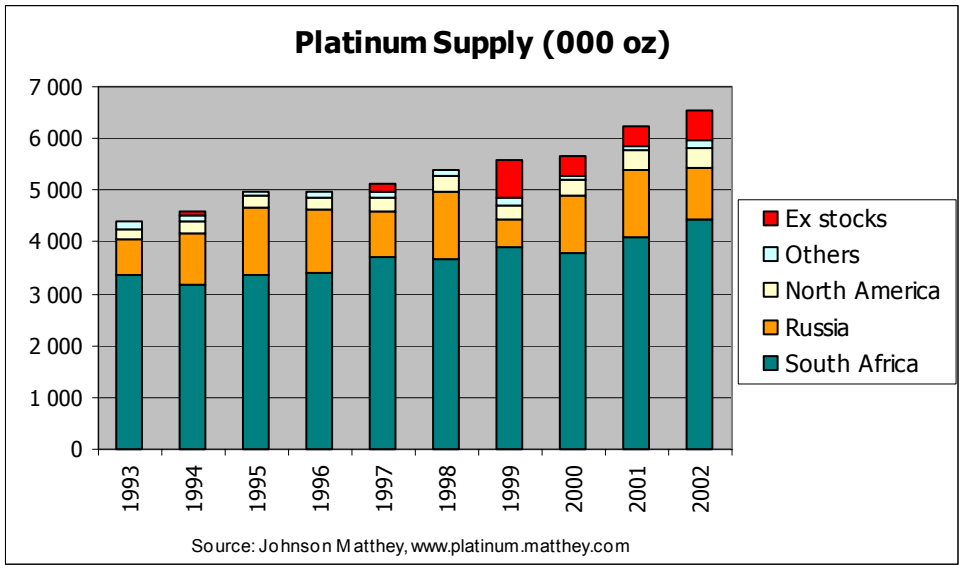


Figure 3 Platinum Supply 1993-2002

The ownership relationships amongst the South African companies are somewhat incestuous, a structure that results from the desire of the major companies to secure feed stocks for their refineries though equity participation in the junior companies, and from past corporate strategies – an example being Impala's ownership of some 27% of the equity in Lonmin Platinum, this being a relic of a 1996 merger attempt that was blocked as anti-competitive by the Competitions Commission of the European Union (Bailey, 2003). A schematic representation of some of these cross-holdings is shown in Figure 4, over.

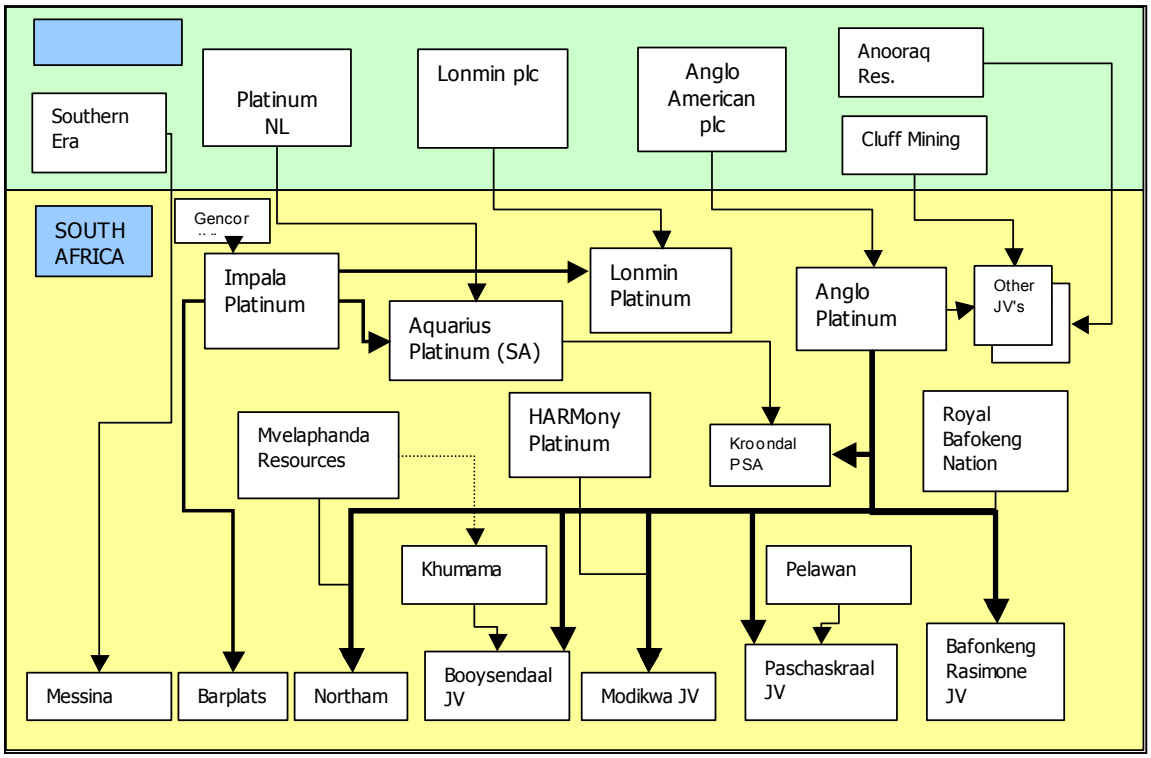


Figure 4 Platinum Industry Structure in South Africa

Among South African platinum miners, the following groups can be recognised:-

(i) Established 'mine to metal' companies that have the capability of producing finished PGM metal products for the market from their own mines and from purchase or tolling of concentrates bought from second-tier companies. Typically, these firms enjoy large resource positions, and are not geographically limited to South Africa. The companies included in this category are Anglo Platinum, Impala, Lonmin and (following its investments in Zimbabwe) Aquarius.

(ii) Smaller firms operate as producers and sellers of concentrates to the first category producers for smelting and refining, though some may have tolling arrangements. Access to mineral resources has been limited but they have ready access to financial markets through listing on the Johannesburg stock market. Firms falling into this category are

Barplats, Messina and Northam; though the latter is somewhat anomalous in smelting its own PGM concentrates.

(iii) Black Economic Empowerment (BEE) companies and other new entrants. Such organisations often suffer severe constraints on access to mineral resources as well as to finance but compensate for this through energetic, entrepreneurial spirit. Since they are often privately held, little data on these companies is publicly available. The Royal Bafokeng Nation is a partner in the Bafokeng Rasimone Platinum Mine (BRPM), and HARMony Platinum (formerly the Platinum division of African Rainbow Minerals, ARM) is a 50% partner with Anglo Platinum in the Modikwa Mine. One listed example included in this study is Mvelaphanda Resources, which owns 22.5% of Northam Platinum and has recently joined forces with the Khumama consortium to develop the Booysendal project.

Corporate activity to re-position companies to meet requirements of the Mining Charter has resulted in the emergence of Mvelaphanda and HARMony (following Harmony's merger with African Rainbow Minerals, ARM) as powerful, well-funded enterprises with unimpeachable empowerment credentials. In a similar vein, Impala has agreed to sell its 27% equity stake in Lonmin to a yet-to-be-announced empowerment partner. Industry observers believe that this may involve the Royal Bafokeng Nation, whose ownership of a large entitlement to royalties on Impala's production seems ripe for securitisation.

In Russia, the Norilsk Company produces palladium and a little platinum as a by-product of nickel mining. Details of the amounts of metal produced have until

now been treated as a state secret, though at the time of writing a bill was before the Russian parliament to de-classify this information.

Zimbabwe has the largest and best-known PGM deposits outside South Africa. Technical and political problems have retarded the development of these resources. However, they are currently being developed into commercial production, and the country seems destined to become a major PGM producer over the next decade.

In the USA, Stillwater Mining Company exploits the Stillwater geological complex in Montana. Stillwater is primarily a palladium producer, with lesser amounts of associated platinum. The recent takeover by of Stillwater by Norilsk was notable in that much of the purchase price was paid in palladium – a rare example of this metal being used as currency.

In Canada, North American Palladium (NAP) exploits a low-grade palladium deposit by opencast mining at Echo Lake. Several companies are actively exploring for PGM's in Canada, Australia, China and elsewhere, but other than the PGMs produced as by-product to nickel mining, there are no other significant commercial operations.

1.2 Problem statement

South Africa's platinum mining industry faces a boom – and a dilemma. Rapid growth in demand means that producers must invest heavily simply to maintain market share. Retained earnings may be inadequate to fund the required growth rate, implying that firms must attract new capital to fund this growth.

However, not all growth opportunities available to the industry will give a return above their opportunity cost of capital. Implementing those projects that satisfy

this condition will increase the value of the firm by an amount equal to the net present value (NPV) of the project. The remainder of the growth opportunities, giving a return at or below their cost of capital, will thus either be value-neutral or will destroy value, respectively.

Compounding the growth/value problem, the South African government has recently transformed the regulatory regime under which the mining industry operates. Legislation has been revised with the stated aim of opening up the industry to historically disadvantaged South African (HDSA) groups:-

- a policy of 'use it or lose it' informs the granting of mining rights, forcing firms with undeveloped mineral resources to commit to their "optimal" development – or allow others an opportunity to do so;
- in terms of the Mining Charter, firms must choose either to dispose of a portion of their assets to HDSA investors, or to work with selected Black Economic Empowerment (BEE) partners on new ventures.
- a revenue-based royalty on mineral production has been proposed. The percentages payable (8% for diamonds, 4% for PGMs, 3% for gold and 2% for coal) relate to a general perception of profitability and make no allowance for its affordability to a particular company or mining operation.

1.3 Research Question

The aim of this research is to investigate the drivers of value creation in the platinum mining industry and to establish whether there is a demonstrable relationship between the rate of growth of platinum mining companies and their ability to create value for their shareholders. Companies implement their most attractive projects first, and so a higher rate of growth implies that projects with

increasingly marginal returns are being accepted. If the rate of growth is sufficiently high, firms may start to accept projects that destroy value. Of particular interest, then, is the question of whether a market-led expansion of production has seduced the industry into relaxing the discipline of capital budgeting, leading to value-destruction.

Conversely, the ability of some firms to grow rapidly and create value may be a measure of how effectively they screen out value-destroying projects – a positive relationship between the rate of value creation and growth can act as an indicator of strong capital budgeting discipline within the firm.

Secondly, the research looks at the impact that the recent changes in South African mining legislation may have on the long-term potential of the industry to create value: does the legislation create an environment in which firms have more opportunities to create value; in which wealth is conserved but redistributed; or in which value is destroyed in the process of redistribution?

In this study, value creation is defined in terms of economic profit – i.e., profit after charging the economic cost of all capital invested in the business. Shareholders may only recognise this value if it is reflected in the market value of the company so, in addition to analysing and comparing the performance of companies in terms of their economic value, the relationship of economic to market value is also examined.

In general terms, then, the hypotheses being tested are that:-

1) the market value of platinum mining companies will exceed their invested capital to the extent of their ability to generate economic profits;

2) growth does not drive value creation – growth merely provides an opportunity to create value.

3) platinum mining companies require strong capital budgeting discipline to maintain their economic profitability during growth;

4) the Mining Charter will increase South Africa's national wealth;

5) implementation of the Minerals & Petroleum Resources Development Act (MRPDA) will reduce the market value of unused old order mineral rights;

6) the MRPDA will bring about the optimal development of South Africa's platinum resources;

7) a proposed royalty on PGM production is preferable to any alternatives.

1.4 Importance of the Study

This study will investigate the link between growth and value creation in the platinum mining industry, a sector of increasing importance within South Africa's economy that has been largely ignored by previous researchers. Companies that measure growth in terms of accounting profits risk incentivising management to make poor capital budgeting decisions in the belief that growth through investment will somehow 'automatically' create value. Rather, mining firms must recognise that the capital employed in the business has a cost as real as the wages paid to staff. Only by taking into account this cost when making business decisions will companies succeed in creating and sustaining the growth in value they seek for their shareholders.

The South African platinum industry is being asked to expand to meet growing demand, to restructure to meet the requirements of the Mining Charter, and to

accommodate in its strategic plans the impact of the Minerals and Petroleum Resources Development Act. At the same time, it must deal with the current strength of the Rand against the US dollar and must defend its revenues against the imposition of a royalty that will damage the economic viability of their operations. In this environment, it is vital that the drivers of value creation be more widely understood to ensure not only that shareholders can be properly rewarded for the capital invested, but also that mining of South Africa's mineral resources takes place in a manner that is both optimal and sustainable.

1.5 Scope of the Research

In this study, it is anticipated that the macro-economic factors that characterise the platinum industry – notably the volatility of PGM prices – and the diversifiable risks associated with geology, mining and mineral processing, etc., will be common to most of the firms in the industry. By virtue of their commonality, such factors can largely be eliminated and it should thus be possible to show differences in the performance of rival firms. For example, it seems reasonable to assume that, leaving aside the effects of gearing, firms in the same industry should have a similar cost of equity – i.e. the unlevered beta of their stocks will be common to all.

All eight major South African producers are included in the study, regardless of their being locally- or foreign-owned. Of these, however, the published financials for two (Messina and Mvelaphanda Resources) proved to be of limited use in the study (see 'Limitations', section 1.6 below). Useful data was obtained for a period of seven years in the case of Aquarius and nine years or more for the others (i.e., Anglo Platinum, Barplats, Impala, Lonmin, and Northam). In addition, both Stillwater and North American Palladium (NAP) were included in the study to

provide a comparison between local and offshore operations; at least nine years financial data was available for each of these.

An examination of the published results for Norilsk showed that although the company has recently made progress towards more adequate disclosure, its reports are constrained by Russian law. It was therefore decided to exclude Norilsk from the study.

In the survey of opinion about the impact of recent changes to South African legislation, the scope included three groups of respondents: established producers, emergent and BEE-controlled companies, and industry analysts, representing the investors. The industry representatives are for the most part South Africa-based, but analysts from both local and international firms were invited to participate.

1.6 Limitations of the Research

For the economic analysis, the depth of research was limited to information in the public domain. This necessarily restricted the degree to which the drivers of value could be examined, and this is therefore an area in which further research could usefully be carried out.

For Mvelaphanda Resources, the data available proved to be of limited interest due to the nature of the company's operating structure. The investment in platinum mining is accounted for on an equity basis, and little can be gleaned from the accounts that is not already evident from those of the underlying operating company: Mvelaphanda's reporting thus tells us little about capital budgeting that we do not already know from Northam's accounts.

1.7 Structure of the study

Chapter 1 has given the background to the study and an overview of the theory as presented in the literature. A statement of the research methodology has also been given.

Chapter 2 will discuss the theory in more detail, and Chapter 3 will provide a rationale for the choice of research methodology.

The results of the research are presented in Chapter 4, and are discussed in Chapter 5. The study concludes with Chapter 6, in which recommendations are made for application of the findings of this research and also for further research.

Chapter 2: Literature review

2.1 The Importance of Value

2.1.1 Shareholder Value

The unifying objective function of a firm is the maximising of shareholder wealth (Damodaran, 1997). This assertion recognises that shareholders have only a residual claim on the firm, subordinate to all other claims. Thus, to create wealth for shareholders, the firm must satisfy all of its stakeholders (customers, suppliers, employees, lenders, government, etc.). This is not to say that shareholders should be passive observers – recent history in South Africa's mining industry suggests that on the contrary, shareholders and their representatives (i.e., company management) need to proactively engage with government and other stakeholders to map out the future of the industry. The disastrous drop in market valuation of listed mining houses in 2002 followed the 'leak' of a draft Mining Charter. The leak may have been made out of frustration at the pace of change, but all parties could see that such an outcome benefited no-one. The consensual document that emerged four months later was widely recognised as a major advance (Mackay, 2002) and companies are busy making sure that its requirements are met, notwithstanding that the Charter has no legislated basis.

Economic profit (which is synonymous with the trademarked term "EVA" coined by Stern Stewart Company) seeks to measure the "economic" rather than "accounting" profit generated by a firm, in order to get a better measure of the value being created or destroyed for its shareholders. This is achieved through a

process of reconstructing and adjusting the published accounts of a company (Copeland et al.,, 2000).

Firstly, net operating profit less adjusted taxes (NOPLAT) is calculated to show the operating profit the company would have made had it been entirely funded by equity. Then, the invested capital (IC) is arrived at by removing from total assets any non-operating assets, investments, excess cash and securities, etc. Next, the weighted average cost of capital (WACC) is calculated for the firm, and applied to the invested capital to determine the appropriate capital charge. Finally, this capital charge is deducted from NOPLAT to find the residual, economic profit:

$$\text{Economic Profit} = \text{NOPLAT} - \{\text{Invested Capital} \times \text{WACC}\}$$

Economic profit thus takes into account not only the operational efficiency of the firm (i.e., its ability to operate profitably) but also the financial resources (capital) which it employs in doing so. By encompassing the cost of capital, the concept of economic profit lends itself perfectly to the study of value creation and of capital budgeting within the platinum industry. It enables the use of data extracted from published accounts in an analysis of the returns generated on new (i.e. incremental) capital invested, and the comparison of those returns with the cost of capital. Further, the drivers of value may be analysed to identify those elements of a company's operations which provide it with a competitive advantage, and also where it perhaps falls short of its peers.

Using terminology analogous to their EVA, Stern Stewart Company also developed the concept of Market Value Added (MVA). This measures the amount by which the aggregate market value of a firm's debt and equity exceeds the

amount invested. In the Stern Stewart measure, numerous adjustments are made to the figures presented in the accounts of a company in order to arrive at a current cost (rather than the traditional, historical cost) for the invested capital. By comparing the market value of the firm to the capital invested, MVA measures the value the company has added for its shareholders. Share prices generally reflect expectations of future cash flows, so MVA is regarded as a forward-looking measure of value, in contrast to EVA's backward-looking perspective.

It is beyond the scope of this research to formally calculate MVA for the platinum industry, but the market capitalisation of the firms' equity will be compared to the invested capital in order to assess the extent to which, in the eyes of the market, platinum producers have succeeded in creating value.

2.1.2 Growth and Value creation

The rate of growth is a strategic choice that firms must make. A sustainable growth rate (SGR) can be funded from retained earnings alone, but corporate strategies may call for a period of unsustainable growth, utilising external sources of finance. In either case, capital budgeting is crucial to the creation of value from that growth: only if the return on invested capital (ROIC) exceeds the opportunity cost of capital will growth create value. Conversely, increasing the rate of growth while ROIC is below the cost of capital simply destroys value, faster (Kaiser, 2003).

Often, companies speak of growth as if it is inevitable that such growth will create value. Rather, though, it should be seen that growth merely provides an opportunity to add value, provided that opportunity offers a return above its cost of capital. In this study, this relationship between growth and value creation will

be demonstrated using the results of an analysis of the performance of platinum producers over a period of up to ten years.

2.1.3 The Role of Capital Budgeting

Capital budgeting is a discipline which firms must exhibit to ensure that their projects deliver an adequate rate of return – i.e., one that exceeds the opportunity cost of capital for that project (Seitz et al., 1999).

Whether the aim is a valuation of the firm or of an investment opportunity, a number of methods are available to management. These can be broken down into two broad categories – accounting and economic measures. Each comprises techniques that are more or less appropriate, depending on the subject and purpose of the valuation. The following sections describe these methods in detail, and seek to identify which can best be applied for the purposes of this study.

2.2 Accounting Measures of Value

2.2.1 Profit and Earnings per share

As noted above, accounting profit takes into account the ability of a company to conduct its current operations effectively. However, it gives an incomplete picture since costs include only the (after-tax) cost of debt and not the whole cost of the invested capital: accounting profit is therefore subject not only to the operations of the firm but also to its capital structure.

Secondly, most interest payments are an allowable expense for the purpose of calculating taxable profits, so a tax-shield is provided by debt and, *ceteris paribus*, a company funded mostly by debt may appear more profitable than one funded by equity, despite the underlying economic profits being the same.

Finally, as a reliable measure of value creation, profit is seen as deficient since it is subject to the sometimes arbitrary and mutable accounting policies of the company. Accounting treatment of inventory and stock valuation, amortisation and depreciation rates, are all subject to manipulation. Recent well-publicised examples at ENRON and Tyco have involved the exploitation of less than prudent policies around revenue recognition to artificially inflate the sales of firms desperately seeking to demonstrate a sustained growth in earnings. (Schifferes, 2003; Taub, 2003)

Because of these problems, in this study accounting profit and earnings multiples were rejected as measures of value.

2.2.2 Dividend yield and discounted dividend yield

As stated at the beginning of this section, the ownership of equity represents a residual claim on the assets of a company. The market value of a firm's equity is therefore linked to the cash flows the shareholder may reasonably expect to receive. This argument has been used to justify the inclusion of dividend yield (DY) as a metric for company valuation.

There are two problems with this. Firstly, the dividend stream accruing to shareholders represents only part of the value of their claim. In the 1990's, it became conventional for rapidly growing firms not to declare dividends at all, arguing that they needed the cash to fund further growth, and that in any case their shareholders did not want to receive dividends – they preferred to participate in the growth of their capital through the rising value of their shares. The dividend yield of these companies was zero, yet they were clearly valuable.

Secondly, a flat dividend yield on a share price that is growing only at the rate of return expected by the market is not adding any economic value, in the same way as company profits that only cover the cost of capital are also value neutral. Since the dividend yield tells us nothing about the firm's cost of capital, it can tell us little about whether the firm is creating value.

Discounted dividend yield brings to dividend yield the concept of a cost of capital, and thus addresses the second problem. For this reason, it is an improvement on the undiscounted DY. The first problem remains, however, being that the dividend stream represents only part of the equity value to shareholders.

This study therefore rejects the use of dividend yield and discounted DY as measures of value.

2.2.3 Return on Equity (RoE)

In much the same way that accounting profit ignores the cost of equity, the measurement of return on equity is profoundly influenced by the capital structure of the business and therefore confuses the measurement of a firm's performance with how that business is funded. Measurement of value through RoE provides management with an incentive to take on debt in the business in order to grow, leveraging the shareholders equity and improving the RoE but at the same time making that return more risky. Strictly, this higher risk should be added to the cost of equity (through a higher re-levered beta) and the attractiveness of this strategy then reduces. Management, however, has no incentive to point this out to shareholders.

Because of the above problems, RoE is also rejected as a measure of value for the purpose of this study.

2.2.4 Return on Capital Employed (ROCE)

One of the problems identified with the RoE measure is that it does not take into consideration all the capital invested in the business. ROCE does seek to address this problem and for that reason is a more reliable indicator than RoE.

Nevertheless, other problems inherent to RoE remain – namely the sensitivity to capital structure and the fact that no account is taken of the cost of the capital employed.

Finally, ROCE is distorted by the inclusion of non-operating assets such as surplus cash and investments on which the shareholders should not expect to earn more that a market rate of return, and so ROCE is also rejected as a measure of value for the current study.

2.2.5 Accounting measures for project valuation

Accounting valuation methods that are used in the valuation of investment opportunities include the average accounting return (AAR), payback period (PP), and discounted payback period (DPP). Because they do not consider the time value of money, AAR and PP methods give unreliable results over the time-scale inherent to most mining projects, and these methods are less widely used now that personal computers and spreadsheets make possible the use of more reliable methods. DPP incorporates the time value of money, but fails to consider all the cash flows (i.e., it excludes those occurring after the discounted payback period) and each of these is therefore rejected for the purposes of capital budgeting for value creation.

Projects can also be valued by comparison to similar projects which have a measurable market valuation (McKnight, [s.a.]). The difficulty with comparisons,

though, is that each mineral deposit is geologically unique. Capital and operating costs will differ, as will the grade and mix of metals available for extraction from the ore. In practice, then, comparative project valuations can rarely be applied objectively, other than to test for the reasonableness of an alternative estimate.

2.3 Economic Measures of Value

A common criticism of each of the accounting measures of value is their lack of consideration for the whole value of the firm, or for the opportunity cost of capital invested. This shortcoming is addressed by the economic measurements, typically either through a capital charge or through the use of a discount rate.

2.3.1 Market Value Added

Market value added (MVA) qualifies as an economic measure since it seeks to remove the distortions of historical cost accounting in order to compare the current value of capital invested in a business with its present market value. MVA is a term coined by Stern Stewart Company that is analogous to their EVA measure: EVA measures the economic profit (or value) added to invested capital, while MVA measures the market value added to that capital. The two measures are complimentary in that whereas EVA measures past operating performance, MVA is a measure of how the market expects that performance to translate into future value creation.

As a measure of management performance, then, MVA can be regarded as a useful indicator of how well a company is managing shareholder expectations while EVA measures how well it is delivering value.

In this study, therefore, the point of departure for the analysis of economic profits is a comparison of these profits with market capitalisation of the firms,

testing whether in the platinum industry a relationship between the two exists as suggested by the literature. Market capitalisation also impacts on the weighted average cost of capital (WACC), through the capital asset pricing model (CAPM), in which a risk-adjusted rate is applied to the market value of a company's shares to find the cost of equity.

2.3.2 Economic Profit

The measurement of economic profit involves analysing a firm's operating results in such a way as to remove any distortions created by the capital structure of the firm. This measurement facilitates the comparison of operational performance across the platinum industry. By focusing on the drivers of intrinsic value within the firm – net operating profit less adjusted taxes (NOPLAT) and return on invested capital (ROIC) – their relative importance for value creation can be established and their relationship to the rate of growth can be determined.

One advantage of the economic profit concept is the simplicity and transparency of the calculations, facilitating adoption of the concept throughout a company. The method is equally applicable to decision-making processes both in operations and in capital budgeting. Indeed, Stern Stewart Company advocates its adoption as the sole measure of management performance throughout an organisation, when it may be linked to incentive schemes and personal performance management (Stewart, 2002).

Starting with a typical set of accounts, estimates of NOPLAT and Invested Capital (IC) are derived. The economic profit can then be calculated by either of two routes:-

(i) Economic Profit= NOPLAT –{IC x WACC}

or (ii) ROIC = NOPLAT / IC

and then Economic Profit = IC x{ ROIC – WACC}

In either case, an estimate of WACC is required. This will not be available from inspection of the published accounts and must be derived separately. Option (ii) requires that ROIC be calculated, which offers the advantage that ROIC may then be compared directly to WACC, the difference between these being the 'spread' (Aggarwal, 2001). Whichever route is adopted, the resulting values should be identical, so neither should be seen as inherently better than the other. Often, both are calculated as this offers a check on the internal consistency of the calculations.

The following sections describe the derivation of the components of the formula.

2.3.2.1 NOPLAT

Copeland, et al. (2000) describe the calculation of NOPLAT. Briefly, the adjustments to be made, starting with EBITA (earnings before interest, tax and amortisation of goodwill) are the:-

1) removal of any income derived from non-operating activities;
2) adding back of any interest charges on debt;
3) adding back of provisions;
4) adding back of any increase in deferred tax;
5) adjustment to the tax charge, removing any benefit of tax shields from debt;
6) subtraction of adjusted tax from adjusted EBITA to find NOPLAT.

Where necessary, these adjustments can be further refined on a company-specific basis in order to take account of each firm's accounting idiosyncrasies, the objective being to arrive at a measure for what the operating profit after tax would have been had the company been entirely financed by equity.

2.3.2.2 Invested Capital

Invested capital (IC) differs from total capital employed in that it excludes non-operating investments. Invested capital comprises net working capital, net property plant and equipment (PPE), plus other assets net of other liabilities. It excludes any investments, excess cash and non-operating assets.

Invested capital may be quoted before or after goodwill. In the accounts of many mining companies, though, goodwill is usually a minor or negligible component.

2.3.2.3 ROIC, RONIC

As we have seen above, having calculated NOPLAT and the invested capital, ROIC is given simply as the ratio of NOPLAT / IC, expressed as a percentage. However, ROIC is not particularly sensitive to growth – it is designed to measure the effectiveness of current operations. Since an objective of this research is to analyse the effect of growth on economic profit, it is therefore more appropriate to measure the return on new capital invested in the business, i.e., take the incremental change in invested capital and measure the incremental change in NOPLAT that results:

$$\text{RONIC} = \text{Change in NOPLAT} / \text{Change in Invested Capital}$$

This measure, called the Return On New Invested Capital (RONIC) (Kaiser, 2003) or simply *incremental* ROIC (Copeland, 2000), allows us to see more clearly whether new investment is adding or detracting value for the company.

Due to the nature of the platinum industry, with its inherent volatility in metal prices and exchange rates, investment returns can vary significantly from one period to another. Another structural difficulty is that new mining projects cannot be built and brought to account in a single period – often, up to five years is required from start of construction to full production. In this study, therefore, it has been thought appropriate to look at an annualised rate of RONIC over multiple periods, to provide a more stable and reliable measure of return.

RONIC is measured as incremental NOPLAT divided by the increment in invested capital:-

$$RONIC = \{NOPLAT_{(t+n)} - NOPLAT_{(t)}\} / \{IC_{(t+n)} - IC_{(t)}\}$$

The following example illustrates the method applied in this study to find the weighted average rate over (n=4) periods:-

	Yr0	Yr1	Yr2	Yr3	Yr4
NOPLAT	100	120	150	180	250
IC	800	1200	1250	1400	1500
ROIC	12.5%	10.0%	12.0%	12.9%	16.7%
	Yr0-1	**Yr1-2**	**Yr2-3**	**Yr3-4**	**Yr0-4**
Incr.NOPLAT	20	30	30	70	150
Incr.IC	400	50	150	100	700
RONIC	5.0%	60.0%	20.0%	70.0%	**21.4%**

In the example, NOPLAT increases by (250 – 100 =) 150 units over four years, while Invested Capital increases by (1500 – 800 =) 700 units. The weighted average return over the four years is then simply (150 / 700 =) 21.4%.

2.3.2.4 Weighted Average Cost of Capital

Weighted Average Cost of Capital (WACC) is typically determined by use of the capital asset pricing model (CAPM), which relates the opportunity cost of capital to the systematic, non-diversifiable risk of that business, taking into account the capital structure of the firm, i.e. its targeted ratio of debt to equity (Copeland, et al., 2000).

Inputs to the CAPM are the risk-free interest rate (R_f), the market risk premium (R_p) and the covariance between the shares and the market, beta (β).

The cost of equity is then:-

$$R_e = R_f + \beta (R_p)$$

Given the pre-tax cost of debt (R_b) and the effective tax rate (t), and using the market values of debt and equity, we can calculate WACC as:-

$$WACC = (\{Debt \times R_b\}\{1-t\} + \{Equity \times R_e\}) / (Debt + Equity)$$

Copeland, et al. (2000) emphasise that within industries the beta of individual firms seems to vary randomly and that, unless there is specific information to the contrary, using the industry beta should give more reliable results.

Accordingly, although separate estimates of beta were available for many of the selected firms, in this study a single value (1.0713) was used across the industry. This value was generated from the database of McGregor BFA in Johannesburg, using ten years of data, a period comparable to that used in the economic analysis.

The estimate of market risk premium is based on the averages presented in Copeland, et al. (2000) wherein the arithmetic mean market risk premium (1926-1998) is 7.5% and the geometric mean over this period is 5.9%. It is argued that DCF forecasts should rather use the arithmetic mean in computing a discount rate, but then the figure is somewhat arbitrarily reduced by 1.5% to provide for a 'survivorship bias' in the mean. In this study, however, the data relates to historical rather than forecast results, and a figure of 6.0% was therefore chosen, since this lies very close to the long-term geometric mean risk premium. This value of the market risk premium was applied consistently across all the companies included in the study.

2.3.3 Discounted cash flow

Discounted cash flow methods, in which projected cash flows are discounted back to their present value, have become near-ubiquitous since the introduction of personal computers and simple spreadsheet programmes. In principle, the method can evaluate any cash flow provided the opportunity cost of capital (WACC) is known so that the appropriate discount rate can be applied. An often-overlooked assumption implicit to all DCF methods is that an investment with similar risk to that being evaluated exists in the market and that its cost of capital is known. The internal rate of return (IRR) and/or net present value (NPV) of the expected cash flows can then be computed. Then, given a positive NPV for a project, a decision to invest can be regarded as value-adding for the company.

One limitation of the DCF valuation method is its inherent assumption that there is little or no management flexibility available after the investment decision is made. By failing to recognise such flexibility, traditional DCF valuation methods systematically undervalue such opportunities (Brennan & Schwartz, 1985).

Other difficulties recognised with DCF analysis include uncertainty in determining the most appropriate discount rate, given that risk is resolved unevenly over the life of a project (Trigeorgis, 1999). By using prices and risk-free interest rates observable in the market, real options valuation (ROV) addresses many of these concerns.

In practice, mining companies often apply the DCF method in a manner that is inconsistent with economic theory. Such inconsistencies include applying a standard discount rate to all projects, regardless of project-specific risk. This policy is only acceptable when the projects being evaluated are technically similar in scope, but as we have seen in section 2.2.5, this is seldom the case. Similarly, by applying the same discount rate (WACC) uniformly over time, firms implicitly assume that their capital structure will remain constant over the life of the project.

The economic theory behind the DCF method is sound, and it is therefore unsurprising that DCF has become widely accepted as the standard for evaluation of companies, investment opportunities, and projects alike – truly a workhorse for the mining industry.

In the process of capital budgeting, the use of DCF techniques is invaluable to management in deciding whether or not to accept projects, and in choosing between projects that have different expected cash flows.

2.3.4 Adjusted Present Value

It is possible to correct for the capital-structure problem using the Adjusted Present Value (APV) technique. In APV, the tax shield provided by debt is discounted separately from the project cash flow. The two NPVs are then

combined to find the project value. The methodology provides a useful addition to the standard DCF toolkit, and finds application in this study when, in order to carry out a real options valuation, it is required to find the NPV of a project's after-tax cash flow separately from the NPV of the capital investment required for its construction.

2.3.5 Benefit-cost ratio, or Profitability Index

The benefit-cost ratio (BCR), otherwise called profitability index (PI) (Ross, et al., 2002) becomes useful when companies, constrained by capital rationing, must decide between mutually exclusive projects. BCR relies on DCF analysis to provide an NPV for each project. When capital is freely available to the firm, ranking projects on the basis of IRR, NPV and PI methods will all give similar results, though NPV is preferred since it captures the scale of the project, which IRR and BCR do not. When capital is rationed, however, BCR is the preferred means to identify the suite of projects which will give the greatest 'bang for the buck' (Higgins, 2001).

It can be shown that for cash flow projections, a DCF valuation provides the theoretical equivalent of a forward-looking economic profit analysis (Copeland, et al., 2000). Other than to provide an input to the real options valuation exercise (section 4.5.3) the DCF method and its variants are not applied in this study as its focus is on the analysis of historical performance.

2.3.6 Continuing Value

A natural extension to DCF valuation is the notion of *continuing value*. When compiling a DCF valuation, the NPV of a specific forecast period (typically anything between three and ten years) can be prepared, but taken in isolation

this will systematically under-value the enterprise if it fails to take into account cash flows beyond the forecast period.

To quantify this continuing value, it is assumed that the initial forecast period will be followed by a perpetual series of cash flows arising from ongoing operations. There may also be an assumption of steady but unspectacular growth, during which the company will continue to add value by investing in projects that have returns (RONIC) above the opportunity cost of capital, or WACC. Thus, given an assumption that RONIC > WACC, the formula for continuing value given by Copeland, et al. (2000) is as follows:-

$$\text{Continuing Value} = \{NOPLAT_{(T+1)}(1-g/RONIC)\} / \{WACC-g\}$$

where 'g' is the rate of growth in NOPLAT and $NOPLAT_{(T+1)}$ is the NOPLAT for the year following that in which the specific forecast ends. If RONIC = WACC, then it can be shown that the formula simplifies to:

$$\text{Continuing Value} = NOPLAT_{(T+1)} / WACC$$

In other words, if new projects give a return only equal to WACC, or if growth were zero, then no further value would be added – the NPV of these projects would be zero. The absence of 'g' from the formula shows that enterprise value is independent of the rate of growth when that growth does not in itself add value.

In most cases, unless the discount rate (i.e., WACC) being applied to the cash flows is unusually large, the value of the DCF from the initial forecast period will be small when compared to the continuing value. This can be shown in a simple, no-growth example:-

Assume that a company has a free cash flow this year of R1 000. During a five-year forecast period, the company expects free cash flow to grow at 12% per year. Thereafter, RONIC is expected to equal WACC, which in this example is 10% p.a. So, although in nominal terms free cash flows will continue to increase after Year 5, in real terms there will be no growth in the value of the cash flows.

		Specific forecast period					Continuing value period -->		
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	etc
FCF	1 000	1 120	1 254	1 405	1 574	1 762	1 939		
CV							19 386		
DCF		1 018	1 037	1 056	1 075	1 094	10 943		
NPV (1-5)	5 279								
PV(CV)	10 943								
Tot.Value	16 222								

In this example, the NPV of the free cash flow in years 1 to 5 is R5 279. But the present value of the continuing value period is R10 493, or over twice the value accruing from years 1 to 5, giving a total enterprise value of R16 222.

2.4 Economic Analysis of Competitiveness: the ROIC tree

The measurement of return on invested capital (ROIC) goes to the heart of the argument for strong discipline in capital budgeting. If projects do not provide a return above their opportunity cost of capital, then they will destroy value in the firm. Through an analysis of the drivers of value, differences in the performance of firms in an industry will emerge. Having identified these differences, the reasons for their existence may be sought through the use of ROIC tree analysis.

The ROIC tree is similar in concept to the Du Pont cascade, in that a single ratio is broken into its component parts in a hierarchical analysis in order to determine the fundamental cause of any anomaly. However, an important difference between the methodologies is that Du Pont focuses on the return on equity

through earnings ratios, while the ROIC tree deals with economic profit, i.e., the return to ALL providers of capital to the business.

As the name suggests, the ROIC tree (as described by Copeland, et al., 2000) starts with the measure of return on invested capital:-

ROIC = NOPLAT / Invested Capital

However, NOPLAT is the after-tax equivalent of EBITA, so the equation can be rewritten to isolate the adjustment for taxes:-

ROIC = (EBITA / Invested Capital) x (1 – cash tax rate)

Multiplying top and bottom by Revenue, we can further split the right-hand-side into two components:-

EBITA/Invested Capital = (EBITA/Revenue) x (Revenue/Invested Capital)

The first ratio is the operating margin; the second is the capital turnover. This completes the first step in the ROIC tree analysis. Each branch is then expanded until a level of detail is reached that enables the differences in performance of competing firms to be isolated.

2.4.1 Operating Margin (EBITA/Revenue)

An analysis of operating margins can be broken down into ratios of the cost of goods sold {COGS/Revenue}; {Overheads/Revenues}; and {Depreciation & Amortisation/Revenues}. Using only public-domain information, this is often the limit of effective analysis, since any further detail is likely to be subject to inconsistencies in disclosure levels and in underlying accounting policies. For example, Anglo Platinum discloses their on-mine (mining and concentrator) costs

separately from off-mine (smelting and refining) costs, whereas Impala includes smelting with concentrating, but lists refining separately.

For the purposes of this study, therefore, the ROIC tree analysis of operating margin has been limited to the second level of disaggregation.

2.4.2 Capital Turnover

If operating margin "…measures how effectively the company converts revenues into profits", then capital turnover "measures how effectively the company employs its invested capital" (Copeland, et al., 2000).

Capital turnover can be related to the rate of economic profit generation, expressed as economic profit per unit of revenue:-

$$\text{Economic Profit} = \text{IC} \times \{\text{ROIC} - \text{WACC}\}$$

$$\text{Economic Profit / Revenue} = \text{IC} \times \{\text{spread}\} / \text{Revenue}$$

but Revenue / IC = Capital turnover, so

$$\frac{Economic\ \text{Pr}\ ofit}{\text{Re}\ venue} = \frac{Spread}{Capital\ Turnover}$$

Each element of capital (working capital; net property, plant & equipment; and other assets) can then be analysed in a similar manner to the operating margin components described above.

2.5 Valuing Opportunities & Management Flexibility

DCF methods of evaluating a company's free cash flow have been described above. Such methods are equally applicable to the valuation of projects or other investment opportunities, and are widely used for capital budgeting decisions in the mining industry.

In order to carry out a DCF analysis, it is necessary to make a set of assumptions about the expected prices, costs and rates of exchange which will prevail over the project life. Implicit in the model is the assumption that, once built, the mine will carry on producing at a predetermined rate until it exhausts its mineral resources. No account is taken of the possibility of temporary closure during periods of low prices, or of expansion to take advantage of higher demand (and prices). It is therefore argued that NPV estimates systematically undervalue projects.

2.5.1 Monte Carlo Simulation

While discussing DCF methods of valuation, it was noted that a single set of assumptions is made in order to arrive at a value for the NPV or IRR. To enable a wider range of possible outcomes to be evaluated, a technique known as Monte Carlo simulation has been developed in which each of the main drivers of value is ascribed a range of values, onto which a probability distribution is imposed. A random number generator then drives a large number of trials in which the variables (value drivers) are allocated values in accordance with their respective probability curves. The result is a set of NPV statistics for the project, distributed around the 'base case' value and, supposedly, demonstrating the range of likely outcomes for the project.

One major difficulty identified with Monte Carlo simulation lies in the interpretation of the results. Each of the trials, with value drivers being allocated different values, describes an outcome that has a unique risk attached to it. Yet, the simulation discounts each of these cash flows at the same rate – making the results difficult if not impossible to interpret logically. In practice, Monte Carlo simulations are most often used to conduct sensitivity studies rather than to

generate definitive valuations. Recently, though, advanced applications have been described that combine Monte Carlo simulation with Real Options Valuation (Trigeorgis, 1999).

This study focuses on actual performance measurement, and so application of Monte Carlo simulation was not appropriate.

2.5.2 Decision Tree analysis

The value of management flexibility (for instance, the possibility of expanding or temporarily closing a mine) can be accounted for using decision tree analysis. This method has the advantage of being readily understandable, and can be applied to situations where an immediate and clear choice exists between two or more options.

For example, a mining company, having completed a preliminary phase of exploration, must decide whether to continue with more detailed exploration of a PGM deposit, or to abandon the area (see Figure 5). Branching from the left hand side of the diagram, the available choices are set out. Abandonment has no further cost (the exploration to date being a sunk cost), whereas continuing will cost a further R5 million. Following the top branch of the decision tree, the company geologists have put the probability of success from this drilling at 50% - there is an equal (50%) chance of having to abandon following this second phase of drilling, for a loss of the R5 million.

Assuming success to this point, the company will then need to spend a further R25 million on a feasibility study, which the consulting engineers would expect to have a 75% chance of demonstrating the potential for a viable mine. Building the

mine will cost R200 million, with a 95% probability of the mine being technically successful, and just a 5% chance of a fatal flaw being present.

By experiment, the decision tree shows that the NPV of the mine, once built, must generate cash flows with a Net Present Value of R270 million to provide the incentive for carrying on with the exploration programme. Knowing this, the required size and grade of the resource can be estimated, and the chances of exploration success re-appraised before deciding on whether to continue drilling or not.

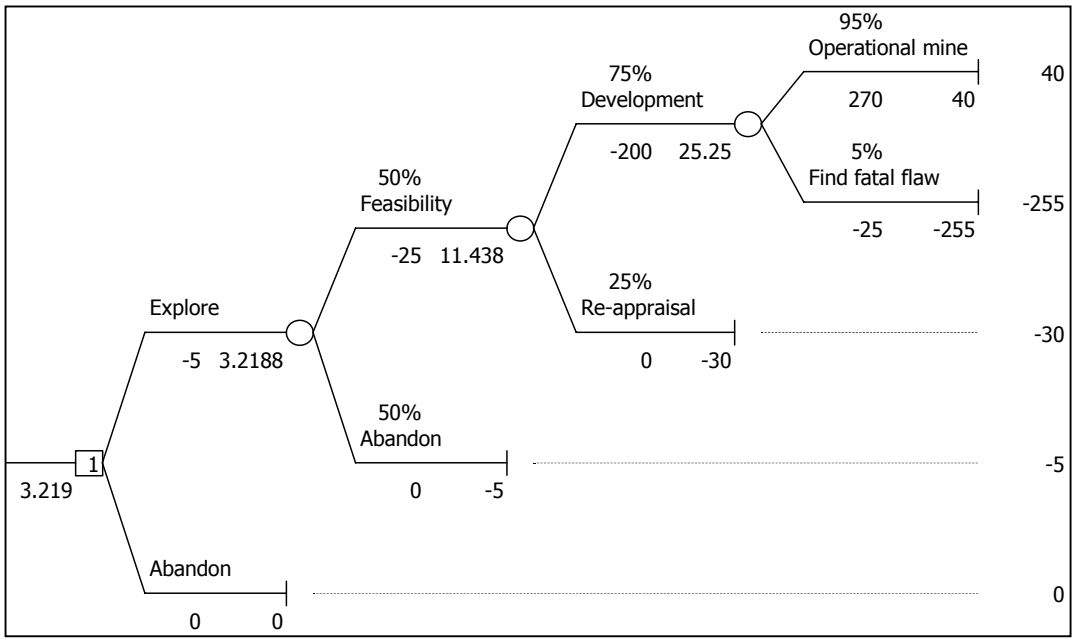


Figure 5 Example of a Decision Tree used to evaluate an exploration target

Many investment decisions can be made in such a manner, but it should be noted that the method does not dispense with the need to construct a DCF model of the proposed mine.

Decision trees can therefore be seen as an enhancement to a basic DCF analysis, rather than as a replacement. As such, they represent a valuable capital-budgeting tool, but find no application in this analysis of economic profit.

2.5.3 Binomial models

As seen above, in decision tree analysis, the NPV of a successful project must be estimated for use as an input to the decision tree. However, this in itself is problematic since it is dependant on many unknowns of which the most obvious is the selling price of the metal produced by the mine at some future date.

Binomial methods of analysis seek to overcome this by applying probabilities to the movement of a metal price at a constant time interval from a given starting point. These probabilities depend on the current (spot) price, volatility of the price and whether there is a 'average' towards which the price will tend to revert over the long-term (Samis, 2002). Using this relationship between time and the probability of any given metal price occurring at that time, the expected value can be arrived at and used in the calculation of a project NPV.

Unfortunately, the method has not been widely adopted, probably due to the 'black box' nature of the calculations. Furthermore, in the PGM industry there are seven or more metals to account for in the typical ore reserve, making the method (or at least the results) seem even less reliable notwithstanding the elegance of the underlying mathematics.

2.5.4 Real Options Valuation

2.5.4.1 Black-Scholes pricing of derivatives

Black and Scholes (1973), working on the pricing of financial options, showed how it was possible to calculate the value of a risk-free portfolio of shares and debt that exactly matched the returns to be had from an option over the share, whatever the price of the share at the time the option was exercised. They were

then able to prove that the value of the option was independent of the perceived risk in the share, and that in fact only five variables need be taken into account:-

(i) the current share price (spot price)

(ii) the exercise (strike) price

(iii) the volatility of the share price

(iv) the length of the option period

(v) the prevailing risk-free interest rate

To demonstrate the effect of the length of the option period on the value of a call option, the following example is offered. Suppose a share has a current price of 1000 cents, a volatility of 20%, and the prevailing risk-free rate is 10% p.a.

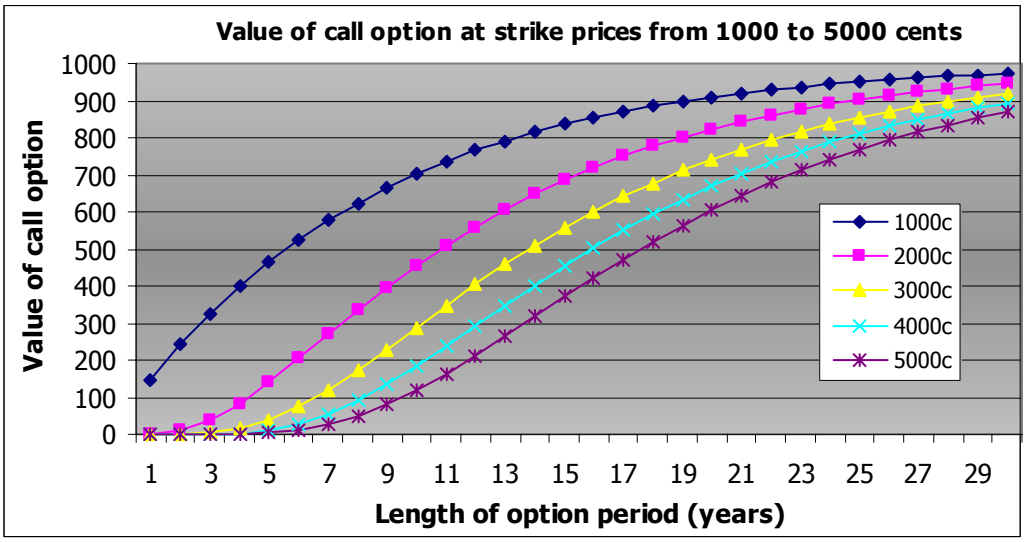


Figure 6 Option value sensitivity to strike price and length of option period

The chart shown in Figure 6 provides a valuation of options from 1 to 30 years in length, given five different exercise prices. It will be seen that when the exercise price is close to the spot price, the option quickly rises in value. However, when the exercise price is far above the spot price (i.e. the option is "out of the money") the value of a short-period option is very small. Note, however, that as

the option period lengthens, the difference in value of the option narrows, as each option value asymptotically approaches the spot price of the share.

2.5.4.2 Real Options

Real options valuations are seen as an alternative to a standard DCF-type analysis where the value of management flexibility is important. Real options exist in many instances within the mining industry; for example, the opportunity to wait before committing to development of a mine, or temporarily to shut a mine that is making a loss due to low commodity prices.

The application of the Black-Scholes method has been proposed for the valuation of "real options" in natural resource investments (Brennan & Schwartz, 1985) and although the mining industry has been slow to adopt the methodology, it is slowly gaining a wider acceptance.

As shown in the financial option example above, the shorter the period over which an option may be exercised, the lower the value of that option. Note, however, that the value of an option is ALWAYS positive (however small that value may be) even when the NPV of a project to develop the underlying mineral deposit is negative.

If a mineral deposit is "in the money", it has a positive NPV from being immediately developed. However, by failing to recognise the value of an option, companies can unwittingly destroy value even when the project has a positive NPV (McCormack & LeBlanc, 2003). It has been shown that, even when the NPV of a project is positive, it may be better to wait for some time before developing the mine. The more marginal a property is, the greater its (option) value as an undeveloped right compared to its (DCF) value as a working mine.

Thus, a mineral deposit with a negative NPV is not worth zero (and certainly not less than zero!) – its value is represented by the option to build a mine later, at which time it may have a positive NPV. It may be supposed that commercial mining companies will endeavour to develop their most profitable opportunities first and so, by implication, those left undeveloped are intrinsically lower in value. Placing a time limit on the exercise of these undeveloped (and possibly marginal) mineral rights by the application of the "use it or lose it" principal reduces the option value of those rights, and hence their market value should also fall.

A demonstration of this, applied to a typical PGM deposit, has been developed and is presented in Section 4.5.3 of this study.

2.6 Conclusion

From this review of the literature concerning the importance and measurement of value, it is concluded that economic measures are superior to accounting measures of value since the former take into consideration the cost of capital invested in the operations of a firm.

In addition to the accounting and economic profit methods of historical performance analysis, techniques for evaluating cash flow forecasts have been presented, and the benefits of alternatives to standard DCF analysis have been discussed. It is concluded that in situations where the value of management flexibility is high, then DCF analysis alone is insufficient and alternative methods such as decision tree analysis or Real Options valuation may usefully be incorporated into the decision making process.

Chapter 3: Research Methodology

3.1 Introduction

The study of capital budgeting and economic profits and, in particular, the research question posed earlier in this report (see section 1.3) places this work clearly in the ambit of a positivist research philosophy, and therefore demands a deductive approach to the research.

In "Research Methods for Business Students" (Saunders, 2003), Robson (1993) is cited as recognising five steps necessary for deductive research:-

(i) deducing a hypothesis

(ii) expressing the hypothesis in terms of a relationship between two specific variables

(iii) testing this through experiment or empirical enquiry

(iv) examining the outcome of the enquiry

(v) if necessary, modifying the theory in light of the findings

The five steps can be seen as one iteration of an essentially cyclic process by which the theory is refined until it is able to accurately and reliably predict what we may observe in reality.

3.2 Definition of Research Objectives

In the most general terms, the objectives of the research are to test the applicability of the theory as presented in the literature review (Chapter 2) to the platinum industry. This section therefore takes a step-wise approach towards the definition of a set of hypotheses, each of which will then be the subject of experiments or empirical studies to determine if the theory is applicable to the

platinum industry data as presented. The results of these tests are then described in Chapter 4, and the conclusions to be drawn from them are presented in Chapter 5.

Seven hypotheses were stated in general terms in Chapter 1, and must now be re-stated in terms of specific variables that are capable of being tested. The first three deal with the drivers of value creation in the platinum industry, while the second three deal with the impact of recent legislation on that value creation. In general form, the first three hypotheses are:-

1) the market value of platinum mining companies will exceed their invested capital to the extent of their ability to generate economic profits;
2) growth does not drive value creation - it simply provides an opportunity;
3) platinum mining companies require strong capital budgeting discipline to maintain their economic profitability during growth;

Hypotheses 4, 5, 6 and 7 deal with the impact of recent legislation on value creation. Specifically, Hypothesis 4 deals with the impact of the Mining Charter, while Hypotheses 5 and 6 cover issues raised by the Mineral and Petroleum Resources Act, and the proposed royalty on mining production is addressed in Hypothesis 7. In general terms, these are stated as:-

4) overall, the Mining Charter will increase South Africa's national wealth;
5) implementation of the MRPDA will reduce the value of unused "old order" mineral rights;
6) the MRPDA will bring about the optimal development of South Africa's platinum resources;
7) a proposed royalty on PGM production is preferable to any alternative.

3.2.1 Hypothesis 1

In order to re-state the hypothesis in a form that can be tested, it must first be expressed as a relationship between two specific variables. We have seen from the literature reviewed in Chapter 2 that there should be a positive correlation between the value created by a firm through its operations (i.e., the economic profits it generates) and the total market value of that firm expressed through its share price plus the value of any debt.

While we would intuitively expect to find a strong correlation between market capitalisation and some measure of the *size* of a firm, in order to test the first hypothesis it is first necessary to establish whether a relationship exists between market capitalisation and *economic profitability*.

Stern Stewart's MVA measure corresponds to the NPV of future economic profits, which value is dependant not only on the profitability of current operations (NOPLAT) but also on the return the company is expected to generate on new investment (RONIC), together with its opportunity cost of capital (WACC) and its rate of growth (g).

If MVA is positive, then market capitalisation must exceed the invested capital, conversely if it is negative, market capitalisation will be less than the capital invested. So, if we take a ratio of market capitalisation to invested capital, we have a proxy for MVA, one that is independent of the size of the firm, the currency in which it is expressed and the date on which it is measured. It is therefore possible to test whether this ratio is dependent on economic profitability.

In order to obtain a measure of economic profitability that is independent of the size of the firm, its currency, etc., we can use the ratio of economic profits to the revenues from which those profits were generated.

The first hypothesis can therefore be restated in terms of an independent variable (economic profit / revenue) and a dependant variable (market capitalisation / invested capital):-

→ Hypothesis 1: {Market capitalisation / Invested Capital} is positively correlated with {Economic Profit / Revenue}

3.2.2 Hypothesis 2

The second hypothesis suggests that growth *per se* is not a value driver, though clearly it has a role in value creation through its appearance in the continuing value formula:-

$$\text{Continuing Value} = \{NOPLAT_{(T+1)}(1-g/RONIC)\} / \{WACC-g\}$$

If growth were a value driver, then a positive correlation should exist between the rate of growth and value creation. Conversely, if no such relationship exists, then the null hypothesis can be said to be true.

3.2.2.1 Growth measures

Various measures of growth are possible. For the purpose of this study, however, we require a measure that is comparable across all of the companies in the industry, regardless of the macro-economic environment in which they operate.

When the CEO of a mining company speaks of growth, it can mean many different things. Often, it is defined as the volume of production – typically, ounces of platinum. However, this leads to difficulties of comparison, since not all

companies in the industry are primarily platinum producers *per se.* Stillwater and NAP, for example, mine ores that are far richer in palladium than in platinum. Amongst South African producers, ore characteristics differ from mine to mine, and from one company to another. Those mining predominantly from the Merensky reef typically have a higher Pt/Pd ratio and also a higher loading of copper and nickel in the ore compared to a mine exploiting the UG2 chromitite layer. Anglo Platinum operates the Potgeitersrust Platinum Mine, exploiting the Plat-reef which has a mix of metals matching neither the Merensky reef nor the UG2 chromitite reef.

Another difficulty arises when considering the volume of metal produced. Anglo Platinum, Impala and Lonmin each operate their own refineries, while their competitors either sell the concentrate which they produce, or have this concentrate toll-treated by one of the three refinery operators. Thus even if we restrict the discussion to a single metal, an ounce of production declared by company A which produces metal in concentrate is, due to unavoidable losses in the refining process not comparable to the results from operation B which is reporting refined metal sales. Volume of production, then, is an unreliable measure of growth when comparing different companies in the PGM industry.

Other measures of growth that are often discussed – headline earnings, earnings per share, dividend growth, are all considered unreliable due to the factors discussed in section 2.2. They are therefore unsuited to the purpose of measuring growth as an independent variable.

Turnover figures suffer some of the same problems as volume of production, but do eliminate the variability introduced by the mix of metals. The basis of revenue recognition, though, may vary from one company to another (e.g. income from

associates not included in revenue). Moreover, turnover lacks stability due to the marked volatility in PGM prices.

If revenue and earnings figures are unsuited to the purpose, then it is necessary to look at measures of productive capacity represented by the assets of the business.

The use of reported *total assets* is not considered appropriate for analysis purposes as such figures could include items such as non-mining assets or strategic short-term holdings of cash or securities. This might for example introduce a bias against companies which, although generating large amounts of cash, have opted to neither re-invest in current operations nor distribute by means of a dividend. Shareholders should not expect to earn a return above WACC on such funds, so it should have no economic value in the business, neither adding nor destroying value.

Using only net property, plant and equipment (PPE) would exclude net working capital from the analysis. However, as shown by Copeland, et al. (2000) the effect of growth on working capital is a significant factor in determining free cash flow and hence continuing value. We therefore need a measure that will include working capital in the analysis, so that firms which have created value through appropriate controls on current assets such as inventory and trade debtors are not penalised.

For the purpose of this study, *invested capital* has been adopted as the most appropriate measure of the size of a business. Invested capital includes net PPE and working capital, but excludes non-operating assets and excess cash.

Use of the compounded annual rate of growth over a period of several years should provide additional stability to the measure of growth in invested capital. The compound rate is calculated by taking the incremental change in invested capital over the period of the study and finding the annualised rate of growth using the formula:

$$\text{Compound growth (Invested Capital)} = [1 + \{(IC_{(t+n)} - IC_{(t)})/ IC_{(t)}\}]^{1/n} - 1$$

where 't' is the start of the period under review, and 'n' is the length of that period.

3.2.2.2 Value creation

Care must be taken in selecting the measure of value creation since the objective is to determine whether growth is a value *driver* rather than merely the product of undisciplined re-investment in a profitable business regardless of its impact on economic value.

Comparing growth directly against economic profit will only show that those firms that make economic profits are able to fund growth in their invested capital base from their own resources (i.e. without recourse to the capital markets). However, this growth may be economically unproductive if it is used, for example, in allowing inventories and debtors to grow faster than revenues, or if it is invested in productive capacity which ultimately fails to earn its cost of capital.

To overcome this problem, in this study it is proposed that growth be compared with the returns earned on new or incremental capital invested in the business – i.e., RONIC. Only if the new capital invested earns a rate of RONIC in excess of WACC will this growth be contributing to economic profits.

Furthermore, due to factors relating to the nature of the mining industry as described in section 2.3.2.3, RONIC will be measured over multiple periods, and the weighted average rate over this period will be used.

The second hypothesis can therefore be restated in terms of an independent variable (compound annual growth in invested capital) and a dependant variable (RONIC):-

→ Hypothesis 2: {RONIC} is NOT positively correlated with {Compound Annual Growth in Invested Capital}

3.2.3 Hypothesis 3

The third hypothesis states, in general terms, that platinum mining companies require strong capital budgeting discipline to maintain their economic profitability during growth. In this context, economic profitability means the economic profits generated per unit of revenue – this ratio can perhaps better be described as an 'economic profit margin'. It has been shown (section 2.4.2) that this is related to Spread (i.e., ROIC – WACC) and Capital Turnover:-

$$\frac{Economic\ \Pr ofit}{\mathrm{Re}\, venue} = \frac{Spread}{Capital\ Turnover}$$

If firms accept value-destroying projects in order to further their growth ambitions, this will manifest itself in a return on new invested capital (RONIC) lower than their cost of capital (WACC). Thus, simply by comparing RONIC with WACC, we can determine whether companies have maintained their capital budgeting discipline.

To test this hypothesis, we can make use of the multi-period RONIC discussed earlier, as well as a WACC computed using the CAPM. A positive 'spread'

indicates firms with a strong capital budgeting discipline. Conversely, a negative spread indicates value-destruction from new investment.

If capital efficiency is an important value-driver, then we should expect to see the benefits of good capital budgeting reflected in the market value of the firm, which leads to the specific form of the third hypothesis, given below.

→ Hypothesis 3: For platinum producers, the spread {RONIC-WACC} is positively correlated with a ratio of market value to invested capital.

3.2.4 Hypothesis 4

In mid-2002, negotiations were in progress over the form and content of a forthcoming Mining Charter. A document was then leaked to the press, apparently containing the Government's negotiating aims and objectives. The result was an immediate and catastrophic fall of over 30% in the share price of South African mining companies, representing billions of rand in lost value for their shareholders. Subsequently, after Government discounted the position set forth in the leaked document, less than half of that lost share value was recovered.

The objective of this part of the research is to discover to what extent the lasting drop in market value is justified by the changes in underlying economic value as a result of the Mining Charter, the Minerals & Petroleum Resources Development Act and the proposed imposition of a royalty on mineral production. The impression left in the minds of some investors by the mid-2002 debacle is that the Charter has destroyed value. But how widespread is this view amongst influential advisors to institutional investors and in the mining companies

themselves? Through the Mining Charter, has Government achieved value creation, a value-neutral redistribution of wealth, or a destruction of value, perhaps incurred as a price for righting the inequalities of the past? Hypothesis 4 is therefore stated in specific terms as:-

→ Hypothesis 4: the effect of the Mining Charter on aggregate shareholder value in South Africa's platinum industry will be a net gain.

3.2.5 Hypothesis 5

Development of the Mining Charter proceeded hand-in-hand with the re-drafting of legislation governing the ownership and development of South Africa's mineral and petroleum resources. The draft Mineral & Petroleum Resources Development Bill ("MPRDB") (since passed into an Act) was tabled with the stated objective:-

"*To make provision for the equitable access to and sustainable development of the nation's mineral and petroleum resources; and to provide for matters connected therewith.*" (MPRDB, January 2002).

Until the promulgation of the Act, mineral rights were treated as private property that could be bought and sold. Concerns about the impact of the Act centre on the potential loss of tenure of these 'old order' mineral rights, since the right to mine can no longer be regarded as automatically devolving to the owner of the mineral rights. Should the Minister decide that it is in the public interest, the right to mine may be awarded to a third party, with a provision for compensation to the owner. However, the Bill provides for this compensation to be set not at a purely free-market level but:-

> *"In determining just and equitable compensation all relevant factors must be taken into account including…*

…(a) the State's obligation to redress the results of past racial discrimination in the allocation of and access to mineral and petroleum resources;

(b) the State's obligation to bring about reforms to promote equitable access to all South Africa's natural resources" (MPRDB, 2002).

To claim compensation, companies must present and justify a 'free market' valuation of their mineral rights. However, since Government has the obligation to take into account other factors it seems unavoidable that, through this intervention, it has irrevocably altered the market and hence the valuation.

The current research aims to establish to what extent the MPRDB has altered this valuation:

→ Hypothesis 5: the Minerals and Petroleum Resources Development Act has reduced the market value of South Africa's platinum resources.

3.2.6 Hypothesis 6

The Act aims to promote "equitable access" to South Africa's platinum resources. During a period of expansion such as that experienced in recent years, the accelerated development of the nation's platinum resources that such a policy promotes will appear consistent with the concept of sustainability. However, as has been demonstrated earlier, should this expansion involve investment in projects that do not meet their cost of capital, then the sustainability of the strategy is called into question. This leads to the formulation of the sixth hypothesis as:-

→ Hypothesis 6: the Minerals and Petroleum Resources Development Act facilitates the sustainable development of South Africa's platinum resources.

3.2.7 Hypothesis 7

A third Government initiative targeting the mining industry is a proposal to impose a royalty on mineral production. The rate at which the royalty is set depends not on the profitability of the mine but on the nature of the mineral produced. Thus, diamond producers would pay 8% of revenue, while PGM mines would pay 4%, gold 3% and coal producers 2%. The rationale appears to be an attempt to keep the royalty calculation at a rate that is "fair" for each sector of the mining industry, but it ignores the viability of individual companies within each sector.

A vigorous debate has ensued and it is hoped that when the draft legislation is published it will take account of feedback from the industry. The seventh and last hypothesis assumes that the format of the royalty is still open to debate, and is aimed at testing the notion that the current proposal represents 'best practice':-

→ Hypothesis 7: a 4% royalty on PGM production will have less impact on value creation than other means of revenue collection available to the Government.

3.3 Method of Economic Analysis

3.3.1 Sample Selection

The objectives of the research include the identification of common drivers of value for platinum mining companies, and also the measurement of differences in these factors that can explain the performance of these companies in terms of

value created for their shareholders. There are just ten significant producers, however, each of which has characteristics that make them in some way unique. For example, the largest producer (Anglo Platinum) is controlled by a parent corporation (Anglo American plc) that takes an active interest in its management, whereas the second largest producer (Impala) is managed independently of its major shareholder, Gencor. The third-ranking company, Lonmin, has evolved in recent years from a traditional mining house into a focused platinum producer, but still retains significant gold mining investments [NB: at the time of writing, these were the subject of an offer from AngloGold].

So, to ensure a representative cross-section, the sample needs to include as many of these companies as possible. All seven companies in the platinum sector of the JSE Securities Exchange were included, plus one Australian listed company (Aquarius) which has its base of operations in South Africa. Other companies included in the survey are both primarily palladium producers: Stillwater of the USA and North American Palladium (NAP) of Canada.

3.3.2 Data Collection

3.3.2.1 Financial results

The primary source of data for the economic analysis comprises the published financial statements of the companies, covering a period commencing in 1993.

For the companies having a listing on the JSE Securities Exchange, a database of published financial results compiled by McGregor BFA was consulted for results up to and including 2002. In the case of companies with a June year-end, their 2003 figures were then added as they became available.

The non-JSE companies (i.e. Aquarius, Stillwater and North American Palladium) were compiled manually from information held electronically on the respective company's web site or alternatively on the web site of the stock exchange on which the company is listed.

Companies included in the study	Financial Data used
Anglo Platinum	1993 - 2002
Aquarius Platinum	1998 - 2003
Barplats	1993 - 2003
Impala Platinum	1993 - 2003
Lonmin Platinum	1994 - 2002
Messina	1994 - 2002
Mvelaphanda Resources	1994 - 2002
Northam	1994 - 2003
North American Palladium	1994 - 2002
Stillwater Mining	1993 – 2002

Figure 7 Table of Companies & Financial Years included in this study

3.3.2.2 Interest Rates and Exchange rates

Risk-free rates for the South African Rand, for the Canadian and US dollars were obtained by inspection of the databases accessible through the web sites of the South African Reserve Bank, the Bank of Canada, and the US Federal Reserve, respectively.

The South African Reserve Bank was also used as a source of exchange rate information. These rates (published as monthly averages against the Rand) were then used to compute cross-rates for the conversion of Sterling and Australian dollars to US dollars for data conversion (see 3.3.3.1, below).

3.3.3 Data Transformation

Transformation of some data was required to render it useable. The reasons for these changes are set out in this section.

3.3.3.1 Changes in Reporting Currency

Lonmin results up to and including 1998 were reported in Sterling (GBP) but from 1999 onwards their results are in US dollars. All the data was translated into US dollars by converting Balance Sheet figures at the year-end rate of exchange and income statement figures at the average rate of exchange for that period.

Similarly, the results of Aquarius Platinum were originally reported in Australian currency, but since 1999 that company has also reported in US dollars. The translation was carried out in the same way as for Lonmin's figures.

3.3.3.2 Addition of operating detail

The McGregor BFA data provided the 'backbone' upon which much of the financial analysis hangs. However, the database does not record some of the operational detail disclosed in the original company reports. Where available, this detail was added to the model and forms part of the financial analysis.

3.3.3.3 Cost of Capital

In order to calculate a cost of capital for the platinum mining industry, ten years of data held in the McGregor BFA database for the platinum sector were interrogated and a value for beta (β) was computed.

These values were then used in the Capital Asset Pricing Model (CAPM) in order to arrive at a cost of equity. The Weighted Average Cost of Capital was then computed using the average market capitalisation of the company's shares for that period, and the average value of total interest-bearing debt (measured at the start and end of the period). For the purposes of this study, it was assumed that the market value of the debt was the same as its book value.

In this way, a value of WACC was calculated for each company, for each period.

3.3.4 Data Analysis

To analyse the data, a spreadsheet model was built in Microsoft Excel. This model was linked to the database file containing the transformed McGregor BFA data and to data files created for the other three companies.

The model was developed using the principles outlined in Copeland, et al. (2000) and is structured in the following way:-

A summary balance sheet and income statement for each period of the study is set up and populated with data from the database. Using these documents, the adjustments required in terms of the economic profit model are made, in order to calculate invested capital and NOPLAT. Those adjustments have been described earlier in this report and will not be repeated here. To confirm these computations, NOPLAT is reconciled to Net Income, and Invested Capital is calculated firstly from the assets side ("where invested") and secondly from the source ("where from"). In both cases, it is then reconciled to total investor funds. Copeland, et al. (2000) describe the use of two measures of invested capital –

before and after the inclusion of goodwill. In practice, the difference for this data set was found to be negligible, and only the figures including goodwill were needed for the analysis.

WACC is computed for each period, using the industry beta, an appropriate average risk-free rate for that period and the country of operation, the average market capitalisation of the firm's equity and the average debt in each period. Note that for Aquarius, the appropriate risk-free rate was taken to be the South African treasury bill rate, as the company has its base of operations here.

Having calculated NOPLAT and invested capital, the ROIC figure can be found by inspection, and by applying the computed WACC to Invested Capital, the capital charge can be determined. The economic profit is then NOPLAT less the capital charge, or simply Invested Capital multiplied by the spread {ROIC-WACC}.

Finally, the model computes various averages, ratios and growth rates used in the economic and ROIC tree analyses.

3.4 Method of Assessing Impact of Legislation

In order to explore the impact of recent legislation, two distinct but complimentary methods are used: firstly, a questionnaire is administered to industry executives and analysts; and secondly, a worked example of a real-world valuation problem is examined in order to develop an empirical measure of the value impact of the legislation.

3.4.1 Questionnaire

In order to test hypotheses 4 to 7, a questionnaire was administered to industry representatives and analysts. The choice of this methodology, in which contact with the subject of the interview is minimised, was driven by the need to avoid

introducing bias into the responses through the perceived opinions of the interviewer transferring to the interviewee in the process of data capture. The sensitivity of the subject matter to the industry – probing their perceptions of the opportunities and challenges presented by the Mining Charter, the Minerals and Petroleum Resources Development Bill, and the proposal to introduce a revenue-based royalty on mineral production – also meant that company executives might see these questions as intrusive; by setting out the questions in written form it was intended that some of their anxiety over the process would be removed. Initial contact with the respondents was by telephone, to gain acceptance of the process in principal. The questionnaire form was then distributed by e-mail, this being deemed appropriate for the high degree of computer literacy and expected mode of work for the target groups.

3.4.1.1 Sample Selection

The selection of a representative sample of senior executives from all segments of the industry presupposes that there is a single population from which to sample. In the platinum industry, this is not necessarily the case, as there are discrete groups of companies, characterised by their ownership. The Scorecard which attaches to the Mining Charter sets targets for, *inter alia*, the participation of Historically Disadvantaged South Africans (HDSA) in the industry, and such distinctions are therefore likely to remain current for some time to come:

"HDSA participation in terms of ownership for equity or attributable units of production of 15 percent in HDSA hands within 5-years and 26 percent in 10-years" (Scorecard for the Broad Based Socio-Economic Empowerment Charter for the South African Mining Industry, 2002).

In selecting a target audience for the questionnaire, therefore, due regard was needed for the grouping of the companies, in order to avoid under- or over-representation of any one group.

The views from within the industry are compared and contrasted with the views of selected industry analysts, a group recognised as hugely influential amongst institutional investors who control the bulk of the equity in the established mining companies.

In any qualitative survey of this nature, care must be taken not to introduce bias into the sample through self-selection of the respondents. The distribution of the respondents from amongst differing segments of the industry must therefore be monitored to ensure one does not become over-represented in the results.

3.4.1.2 Questionnaire design

The questionnaire sets out to elicit a response to specific questions, and follows a pattern of asking one *category* question (i.e. with a pre-determined list of possible responses) and following then asking the respondent to justify their choice in an open-ended question. In this way, there is scope for the respondent to give their opinion, but the subject matter is well defined to avoid blurring of the issues.

Care was taken to ensure the questions were unambiguous and avoided bias towards any particular answer.

3.4.1.3 Data Analysis

A frequency analysis was conducted for the responses to each of the questions, firstly for the pre-defined answers to the category questions,

and then by first listing and then coding the replies to the open-ended questions.

Given the nature of the survey and the size of the sample relative to the population, it was considered that the application of more elaborate statistical techniques in order to further generalise the results would not be appropriate.

3.4.2 Mineral Rights Valuation

This research has proposed the hypothesis that

→ Hypothesis 4: the effect of the Mining Charter on aggregate shareholder value in South Africa's platinum industry will be a net gain.

This hypothesis will be tested by means of a questionnaire, and also by means of a theoretical exercise – a thought experiment – in which the impact of the legislation on a hypothetical suite of platinum deposits is examined in anticipation that these results can be generalised to actual platinum deposits.

Firstly, a resource is defined in terms of its grade and tonnage, the content of each of the four principal precious metals (platinum, palladium, rhodium and gold), the metallurgical recovery and the concentrate selling price. Capital and operating cost estimates are set, and the likely timing of the construction and development programme is estimated. Metal prices and exchange rates close to current values (in real terms) are assumed to prevail for the life of the project.

A base case is chosen where the grade of the project at 4.0 g/t is just adequate for the project to achieve a hurdle rate return of 10%, i.e., the NPV of the project is zero.

A second case is then developed in which the grade falls to 3.7 g/t but all other variables are kept constant. The project has an IRR of 6% and a negative NPV of R328 million.

Finally, a third case is developed in which the grade falls to 3.4 g/t but all other variables are kept constant. The project has an IRR of 1.3% and a negative NPV of R680 million.

This suite of three investment opportunities is then taken to represent three unused, old-order mineral rights. They remain undeveloped for the valid reason that they cannot be profitably developed at this time.

Since even the best of these potential mines has a zero NPV, can it be true that these mineral rights are worthless? In order to show that this is not the case, a series of call option values are computed that represent the value of an option to develop a mine at some later date during the option period.

Option periods of up to twenty years are computed, on the basis that after twenty years the option will gain little extra value from each successive year of its duration.

Taking the 'old order' value of the mineral rights pertaining to the hypothetical project suite to be the option value at twenty years, this value is compared to that obtained from the same mineral resource when the option is limited to five years. The difference is taken to represent the mineral rights value which has been appropriated from the holders of those rights by virtue of the change in mining legislation.

3.5 Summary

The research methodology is summarised into the flow-sheet diagram in figure 8, which shows the principal sources of data for the economic analysis and the real-options valuation of mineral rights.

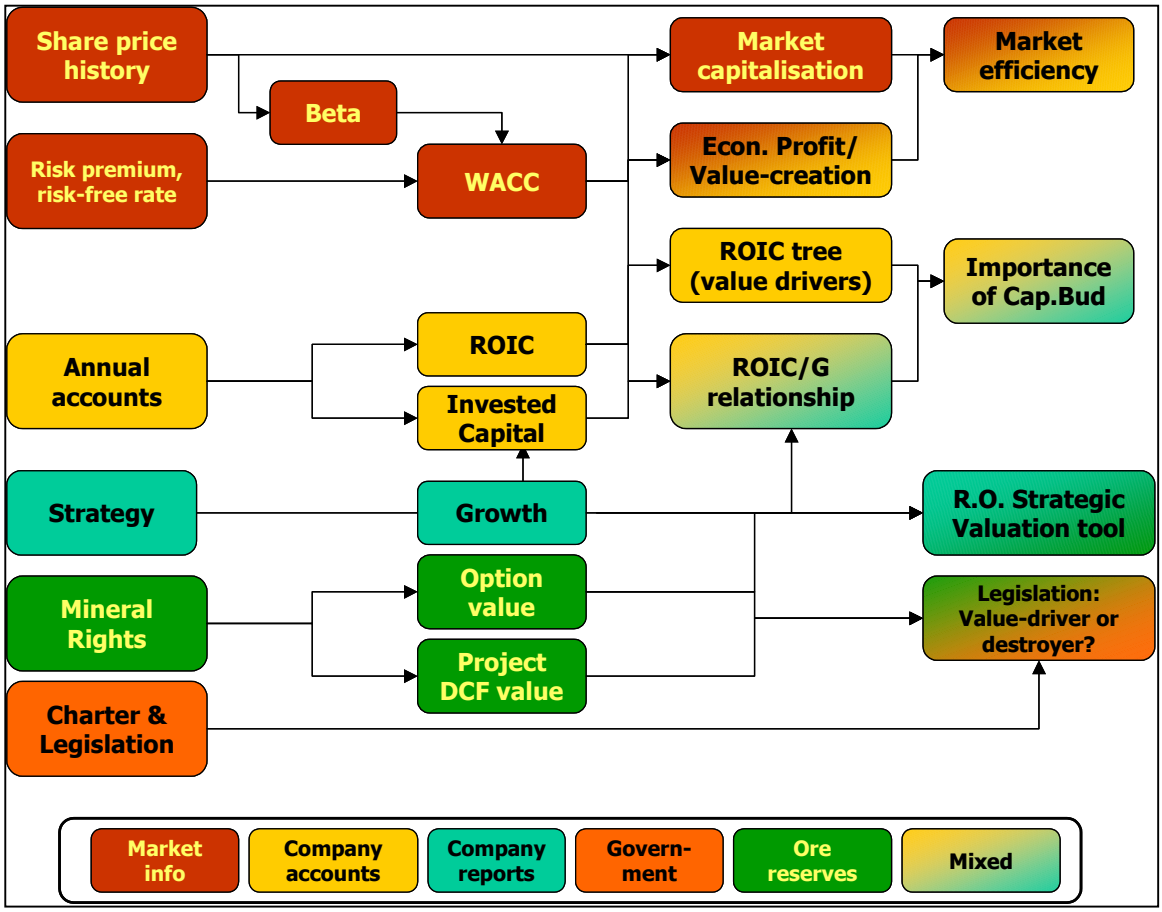


Figure 8 Flow diagram showing economic research methodology

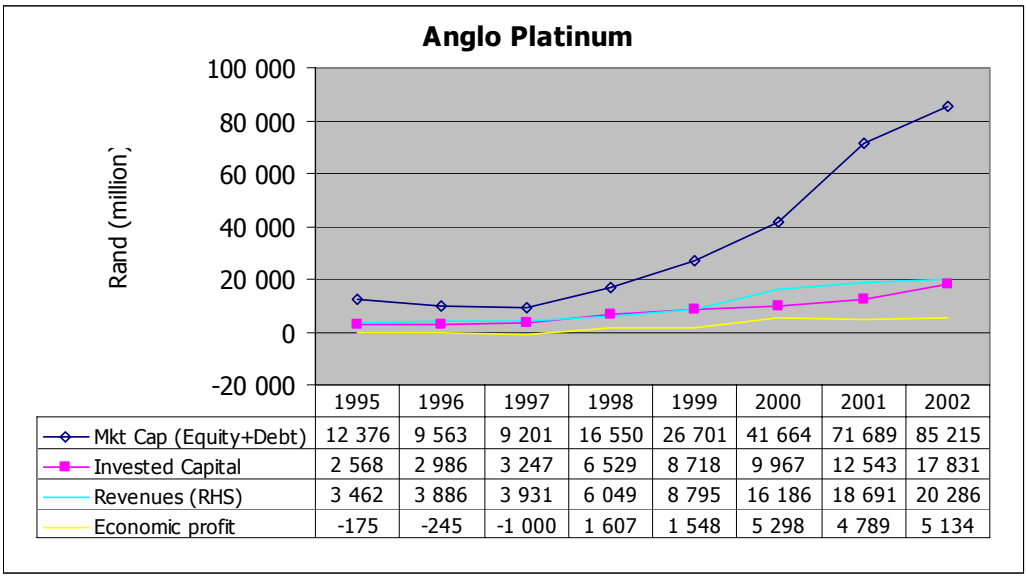
Chapter 4: Research Results

4.1 Value Creation

The first hypothesis being tested states that there is a positive correlation between the ratio {Market capitalisation / Invested Capital} and the ratio {Economic Profit / Revenue}.

Changes over time may be an important influence on the results and therefore a time-series of the results was prepared for each company. The data were then plotted as a series of charts, as per the following examples:-

4.1.1 Anglo Platinum



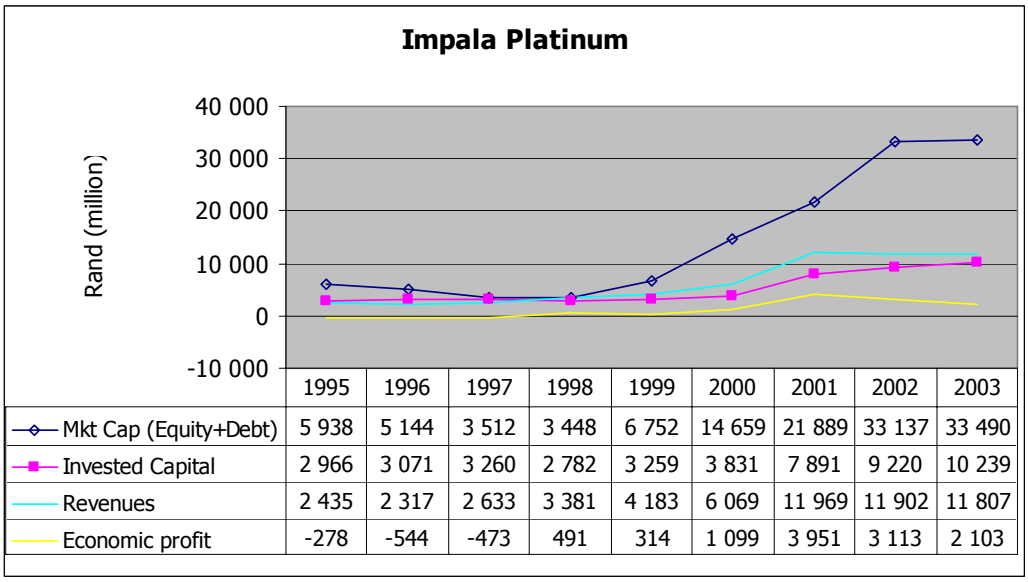
	1995	1996	1997	1998	1999	2000	2001	2002
Mkt Cap (Equity+Debt)	12 376	9 563	9 201	16 550	26 701	41 664	71 689	85 215
Invested Capital	2 568	2 986	3 247	6 529	8 718	9 967	12 543	17 831
Revenues (RHS)	3 462	3 886	3 931	6 049	8 795	16 186	18 691	20 286
Economic profit	-175	-245	-1 000	1 607	1 548	5 298	4 789	5 134

Figure 9 Historical Economic Profit - Anglo Platinum

All four measures have risen by similar percentages over the period since 1995, though the rate of change clearly accelerated between 1999 and 2001, fuelled by the rise in PGM prices coinciding with weakness in the South African rand. The marked increase in market capitalisation and invested capital during this period is

not matched by growth in revenues and economic profits, placing the sustainability of this performance in question.

4.1.2 Impala Platinum



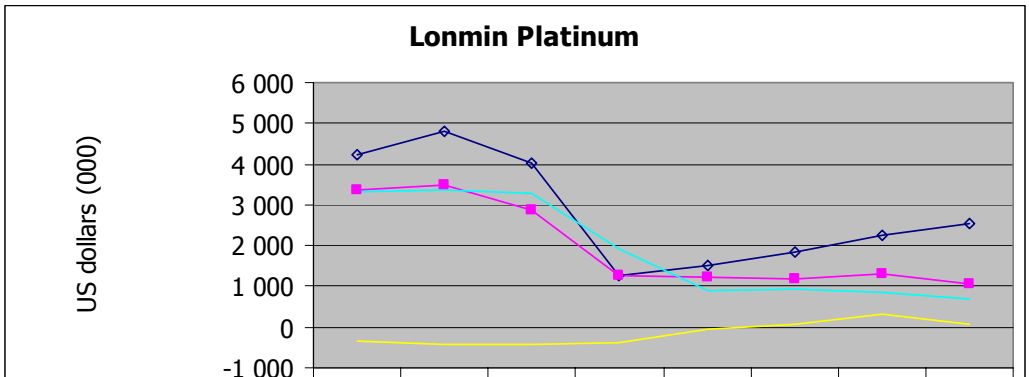
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mkt Cap (Equity+Debt)	5 938	5 144	3 512	3 448	6 752	14 659	21 889	33 137	33 490
Invested Capital	2 966	3 071	3 260	2 782	3 259	3 831	7 891	9 220	10 239
Revenues	2 435	2 317	2 633	3 381	4 183	6 069	11 969	11 902	11 807
Economic profit	-278	-544	-473	491	314	1 099	3 951	3 113	2 103

Figure 10 Historical Economic Profit – Impala Platinum

Impala's results are similar to those of Anglo Platinum, in that the period since 1999 has shown rapid increases in market capitalisation despite a flat trend in revenues and, in this case, a declining economic profit line.

4.1.3 Lonmin plc

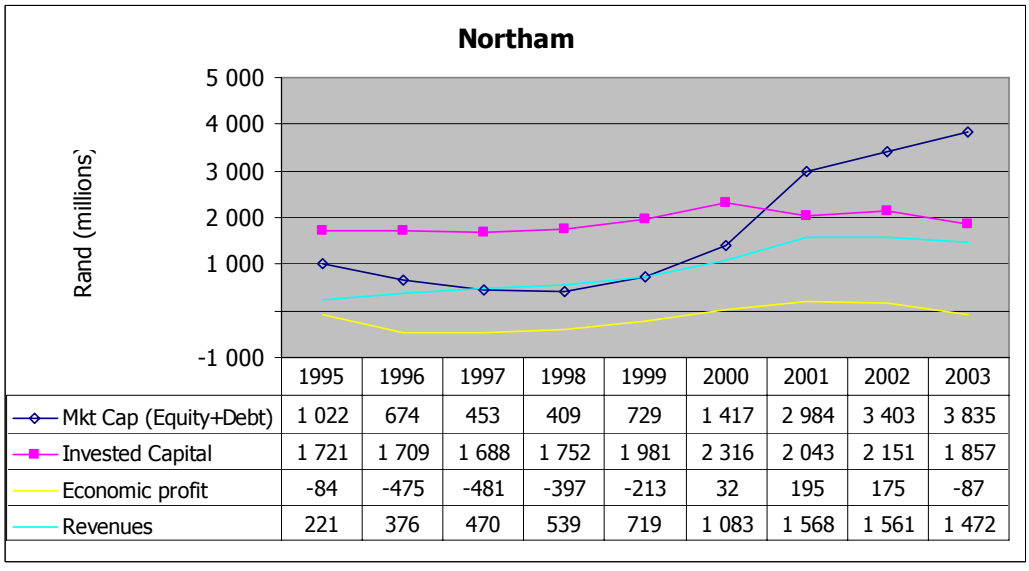
A major re-structuring at Lonmin in 1997-98 is reflected in the drop in market capitalisation, invested capital and revenues. Since then the trends have been upward, the ratio of Market Capitalisation/Invested Capital is rising and economic profits have turned narrowly positive.



	1995	1996	1997	1998	1999	2000	2001	2002
Mkt Cap (Equity+Debt)	4 212	4 810	4 040	1 259	1 522	1 831	2 253	2 533
Invested Capital	3 375	3 477	2 864	1 249	1 237	1 173	1 289	1 041
Revenues	3 332	3 356	3 272	1 910	896	951	866	697
Economic profit	-353	-404	-431	-365	-44	63	303	55

Figure 11 Historical Economic Profit – Lonmin Platinum

4.1.4 Northam Platinum

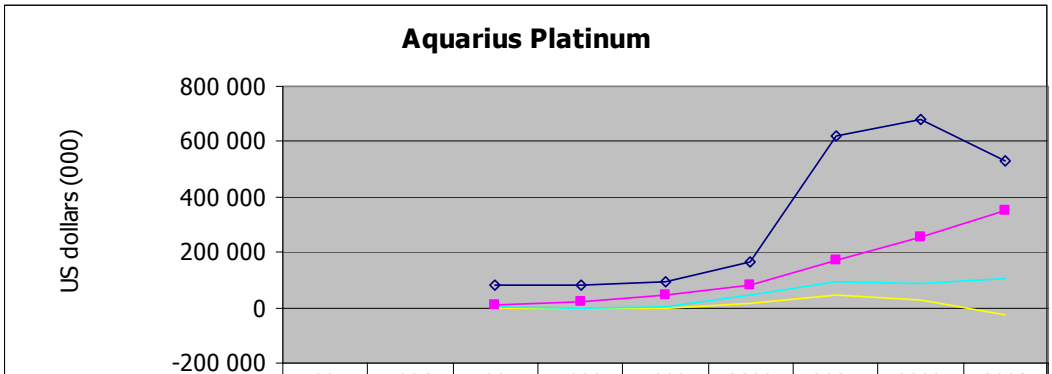


	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mkt Cap (Equity+Debt)	1 022	674	453	409	729	1 417	2 984	3 403	3 835
Invested Capital	1 721	1 709	1 688	1 752	1 981	2 316	2 043	2 151	1 857
Economic profit	-84	-475	-481	-397	-213	32	195	175	-87
Revenues	221	376	470	539	719	1 083	1 568	1 561	1 472

Figure 12 Historical Economic Profit – Northam Platinum

During the 1990's, Northam had a market capitalisation below the level of its invested capital but, by 2001, the company had eliminated its negative economic profits and the Market Capitalisation surplus over Invested Capital was growing.

4.1.5 Aquarius Platinum

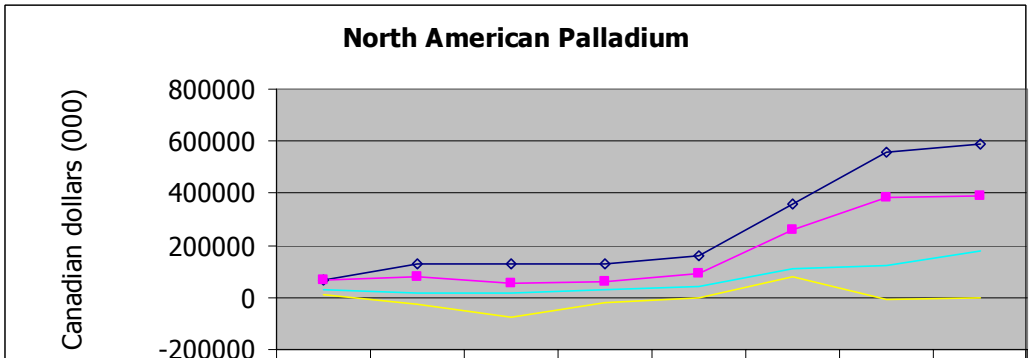


	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mkt Cap (Equity+Debt)			79.64	83.78	94.33	163.07	618.60	679.68	533.38
Invested Capital			9.30	19.07	44.94	82.79	173.15	253.86	349.24
Economic profit			-1.28	-2.64	-4.29	14.96	43.21	29.23	-24.74
Revenues			0.65	0.07	2.21	47.08	94.28	88.50	105.91

Figure 13 Historical Economic Profit – Aquarius Platinum

Aquarius established its first platinum mine in 1998 and has grown rapidly since then. Invested capital, though, has grown faster than revenues or economic profits, indicating that this growth has required funding from external sources.

4.1.6 North American Palladium

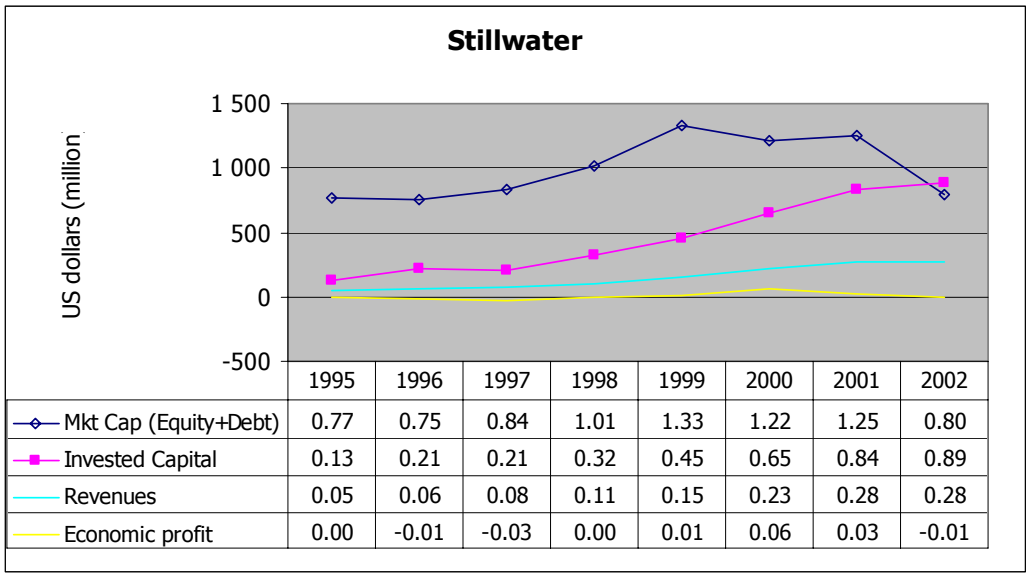


	1995	1996	1997	1998	1999	2000	2001	2002
Mkt Cap (Equity+Debt)	65.43	127.30	127.65	126.89	158.02	357.21	558.70	589.95
Invested Capital	65.97	81.93	55.98	60.35	88.97	261.17	386.87	388.95
Economic profit	8.51	-24.99	-78.16	-19.18	0.88	77.73	-7.34	-1.31
Revenues	27.35	20.25	19.19	28.15	44.56	109.50	121.50	176.77

Figure 14 Historical Economic Profit – North American Palladium

North American Palladium exhibits a very flat profile through the 1990's, but has had significant growth in its market capitalisation since then, driven by the rise in the palladium price. Economic profits have not kept pace, however, due to the rapid rise of invested capital during this time, and the lack of growth in market capitalisation since 2001 is understandable in the light of the neutral economic profit position.

4.1.7 Stillwater Mining



	1995	1996	1997	1998	1999	2000	2001	2002
Mkt Cap (Equity+Debt)	0.77	0.75	0.84	1.01	1.33	1.22	1.25	0.80
Invested Capital	0.13	0.21	0.21	0.32	0.45	0.65	0.84	0.89
Revenues	0.05	0.06	0.08	0.11	0.15	0.23	0.28	0.28
Economic profit	0.00	-0.01	-0.03	0.00	0.01	0.06	0.03	-0.01

Figure 15 Historical Economic Profit – Stillwater Mining Co.

In the 1990's, Stillwater enjoyed a slow but steady growth in revenues, accompanied by a similar rise in both market capitalisation and invested capital. During this time, market capitalisation was at a healthy premium to invested capital. Since 1999 market capitalisation has fallen back but invested capital has continued to grow and, in 2002, a funding crisis hit the company that was only resolved by the issuing of new shares to Norilsk, with existing shareholders yielding control to that company.

4.1.8 Regression diagram

Taking the data for all the companies in the study, the ratios of {Market capitalisation to Invested Capital} and of {Economic Profit / Revenue} were plotted using data from 2002, and the square of the Pearson product moment correlation coefficient (R^2) was computed.

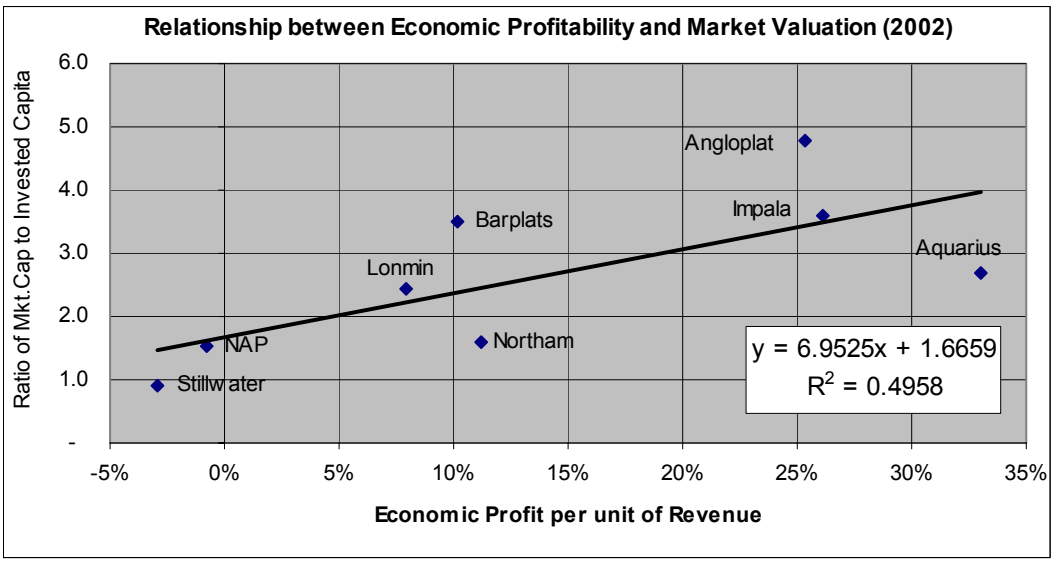


Figure 16 Regression of Mkt.Cap/Inv.Cap and Economic Profit/Revenue

The results, presented in Figure 16, show a positive correlation exists between these two ratios, though the R^2 score of 0.50 is only moderate. To confirm that this result is meaningful, the exercise was extended to the rest of the study period. The R^2 scores for each year are shown in the bar chart in Figure 17.

The scores of zero and 11% in 2000/2001 are clearly anomalous, and the score of 50% in 2002 is close to the average for the rest of the period if the years 2000/2001 are excluded. The reason for the temporary anomaly is not clear, and will be discussed further in Chapter 5. However, for the purposes of this study, the long-term trends in the platinum industry are of greater relevance.

It is therefore concluded that the first hypothesis is proven.

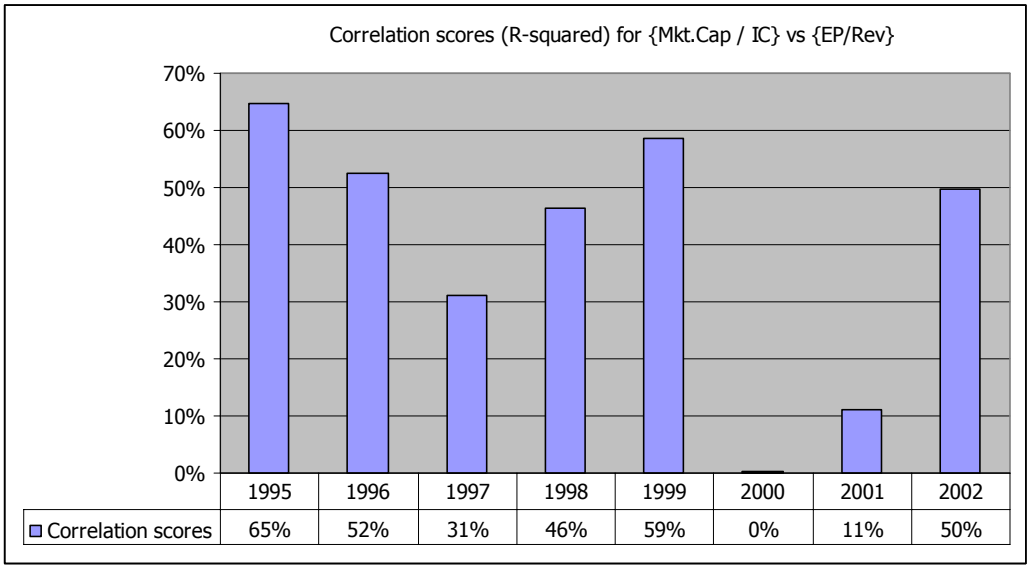


Figure 17 Time series of R-squared values for Mkt.Cap/IC and EP/Revenue

4.2 Growth as a value driver

The relationship between rate of growth and the market valuation of firms in the study can be demonstrated by a plot of the ratio {Market Capitalisation / Invested Capital} against the compound growth rate of those firms' Invested Capital (Figure 18(a)).

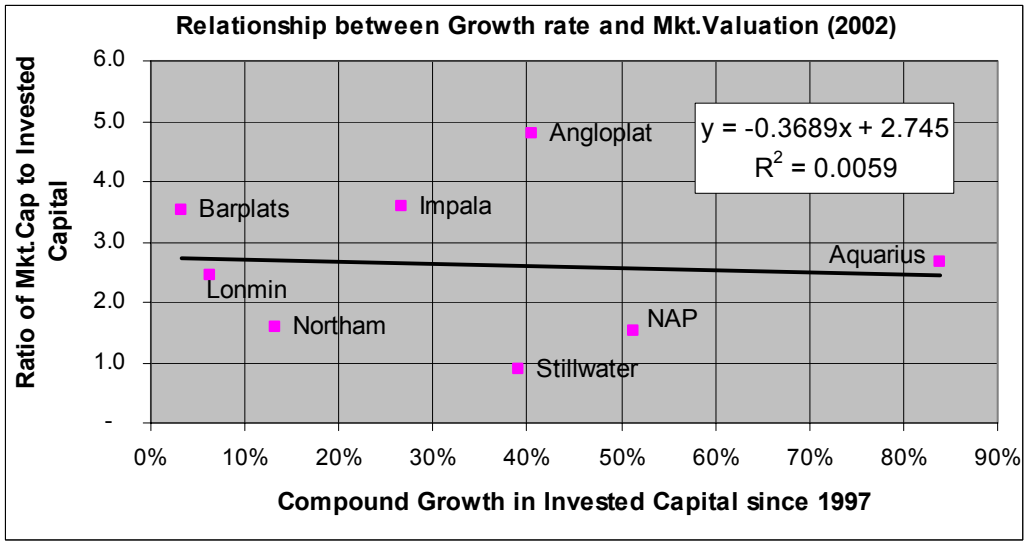
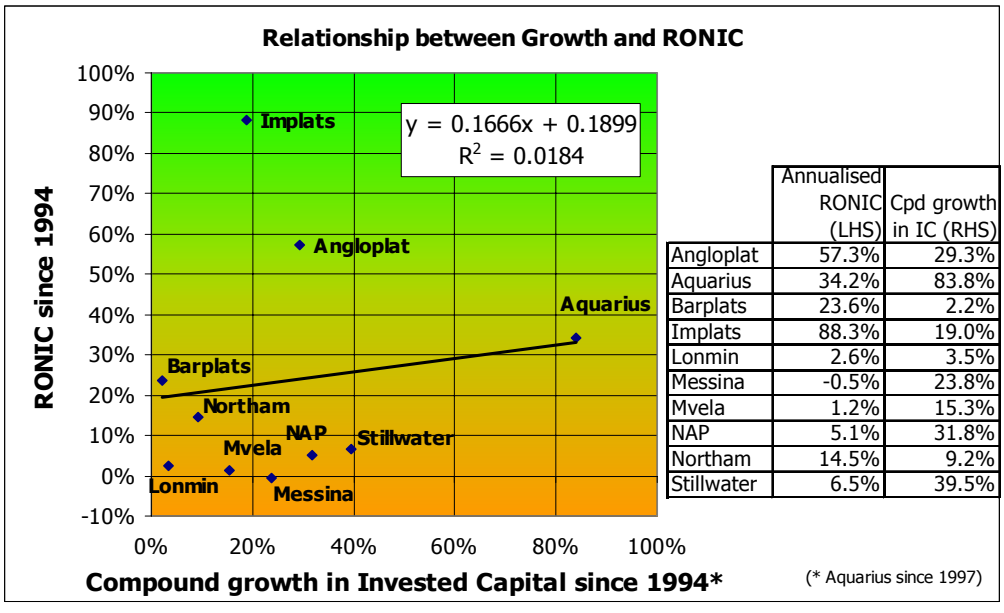


Figure 18(a) Relationship between Growth rate and Market Valuation

In Figure 18(a), the Pearson correlation coefficient (R^2) of less than 0.01 shows that the market does not attribute value to a firm on the basis of its growth rate. However, to test Hypothesis 2 – which states that growth is not correlated with RONIC – we need to measure the correlation between growth and each firm's average RONIC. The resulting scatter diagram is presented in Figure 18(b).

In Figure 18(b), the performance of most platinum producers places them in the lower left quadrant, having low or moderate growth with a poor return on incremental capital invested. Two firms fall in the upper left quadrant – Anglo Platinum and Implats have achieved high rates of return on new investment, notwithstanding that their rate of growth is in line with that of most of their competitors. Aquarius alone plots in the lower right quadrant of the diagram, having achieved exceptional growth with acceptable returns. It should be noted, though, that Aquarius' performance is measured only since the inception of its Kroondal mine in 1997, so its growth is measured off a low base and over a shorter period than for the other firms.



	Annualised RONIC (LHS)	Cpd growth in IC (RHS)
Angloplat	57.3%	29.3%
Aquarius	34.2%	83.8%
Barplats	23.6%	2.2%
Implats	88.3%	19.0%
Lonmin	2.6%	3.5%
Messina	-0.5%	23.8%
Mvela	1.2%	15.3%
NAP	5.1%	31.8%
Northam	14.5%	9.2%
Stillwater	6.5%	39.5%

Figure 18(b) RONIC plotted against Growth in Invested Capital

Statistically, the average RONIC and the compound growth in invested capital of the platinum producers shows a correlation (R^2) of under 0.02, proving the second hypothesis, that growth does NOT correlate with value creation as measured through RONIC.

4.3 Importance of Capital Budgeting

In this study, the relative importance of operating margin and capital budgeting as determinants of the market value of the firms is measured by their correlation with market value (using the ratio of Market Capitalisation to Invested Capital).

4.3.1 Operating Margin

A positive correlation between profitability and market value of the firm is to be expected yet, in Figure 19, the correlation between the market value and the operating margin of platinum producers is weak (R^2=0.38). This implies that operating margin (and thus other accounting measures of profitability such as net earnings) can be only partly responsible for determining the market value of platinum producers.

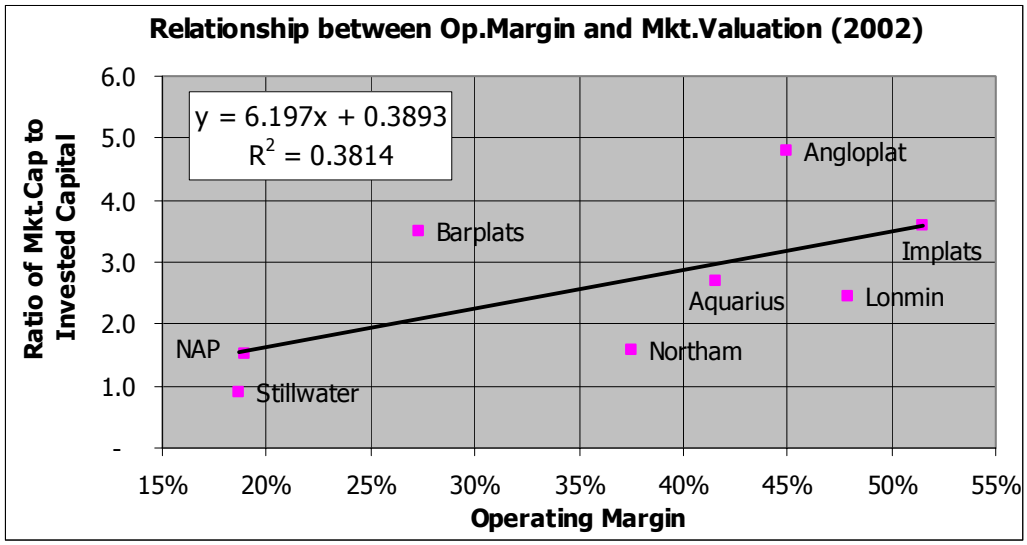


Figure 19 Relationship of Operating Margin and Mkt.Cap./Invested Capital

4.3.2 Capital budgeting

In section 4.3.1, we were able to measure the correlation with market value using operating margin as the independent variable. For capital budgeting, though, we take as our independent variable the spread between RONIC and WACC. It will be recalled that a positive spread means that companies are accepting projects that (at least in aggregate) give a return in excess of their cost of capital: they are adding value for shareholders.

In Figure 20(a), a scatter plot showing the relationship between WACC and RONIC sorts those with a positive spread (i.e. those plotting above the red line) from those whose spread is negative (meaning that in aggregate their return on new projects is less than their cost of capital). In section 4.2 we saw that growth is not a driver of value – i.e., growth does not correlate with RONIC. Figure 20(a) shows that many platinum producers have achieved returns on new capital that are less than the cost of that capital: they have destroyed value through growth.

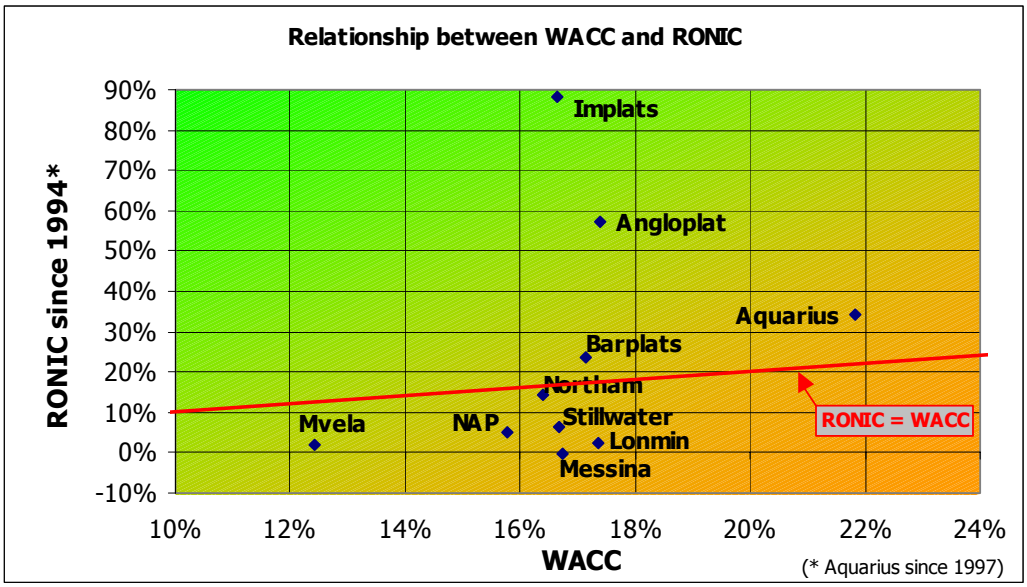


Figure 20(a) Relationship between WACC and RONIC

The next step is to compare this performance with the market valuation of the firms to determine whether there is a link. A positive correlation between the spread (the net amount earned on new invested capital since 1994 (RONIC) after deducting the cost of capital) and the ratio of market capitalisation to invested capital (used in this study as a proxy for MVA) will show whether the market values companies that can achieve positive returns on new investment.

The data are shown in Figure 20(b), and exhibit a correlation (R^2) of 0.54. This moderate correlation suggests that just over half of the market value enjoyed by the company in excess of its invested capital can be attributed to the spread on new invested capital (RONIC-WACC).

Hypothesis 3, that for platinum producers, the spread {RONIC-WACC} is positively correlated with a ratio of market value to invested capital, is proved.

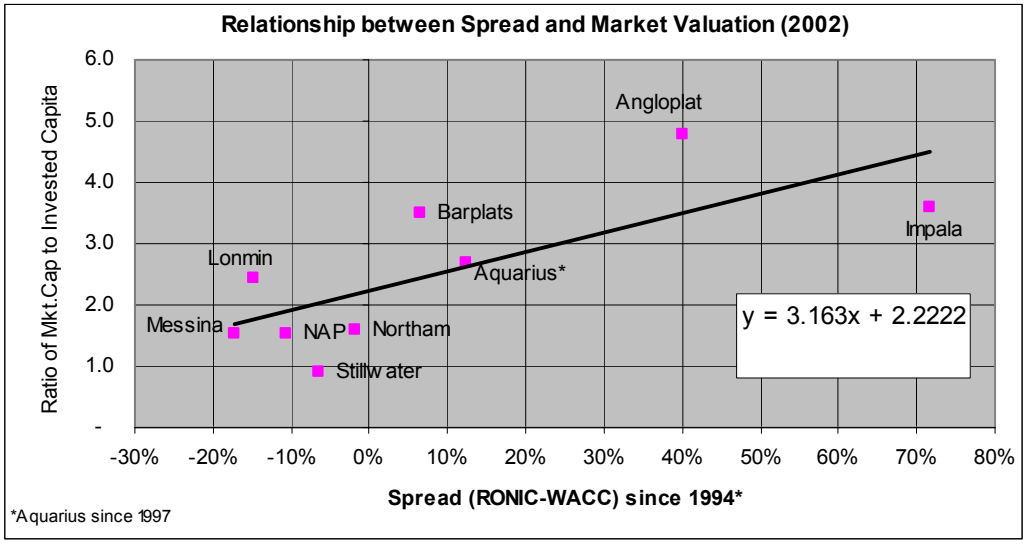


Figure 20(b) Relationship between Spread and Market Cap./Invested Capital

4.4 Competitive analysis of Established Firms

The link between market performance and economic performance by members of the industry appears strong. This section of the research aims to identify those critical elements of company performance which differentiate strong performers. This analysis relies on the ROIC tree, which disaggregates the ROIC achieved by a firm into an operating margin element and a capital turnover element, and then breaks these down further to identify the drivers of value at the lowest level of analysis possible from the data.

4.4.1 ROIC

Taking 2002 data (the most recent year for which all companies in the survey have reported), the average return earned on invested capital is plotted in the chart (Figure 21).

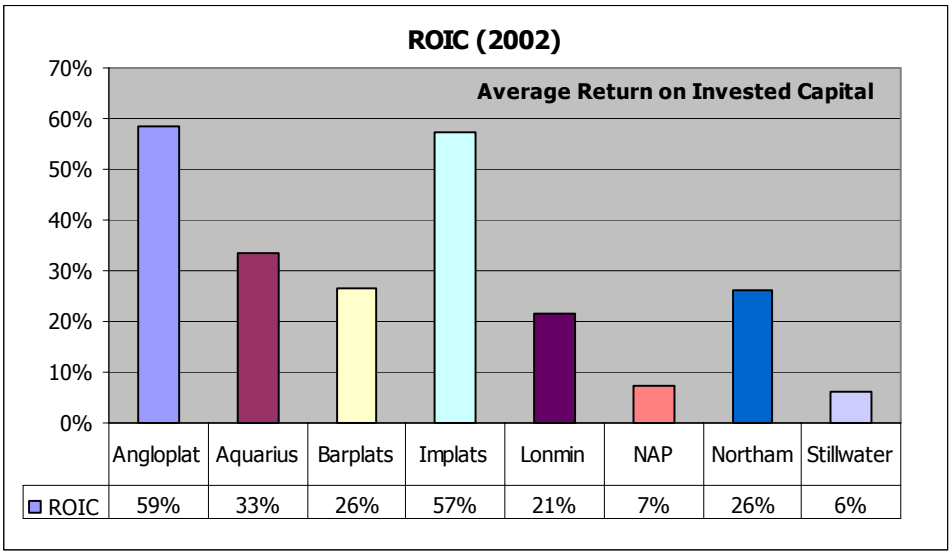


Figure 21 Average return on invested capital

Clearly, two companies – Anglo Platinum and Impala – stand clear of the others in this measure of performance, while NAP and Stillwater are well below the average and the others occupy the middle ground.

Disaggregating ROIC into operating margin and capital turnover, may help us to identify the reasons for this range of performance.

4.4.2 Operating Margin

In Figure 22, it is apparent that there is no significant difference between the companies in their cost of goods sold, suggesting that none of the companies has a distinct competitive advantage in its operating cost structure.

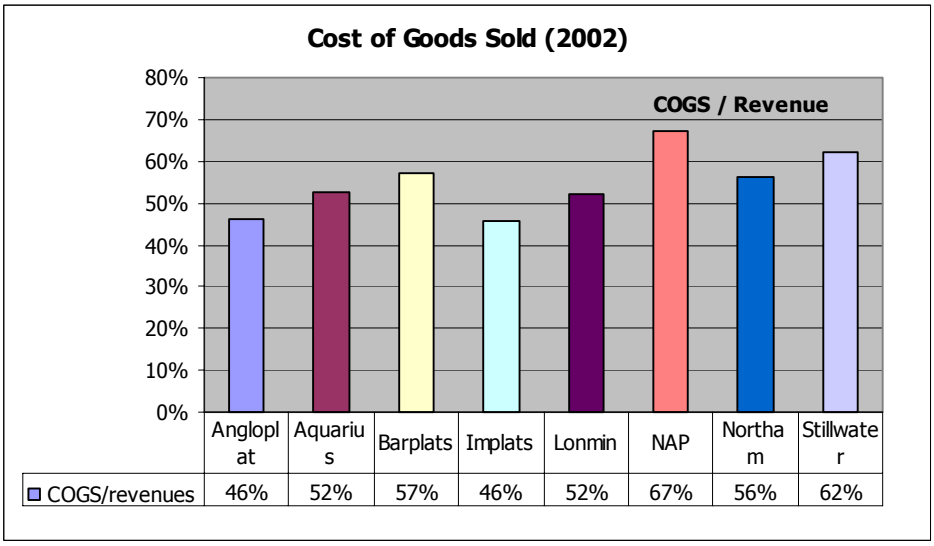


Figure 22 Cost of Good Sold / Revenue

Even at the Net Margin level, there is little to distinguish the two leading firms from their next three or four competitors, though we are now able to distinguish the marginal producers, Stillwater and NAP (Figure 23).

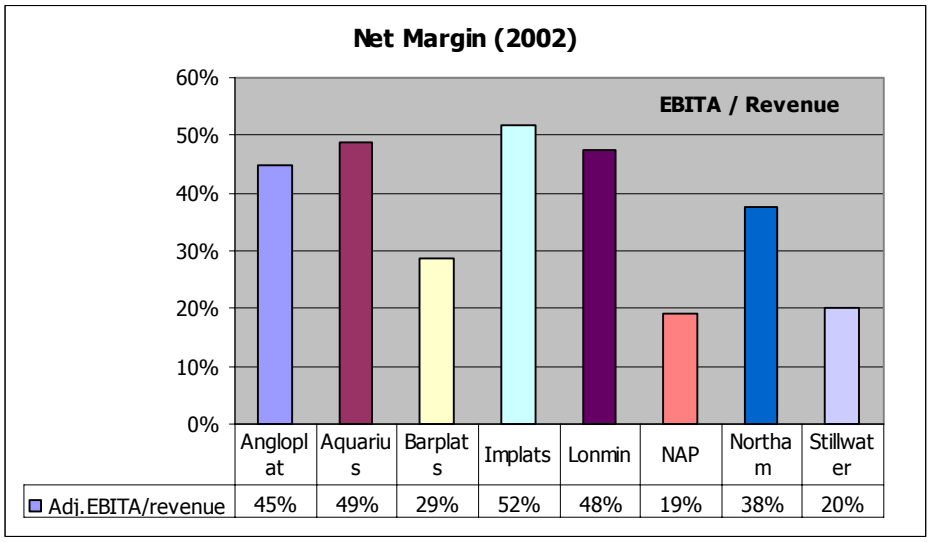


Figure 23 Net Margin (EBITA/Revenue)

4.4.3 Capital Turnover

The analysis of capital turnover reveals a difference between the top two performing firms and their closest rivals (see Figure 24). This is a good indication that a significant competitive advantage is to be had from the management of capital. In order to refine this conclusion, though, it is necessary to further disaggregate the Capital Turnover.

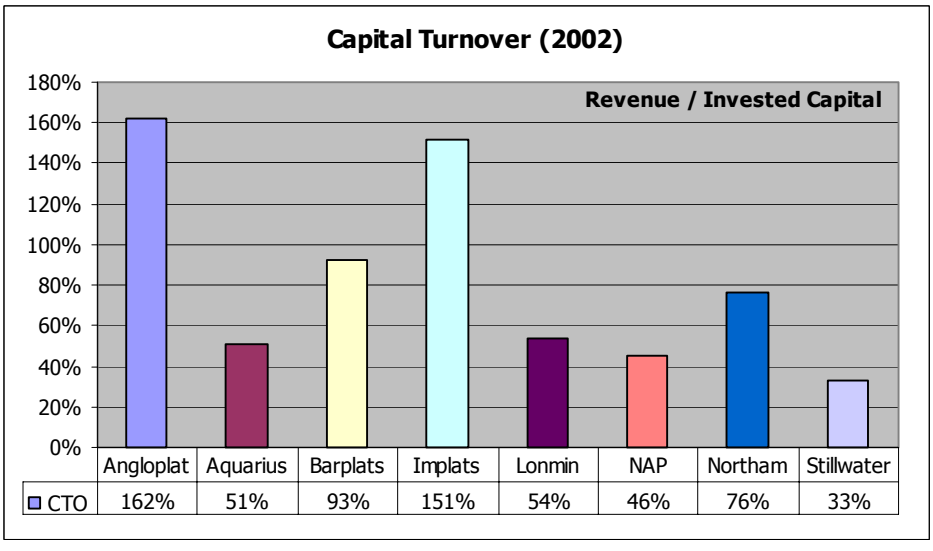


Figure 24 Capital Turnover (Revenue / Invested Capital)

Barplats, Aquarius and, to some extent, Lonmin all appear to manage inventory better than Anglo Platinum or Impala (see Figure 25). However, this does not manifest into an effective competitive advantage at the capital turnover level, and so may be discounted as a source of significant advantage in the platinum industry. That is not to say that it is unimportant, since in terms of best practice both Anglo Platinum and Impala appear to have something to learn from Lonmin, Aquarius and Barplats

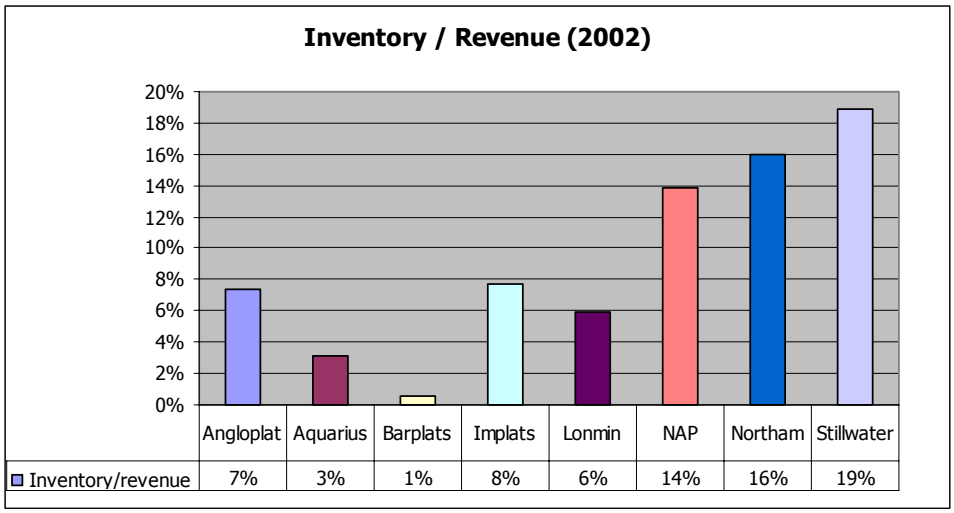


Figure 25 Inventory / Revenue

In Figure 26, the net working capital per unit of revenue is plotted. This measure appears to favour Anglo Platinum, and to a lesser extent, Impala and Stillwater. In contrast, Lonmin performs badly on this measure, despite a strong performance in inventory management.

Investigating this apparent anomaly would require more detailed information – this possibly represents an area for further research.

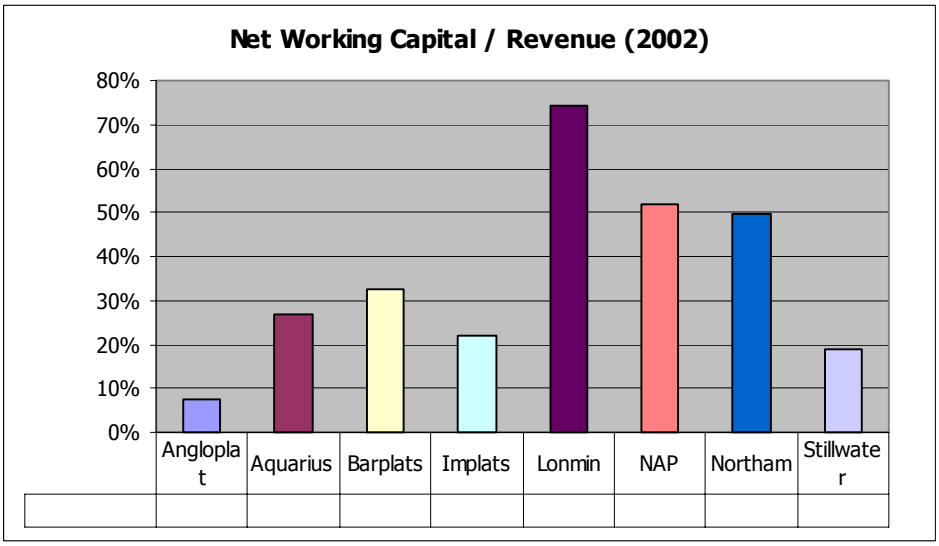


Figure 26 Net Working Capital /Revenue

Figure 27 demonstrates the Net Property, Plant and Equipment per unit of revenue. Anglo Platinum and Impala emerge as dominant, though Northam and Barplats are close behind. Given the scale of investment in both the former companies, such a lead in capital efficiency must surely be a source of significant competitive advantage.

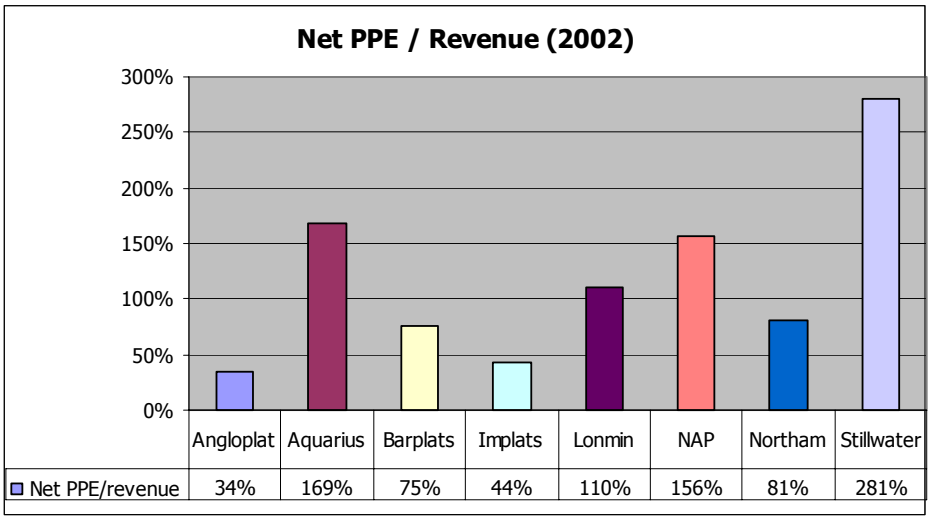


Figure 27 Net Property, Plant & Equipment / Revenue

4.5 Effect of legislation

4.5.1 Sampling results

Fourteen questionnaires were despatched, being six to analysts, four to established mining companies and four to BEE companies and juniors. The response rate to the questionnaire was as follows:-

Group	Despatched	Completed surveys Received	% response
Analysts	6	3	50%
Established Companies	4	3	75%
BEE & Junior Co.'s	4	2	50%
Total / average	14	8	57%

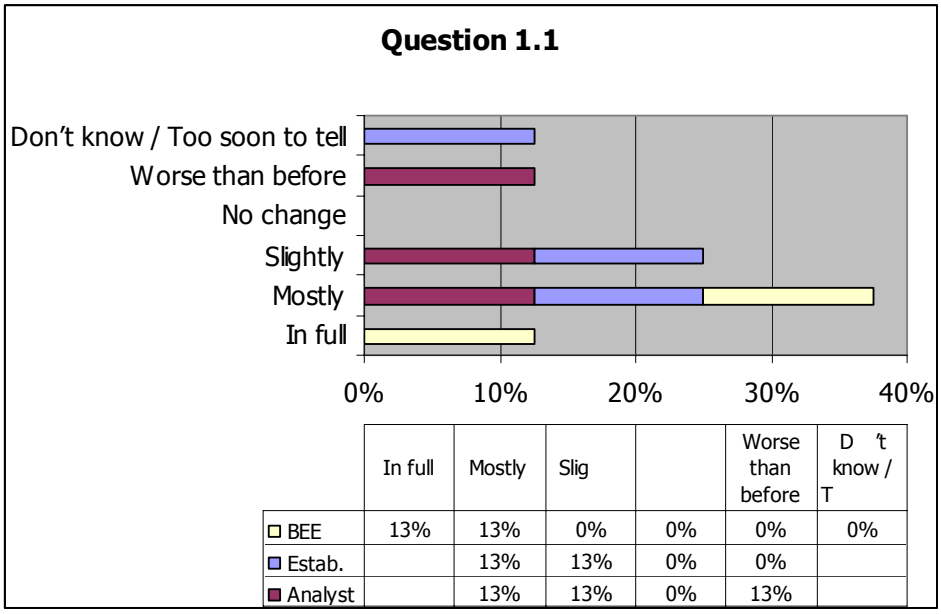
Figure 28 Response rate to Questionnaire

Overall, the response rate was acceptable for a survey of this nature, and the frequency of response from each category was broadly similar, so that the representivity of the sample was not compromised. It was therefore justifiable to continue with analysis of the results.

4.5.2 Questionnaire responses

4.5.2.1 Questions 1.1 & 1.2

> "The Mining Charter aims to ensure that BEE companies and other new entrants have more opportunities to add value for their shareholders than previously. To what extent does it achieve this? Why?"



	In full	Mostly	Slig		Worse than before	D 't know / T
BEE	13%	13%	0%	0%	0%	0%
Estab.		13%	13%	0%	0%	
Analyst		13%	13%	0%	13%	

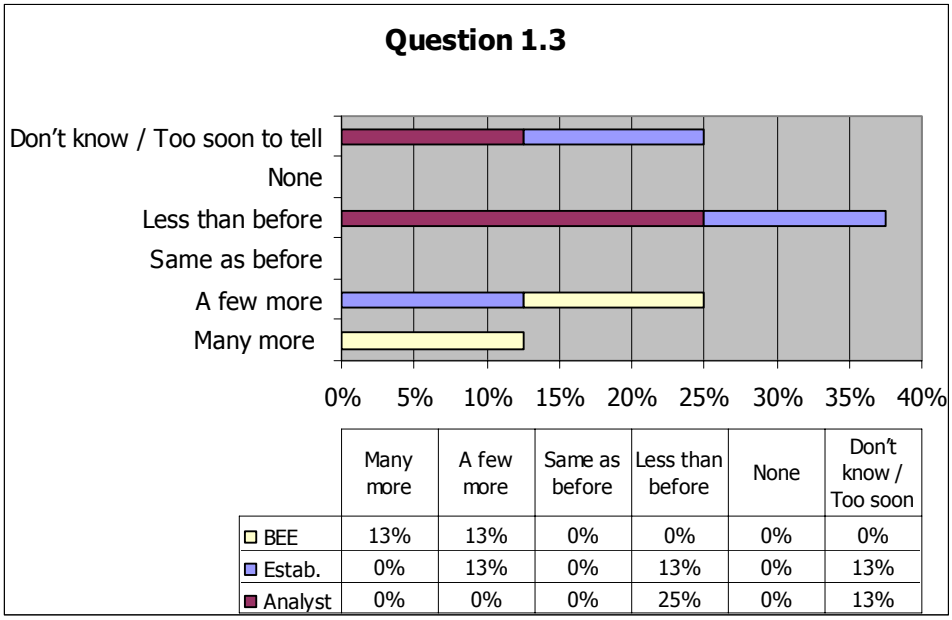
Figure 29 Responses to Question 1.1

The reasons given by respondents showed that most expect deals to be done close to 'fair value', with a caveat that should heavy borrowings be required, then a discount may be needed to make the transaction affordable. The closer to fair value, the nearer to value-neutral is likely to be the result. The need to ensure broad-based (inclusive) empowerment was raised by one respondent, this being a principal aim of the Mining Charter.

4.5.2.2 Questions 1.3 & 1.4

"Do established companies now have more opportunities to add value for their shareholders than previously? Why is this?"

The Charter (and particularly the matter of the 'leak') is seen as having increased the discount attaching to South African assets, due to higher country risk. Deals struck at a discount will cause a short-term dip in value for the vendor.



	Many more	A few more	Same as before	Less than before	None	Don't know / Too soon
BEE	13%	13%	0%	0%	0%	0%
Estab.	0%	13%	0%	13%	0%	13%
Analyst	0%	0%	0%	25%	0%	13%

Figure 30 Responses to Question 1.3

Benefits of the Charter will, it is thought, only be recognised over a period of time and will include the opportunity to rationalise 'farm boundary' mining rights into more optimal mining units.

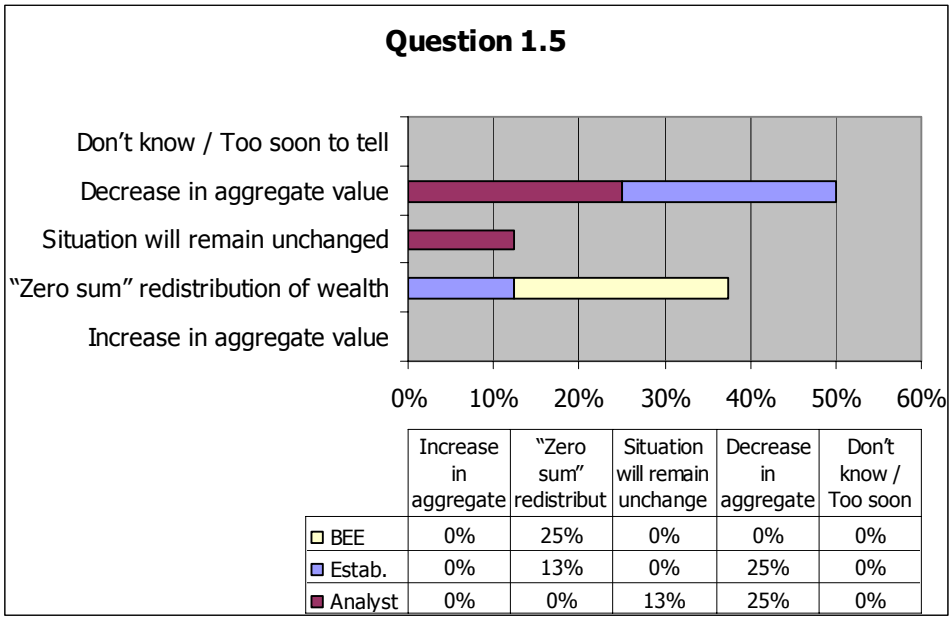
Respondents foresee costs to implementing some provisions the Charter but recognise that this should perhaps be treated as a "cost of doing business", and "be managed like any other cost."

4.5.2.3 Question 1.5

"What do you think will be the overall effect of the Mining Charter on aggregate shareholder value amongst all groups?"

Most respondents believe that the long-term impact of the Charter will be a decrease in aggregate value, at least in the short-term, while a significant number expect the outcome to be value-neutral redistribution of wealth.

Concerns were raised over the process of allocating mining rights once these are at the disposal of the State, and whether this might result in unsustainable growth of supply and the premature depletion of the nation's mineral wealth.



	Increase in aggregate	"Zero sum" redistribut	Situation will remain unchange	Decrease in aggregate	Don't know / Too soon
BEE	0%	25%	0%	0%	0%
Estab.	0%	13%	0%	25%	0%
Analyst	0%	0%	13%	25%	0%

Figure 31 Response to Question 1.5

Another concern raised is that the distribution of assets will lead to inefficiencies (i.e., the loss of economies of scale) and that other provisions of the Charter will also cause costs to rise.

The hypothesis being tested was:-

→ Hypothesis 4: the effect of the Mining Charter on aggregate shareholder value in South Africa's platinum industry will be a net gain.

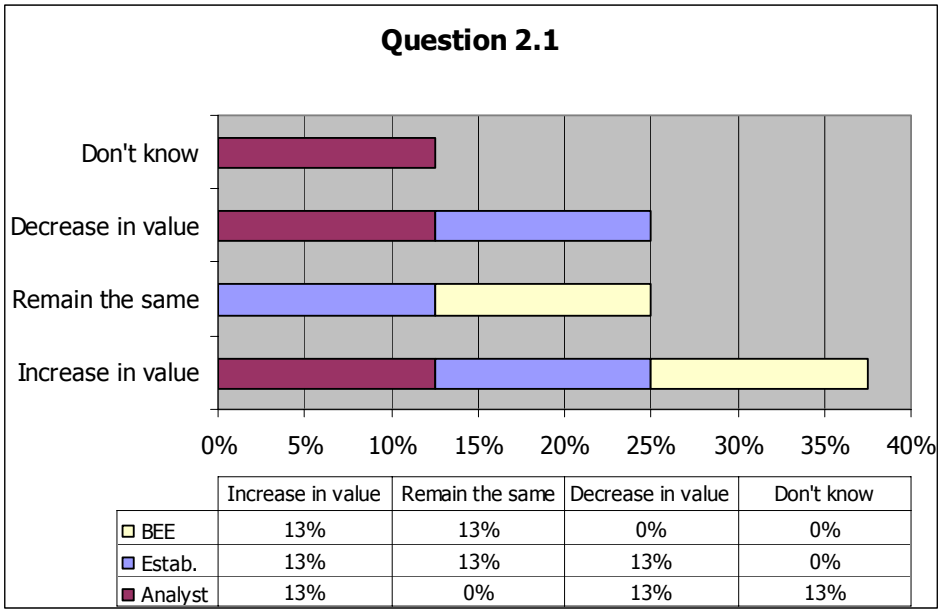
The results do NOT support the hypothesis that there will be a net gain; the NULL hypothesis is proven.

4.5.2.4 Question 2

"Recently, the Minerals & Petroleum Development Act set a time frame within which companies must commit to a plan for developing their mineral rights or risk seeing them awarded to new entrants. What impact has this on their market value? The market value of unused 'old order' mineral rights should …"

The hypothesis being tested was:-

→ Hypothesis 5: the Minerals and Petroleum Resources Development Act has reduced the market value of South Africa's platinum resources.



	Increase in value	Remain the same	Decrease in value	Don't know
BEE	13%	13%	0%	0%
Estab.	13%	13%	13%	0%
Analyst	13%	0%	13%	13%

Figure 32 Responses to Question 2.1

This question seemed to cause the most problems for respondents – opinion seems evenly divided over whether mineral rights will trade at a higher or lower value than previously, with a pessimistic view from both sides of the table – BEE and junior companies expecting to pay a higher

price to acquire mineral rights, and established firms expecting to receive less than they would previously have been able to demand.

Of general concern was the ability of companies to continue trading in mineral rights once the state takes a role in what has until now been a free market activity.

Analysts are evenly divided on the issue, and there seems to be widespread uncertainty. Question 2.2 asked by what percentage the value (of mineral rights) might change. This went unanswered by 7 out of 8 respondents, the exception being a response of (minus) 100% by one analyst, on the basis that "old order rights technically have no value as….the ability to convert [to a new order right] is pursuant to the ability to empower."

Results of testing the hypothesis are thus inconclusive. However, the hypothesis is further tested in section 4.5.3 – Mineral Rights Valuation.

→ Hypothesis 6: the Minerals and Petroleum Resources Development Act facilitates the sustainable development of South Africa's platinum resources.

Responses to the open-ended questions suggest that some aspects of the MPRDA will facilitate sustainable development – such as the removal of farm boundaries from the consideration of where to locate mining infrastructure, shafts, etc. Other aspects are negative: the Mining Charter is seen as having introduced new costs and obligations that will diminish economies of scale and so lead to inefficiencies.

The results of this survey are inconclusive on this issue.

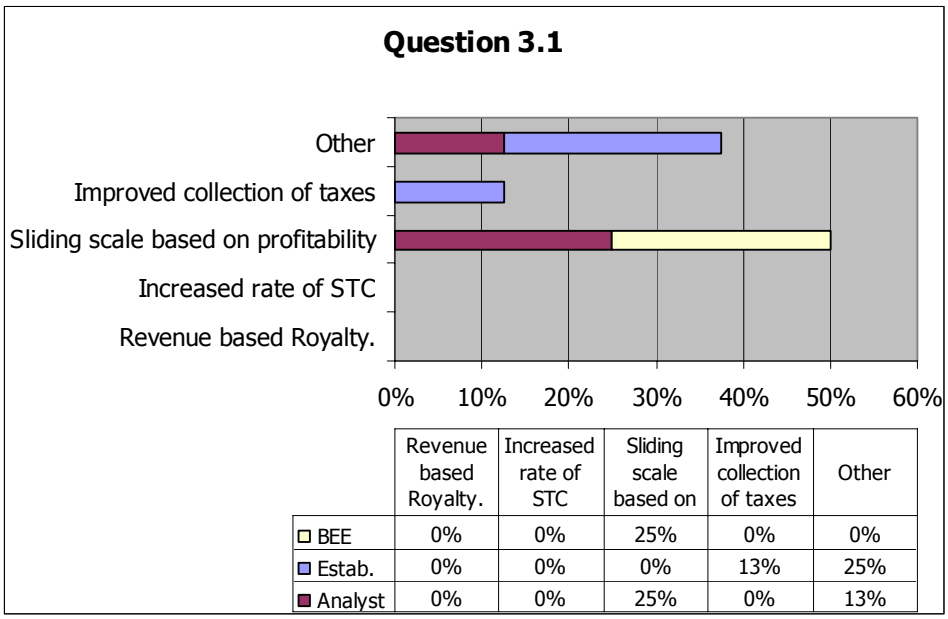
4.5.2.5 Questions 3.1 & 3.2

"Concerns have been expressed about the impact on mining of the proposed revenue-based royalties. Assuming some additional contribution to the fiscus to be inevitable, what would be your preference for this in terms of enhancing shareholder value?"

The hypothesis being tested is:-

→ Hypothesis 7: a 4% royalty on PGM production will have less impact on value creation than other means of revenue collection available to the Government.

The proposed revenue-based royalty is universally disliked by respondents, on the grounds that it will raise cut-off grades and so shorten mine life, and will inequitably damage marginal producers, perhaps pushing them to closure. Consequential unemployment and loss of competitiveness of the South African mining industry were also cited.



	Revenue based Royalty.	Increased rate of STC	Sliding scale based on	Improved collection of taxes	Other
BEE	0%	0%	25%	0%	0%
Estab.	0%	0%	0%	13%	25%
Analyst	0%	0%	25%	0%	13%

Figure 33 Responses to Question 3.1

Preference seems to be for a sliding scale of royalty based on the profitability of the mine, though a few respondents called instead for changes in current taxes and for improved collection of existing taxes. Support was also given to the use of a formula analogous to the old gold mining tax formula.

The hypothesis is not supported by the research. The NULL hypothesis is proven.

4.5.3 Mineral Rights Valuation

This research has proposed the hypothesis that:-

→ Hypothesis 5: the Minerals and Petroleum Resources Development Act has reduced the market value of South Africa's platinum resources.

Responses to Question 2.1 were inconclusive, the opinion of industry executives and analysts being spread across the range of possible answers. The uncertainty surrounding this issue needs to be resolved, and real options valuation has been proposed as a possible solution to this problem.

4.5.3.1 Real Options Valuation

The underlying assumption in the real options analysis is that the NPV of the project capex represents an exercise price, and the NPV of the after-tax cash flow (excluding the capex) represents the spot price which is earned through exercising the option. Other inputs to the Black-Scholes formula are the length of the option, the risk free rate (assumed to be 3% real) and volatility, which was assumed to be 5% (a rather low estimate) to maintain conservatism in the valuation.

The chart at Figure 34 shows the value of the mineral rights computed for three mineral deposits that differ only in the grade of ore. The resource is assumed to contain sixty million tonnes of mineable ore, and have a capital cost to develop of R1.5 billion. Other details of the assumptions used can be found in Appendix 1.

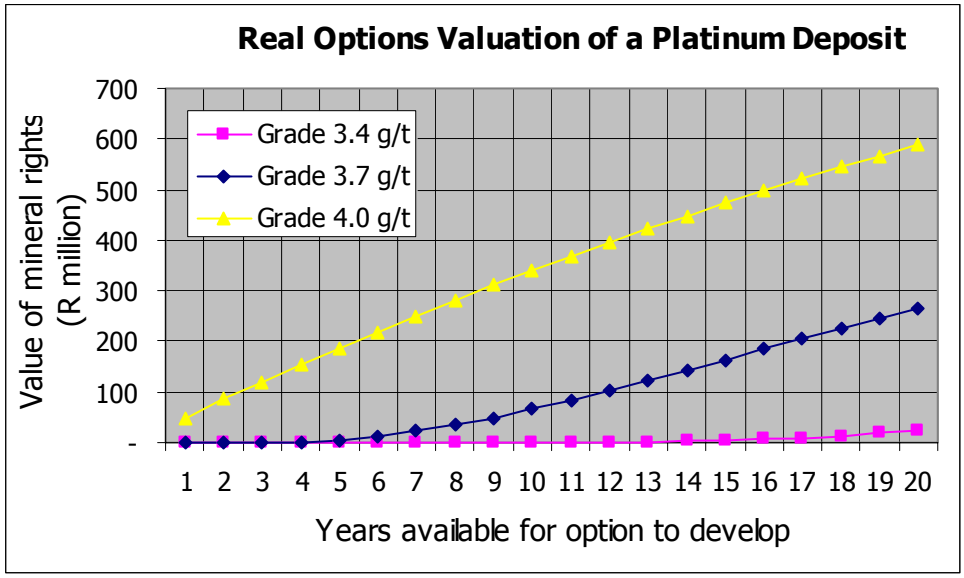


Figure 34 Real Options Valuation of a Platinum Deposit

Examination of the chart shows that the highest grade deposit, which would make a 10% return if developed immediately, has a value, as an undeveloped right with a twenty year option, of R588 million. The medium grade deposit has almost no option value for periods up to five years, but at twenty years its option value is R266 million. The lowest grade deposit has only a nominal value at any length of option up to 20 years, over which period the resource has an option value of R24 million.

	Option Value (Rand million)			
Option (years)	3.4 g/t Case	3.7 g/t Case	4.0 g/t Case	TOTAL
5-year	0.00	5.80	187.09	192.89
10-year	0.10	65.70	339.58	405.38
15-year	4.17	163.48	472.68	640.32
20-year	24.32	266.15	587.88	878.34
Option (years)	Option Value lost (%)			
5yr vs 10yr	100.0%	91.2%	44.9%	52.4%
5yr vs 15yr	100.0%	96.5%	60.4%	69.9%
5yr vs 20yr	100.0%	97.8%	68.2%	78.0%

Figure 35 Option Valuation of Mineral Rights

These results equate to approximately US$10.80, US$5.30 and US$0.50 per ounce of PGM for a twenty year option over the high, medium and low grade deposits respectively.

4.5.3.2 Comparison to market valuation

In order to validate the ROV results, it is necessary to compare with a current market valuation of a similar deposit. The nearest equivalent available would be a listed company that has no current production but owns a platinum resource. The 'benchmark' company chosen for this study is Cluff Mining plc (Cluff).

Cluff is listed on the Alternative Investment Market (AIM) in London and has, as its principal asset, a platinum mineral resource under exploration at the Blue Ridge deposit in South Africa. An *in situ* resource of some 4.6 million ounces of PGMs has been declared.

At January 2003, Cluff had almost 26 million shares outstanding, at a market price (then) of 170 pence, giving the company a market value of equity of around US$73 million. Adding net debt of US$9 million gives a total market capitalisation of US$82 million, or $17.80 per ounce of PGM in the Blue Ridge resource. The share price has since fallen back to 105

pence, reducing current value of the resource to US$11.75 per ounce PGM.

The real options valuation of the hypothetical resource thus appears to be broadly consistent with the market value of undeveloped resources, based on a comparison with the market capitalisation of Cluff Mining plc.

Old-order mineral rights were regarded as property and thus had no 'expiry date'. However, if we take an unused old-order mineral right as having represented a 20-year option to develop a mine, and assume that those rights now carry a tenure of no more than 5 years, from Figure 35 it can be seen that between 60% and 100% of the value of the rights is lost, depending on how far from viability the project is under current economic conditions. Taking an equal weighting of all three properties suggests a reduction from R640 million to R193 million, equating to a 69.9% loss in value from the suite of mineral rights.

The above valuation is taken in principal as conclusive proof that a loss in value of mineral rights to the holder as a result of the Minerals Bill.

→ Hypothesis 5: the Minerals and Petroleum Resources Development Act has reduced the market value of South Africa's platinum resources is proved.

Chapter 5: Discussion

5.1 Value Creation

5.1.1 Market Value and Economic Profit

This research has successfully shown that the market value of platinum mining companies exceeds their invested capital as a consequence of their ability to generate economic profits. The reason for the sharp rise in the market capitalisation of both Anglo Platinum and Impala at a time when their levels of invested capital were growing relatively slowly becomes apparent when their sustained performance in achieving high returns on new invested capital is recognised.

Measuring growth and value creation within these two successful firms would show a high correlation between the two factors, and it might thus be tempting to conclude that growth drives value. However, several of the other firms in the study have invested large amounts of capital which have yielded very meagre returns in terms of economic profit. Rather, then, we should regard growth as providing nothing more than an opportunity to create value.

Correlation scores for {Market Capitalisation/Invested Capital} against {Economic profit/Revenue} show a stable relationship through the second half of the 1990's, but in 2000 and 2001 this relationship seems to have broken down. It is surmised that this may reflect the volatility of the metal prices and exchange rates during that period, which factors disrupted the normally efficient market system. Certainly, in 2002 there is a return of the correlation score to earlier levels which appears to coincide with the return of stability to the currency market and bullion exchange.

Having established the link between market valuation and economic profitability, the study then focused on the relative importance of operating margin and capital budgeting. It was shown that market valuation is more strongly correlated with spread {RONIC-WACC} than with operating margin, and this is interpreted to mean that the former is a more potent driver of value than the latter. This conclusion is borne out by the ROIC analysis, in which the factors that differentiate top performing platinum producers from their rivals are shown to be components of capital turnover, principally PPE/revenue and net working capital/revenue.

5.1.2 Growth and RONIC

The annualised (average) RONIC for platinum companies, plotted against compound growth in Invested Capital (see figure 18(b)) shows a correlation (R^2) of just 0.02 disproving the myth that growth creates value. The same chart also highlights significant differences between the firms' performances, which are dealt with more fully under section 5.1.3.

Likewise, figure 20(a) shows that at least half of the companies covered by this research have earned returns on new invested capital of less than their cost of capital. This a reminder that platinum mining companies are no exception to the requirement for strong capital budgeting discipline in order to maintain economic profitability during growth.

5.1.3 Competitive analysis

Analysis of the ROIC tree suggests that the ratio PPE/Revenues is the source of much of the competitive advantage evident in the superior capital turnover enjoyed by Impala and Anglo Platinum. One possible reasons offered for this

phenomenon is that both firms have the opportunity to obtain economies of scale due to their smelting and refining capabilities; such advantage may not be available to their rivals. However, the effect of such economies is largely concentrated in the operational field and should, therefore, be reflected in the Net Margin side of the ROIC analysis, yet no impact is seen in the COGS/Revenue or Net margin/Revenue ratios which might illustrate this.

It has been shown that differentiation results from these firms maintaining superior discipline in their capital budgeting procedures. If this were the only reason, however, we should expect to see a *negative* correlation of growth with RONIC. In practice, as shown in Figure 18(b), there is no significant correlation, negative or positive. It thus appears that capital budgeting is a necessary discipline, but is not by itself an adequate explanation for the differentiation of a company's performance.

Companies will always tackle their most rewarding projects first, and so it is inevitable that, over time, the quality of the available investment opportunities will diminish. For capital budgeting to produce superior returns, the firm must have a continuously replenished supply of opportunities available for screening. These opportunities will result from the firm's successful pursuit of its strategy.

Anglo Platinum has focused on developing and thus bringing to account its extensive portfolio of South African mineral resources in joint venture with HDSA groups. These strategic mineral rights were acquired over a long period of time (i.e., old-order mineral rights), so their value must have been reflected in the share price of the company. Impala, somewhat less well endowed with ownership of South African mineral rights, has established strategic equity positions in platinum producers in South Africa and Zimbabwe, and thus has

been able to secure a growing volume of concentrate available for its smelting and refining operations.

Aquarius, which has shown the most aggressive growth in invested capital, has been unable to match the returns being earned by the two larger firms. If, as it appears, this situation stems from the inability of Aquarius, and other firms, to gain access to suitable mineral resources in South Africa, then ownership of mineral rights has presented a significant competitive advantage to the large firms.

With the advent of the Mining Charter, that situation has been irrevocably altered, and the challenge for the large firms will be to maintain their competitive strength in the absence of this factor.

With further regard to PPE/Revenues, an interesting contrast emerges between Stillwater and NAP. Both exploit palladium-rich deposits in North America – NAP from a large opencast mine and Stillwater from underground. NAP, however, employs only half the capital required by Stillwater to generate one unit of revenue.

It is possible that much of Stillwater's additional cost stems not from the different mining methods utilised but from the abortive East Boulder project into which Stillwater invested significant effort and money. The project did not produce the anticipated revenues (or returns). Although this unfortunate investment may not account for the failure of Stillwater (which led directly to its takeover by Norilsk) it must surely have been a significant contributing factor in its demise.

5.2 Effect of legislation

5.2.1 Mining Charter

Results of the research have shown that the Mining Charter is not expected to increase South Africa's national wealth. In the long-term it is to be hoped that the Charter will achieve its objective of facilitating access to HDSA groups, however, in the short-term the established companies see the Charter as a cost to be borne. Depending on the company in question, there appear to be different perceptions of the impact which the Charter will have on the value of 'old order rights'. Executives from established firms expect prices to fall below the free market price, while BEE companies expect the price to rise. Analysts were equally divided on the issue, suggesting that there remains scope for a scientific methodology which will allow a value to be placed on a mineral claim

5.2.2 Minerals & Petroleum Resources Development Act

There is no evidence that the Minerals and Petroleum Resources Development Act will result in the optimal development of South Africa's mineral resources, since the benefits to be obtained from the rationalisation of mineral rights boundaries seem likely to be balanced by the additional costs of implementing the Charter. Additional costs will comprise cash costs and the opportunity costs of lost economies of scale as well as higher discounts applied to South African assets by international investors perceiving an increased risk in doing business in South Africa.

The impact of the MRPDA on the value of unused 'old order' mineral rights has been assessed from two perspectives: the opinions of industry and investors; and the application of economic theory through Real Options Valuation.

In the eyes of managers and investors (represented by industry analysts) there is a wide spread of opinion. Some foresee a more competitive market in which competition from new entrants ensures that 'fair value' is paid. Others expect that established companies will be obliged to sell at a discount to fair value, given that the MRPDA states that factors other than market value must be taken into account in compensating owners whose rights may be expropriated.

Real Options Valuation, when applied to the hypothetical platinum resource portfolio described in section 4.5.3, demonstrates that a reduction in the period in which companies may decide to develop a mineral resource has a profound impact in the value of that option. It is suggested that this is representative of the loss in value that occurs when companies are faced with a 'use it or lose it' scenario through implementation of the MRPDA. In the hypothetical example given, an aggregate loss in value of some 70% of the "old order" value of the mineral rights is calculated.

It was shown (section 2.3.6) that a significant portion of a company's intrinsic worth lies in the 'continuing value' portion of its cash flows. For a mining company, this continuing value is inseparable from its right to develop and exploit its portfolio of mineral resources. Suppose that the market formerly valued platinum companies at a premium of, say, twenty-five percent to the NPV of the existing operations on the basis of owning a mineral rights portfolio which might be turned into continuing value. Then the unrecovered loss of fifteen percent in mining shares since the release of the 'leaked' Mining Charter is consistent with the market discounting that premium by 70%.

5.2.3 Royalties

Finally, reaction amongst survey respondents was universally negative regarding the proposed royalty on PGM production. Thus the contention that a royalty is preferable to any alternative form of contribution to the fiscus is disproved. Numerous alternatives exist, some (like the gold tax formula) having been proven under similar circumstances. The process by which the Charter was debated and differences resolved has at least provided the platinum industry with a model for future use in discussion and consensus building.

Chapter 6: Recommendations & Conclusion

This study has shown the applicability of the theory of economic profit to the platinum mining industry. It is, therefore, recommended that this work be extended to encompass other sectors of the mining industry, which are equally capital intensive and where narrow operating margins may cause management to focus unduly on unit operating costs and budgets, at the expense of good capital budgeting.

In order to promote the use of economic analysis in decision-making beyond the field of capital budgeting, it is recommended that management reports and incentive schemes should include measures of economic profit alongside the more traditional accounting and volume-driven measures of performance.

The depth of the analysis in this work has been constrained by lack of access to detailed cost information for most of the companies surveyed. However, taking this study as a point of departure, it would be interesting to pursue the analysis deeper in order to fully understand the reasons for the competitive advantage enjoyed by a few companies in certain areas of their operations.

It has been suggested in this study that some part of the competitive advantage which Impala and Anglo Platinum enjoy stems from their holding a superior portfolio of opportunities for investment, based on ownership of mineral rights. The extent of this advantage, and the impact of the MRPDA on this advantage, remains an area that warrants further research.

Finally, the application of Real Options Valuation has demonstrated that a valuation may be made of unused old-order mineral rights, based soundly on a

DCF evaluation of the development potential of the property in question, even when the current DCF model shows a negative NPV. The method avoids over-dependence on a single set of assumptions about expected prices and exchange rates, and appears to provide a valuation comparable to that found in the market. The MRPDA provides for market-related compensation to be paid in the event of expropriation of old-order mineral rights. Accordingly, it is recommended that the ROV method may find application in providing an objective valuation of any such claims.

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Appendix 1 Real Options Valuation

Black-Scholes Call option pricing formula applied to valuation of mineral rights.

Exercise price is the NPV of the investment capital needed to establish the mine.

Stock price is the current NPV of the project less the NPV of capex.

Days represent the length of the option period.

Risk-free rates – a real interest rate of 3% was assumed here

Volatility is the annual volatility in the stock price. The estimate of 5% here is probably rather low, deliberately to provide a conservative value estimate.

The table below shows the value of a call option, for periods of 1 to 20 years.

		3.4	3.7	4.0
Stock		621.83	973.17	1 301.71
Exercise		1 301.65	1 301.65	1 301.65
Days		2 191.50	2 191.50	2 191.50
Risk-free		3%	3%	3%
Volatility		5%	5%	5%
Call option		0.00	12.56	219.17
	1	-	0.00	49.35
	2	-	0.01	85.74
	3	0.00	0.32	120.47
	4	0.00	1.90	154.20
	5	0.00	5.80	187.09
	6	0.00	12.56	219.17
	7	0.00	22.23	250.46
	8	0.01	34.58	280.96
	9	0.03	49.21	310.66
	10	0.10	65.70	339.58
	11	0.28	83.65	367.72
	12	0.66	102.69	395.08
	13	1.35	122.51	421.69
	14	2.48	142.84	447.55
	15	4.17	163.48	472.68
	16	6.54	184.24	497.08
	17	9.69	204.99	520.79
	18	13.68	225.61	543.82
	19	18.55	246.02	566.17
	20	24.32	266.15	587.88

Schedules of the DCF analysis for the 3.4 g/t, 3.7 g/t and 4.0 g/t case follow.

Revenue	Metal Prices (Life of Mine)	Recovery to concentrate	Value paid for metal in concentrate	Grade of metal in ore (g/tonne)	Revenue US$ per tonne	Revenue Rand per tonne
	US$/oz					7.049
			31	3.40	32.64	230.06
Platinum	750.00	80%	80%	1.53	23.61	166.44
Palladium	200.00	80%	80%	1.53	6.30	44.38
Rhodium	450.00	80%	80%	0.14	1.26	8.88
Gold	350.00	80%	80%	0.20	1.47	10.36

	NPV at 10% p.a.
EBITA	634.4
TAX	12.6
PAT	621.8
CAPEX	1 301.7
PROJECT	-679.8

Operating costs per tonne	200.00
Operating margin (per tonne)	30.06
Operating margin (percent)	13.1%

Base Case	
NPV (R million at 10%)	-679.8
IRR	1.3%

Tonnes per annum treated (million)	3.000	60
EBITA	90	204

4E oz 000
6 559

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EBITA	-	-	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
CAPEX	750	750																			
TAX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	27	27
FCF	-750	-750	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	80	63	63
Tax computation: On-mine																					
Assessed loss (opening)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profit/(Loss) for the period	-	-	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Taxable profit / (Assessed loss c/fwd)		-	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Unredeemed capex (opening)	-	750	1 500	1 410	1 320	1 229	1 139	1 049	959	869	779	688	598	508	418	328	238	147	57	-	-
Capex for the period	750	750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unredeemed capex (closing)	750	1 500	1 410	1 320	1 229	1 139	1 049	959	869	779	688	598	508	418	328	238	147	57	-	-	-
Taxable Profit (after losses b/fwd)	-	-	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Capex redeemed this period	-	-	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	57	-	-
Net taxable profit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	90	90
Tax on income (30%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	27	27

Revenue	Metal Prices (Life of Mine)	Recovery to concentrate	Value paid for metal in concentrate	Grade of metal in ore (g/tonne)	Revenue US$ per tonne	Revenue Rand per tonne
	US$/oz					7.049
			31	3.70	35.52	250.36
Platinum	750.00	80%	80%	1.67	25.69	181.13
Palladium	200.00	80%	80%	1.67	6.85	48.30
Rhodium	450.00	80%	80%	0.15	1.37	9.66
Gold	350.00	80%	80%	0.22	1.60	11.27

	NPV at 10% p.a.
EBITA	1 062.9
TAX	89.8
PAT	973.2
CAPEX	1 301.7
PROJECT	-328.5

	g/t recov	Pt tpa	Pt koz
	1.33	4.00	128

Operating costs per tonne	200.00
Operating margin (per tonne)	50.36
Operating margin (percent)	20.1%

Base Case	
NPV (R million at 10%)	-328.5
IRR	6.0%

		4E oz 000
Tonnes per annum treated (million)	3.000	60
EBITA	151	222 7 138

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EBITA	-	-	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151
CAPEX	750	750																			
TAX	-	-	-	-	-	-	-	-	-	-	-	3	45	45	45	45	45	45	45	45	45
FCF	-750	-750	151	151	151	151	151	151	151	151	151	148	106	106	106	106	106	106	106	106	106
Tax computation: On-mine																					
Assessed loss (opening)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profit/(Loss) for the period	-	-	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151
Taxable profit / (Assessed loss c/fwd)		-	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151
Unredeemed capex (opening)	-	750	1 500	1 349	1 198	1 047	896	745	594	443	291	140	-	-	-	-	-	-	-	-	-
Capex for the period	750	750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unredeemed capex (closing)	750	1 500	1 349	1 198	1 047	896	745	594	443	291	140	-	-	-	-	-	-	-	-	-	-
Taxable Profit (after losses b/fwd)	-	-	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151
Capex redeemed this period	-	-	151	151	151	151	151	151	151	151	151	140	-	-	-	-	-	-	-	-	-
Net taxable profit	-	-	-	-	-	-	-	-	-	-	-	11	151	151	151	151	151	151	151	151	151
Tax on income (30%)	-	-	-	-	-	-	-	-	-	-	-	3	45	45	45	45	45	45	45	45	45

Revenue	Metal Prices (Life of Mine)	Recovery to concentrate	Value paid for metal in concentrate	Grade of metal in ore (g/tonne)	Revenue US$ per tonne	Revenue Rand per tonne
	US$/oz					7.049
			31	4.00	38.40	270.66
Platinum	750.00	80%	80%	1.80	27.78	195.81
Palladium	200.00	80%	80%	1.80	7.41	52.22
Rhodium	450.00	80%	80%	0.16	1.48	10.44
Gold	350.00	80%	80%	0.24	1.73	12.18

	NPV at 10% p.a.
EBITA	1 491.4
TAX	189.7
PAT	1 301.7
CAPEX	1 301.7
PROJECT	0.1

	g/t recPt tpa	Pt koz
	1.44 4.32	139
		2778

Operating costs per tonne	200.00
Operating margin (per tonne)	70.66
Operating margin (percent)	26.1%
Tonnes per annum treated (million)	3.000
EBITA	212

Base Case	
NPV (R million at 10%)	0.1
IRR	10.0%

	4E oz 000
60	
240	7 716

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EBITA	-	-	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212
CAPEX	750	750																			
TAX	-	-	-	-	-	-	-	-	-	59	64	64	64	64	64	64	64	64	64	64	64
FCF	-750	-750	212	212	212	212	212	212	212	153	148	148	148	148	148	148	148	148	148	148	148
Tax computation: On-mine																					
Assessed loss (opening)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profit/(Loss) for the period	-	-	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212
Taxable profit / (Assessed loss c/fwd)		-	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212
Unredeemed capex (opening)	-	750	1 500	1 288	1 076	864	652	440	228	16	-	-	-	-	-	-	-	-	-	-	-
Capex for the period	750	750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unredeemed capex (closing)	750	1 500	1 288	1 076	864	652	440	228	16	-	-	-	-	-	-	-	-	-	-	-	-
Taxable Profit (after losses b/fwd)	-	-	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212
Capex redeemed this period	-	-	212	212	212	212	212	212	212	16	-	-	-	-	-	-	-	-	-	-	-
Net taxable profit	-	-	-	-	-	-	-	-	-	196	212	212	212	212	212	212	212	212	212	212	212
Tax on income (30%)	-	-	-	-	-	-	-	-	-	59	64	64	64	64	64	64	64	64	64	64	64

Appendix 2 Questionnaire

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

GORDON INSTITUTE OF BUSINESS SCIENCE
University of Pretoria

MBA Research Report Questionnaire

Thank you for taking the time to complete this questionnaire. The answers you provide will form part of a research report into *Value Creation in the Platinum Industry of South Africa*. If you need more space to complete your answer, please attach a separate sheet of paper. The completed questionnaire should be returned by **05 November 2003** (or sooner if you can!). If you have any questions while answering this survey, please contact me on (083) 455 2660 or c-jacobs@mweb.co.za. Thanks again.

Chris Jacobs - October 2003

Background

Over the last two years, the mining industry in South Africa has been the focus of new legislation aimed at providing wider opportunities for Historically Disadvantaged South Africans to become actively involved in the ownership and management of mines and mining companies. The Mining Charter sets targets for equity participation, and royalties determined as a percentage of revenue are proposed.

This questionnaire aims to sound out opinion as to the likely long-term impact of these changes in terms of value accruing to the shareholders of established platinum mining companies, in Black Economic Empowerment ("BEE") groups, and for the nation.

1. Effect of Mining Charter on Value Creation Opportunities

				(Tick one)
1.1	The Mining Charter aims to ensure that **BEE** companies and other new entrants have more opportunities to add value for their share-holders than previously. To what extent does it achieve this?	1.	In full	
		2.	Mostly	
		3.	Slightly	
		4.	No change	
		5.	Worse than before	
		6.	Don't know / Too soon to tell	
1.2	Why? Briefly explain your answer to question 1.1			
1.3	Do **established** companies now have more opportunities to add value for their shareholders than previously?	1.	Many more	
		2.	A few more	
		3.	Same as before	
		4.	Less than before	
		5.	None	
		6.	Don't know / Too soon to tell	
1.4	Why is this?			

1.5	What do you think will be the overall effect of the Mining Charter on **aggregate** shareholder value amongst **all** groups?	1.	Shareholder value will *increase* in aggregate	
		2.	"Zero sum" – simply a redistribution of wealth	
		3.	None – the situation will remain unchanged	
		4.	Shareholder value will *decrease* in aggregate	
		5.	Don't know / Too soon to tell	
1.6	What is the long-term effect on the aggregate market value of South Africa's platinum mining industry?			

2. Value of 'Old Order' and 'New Order' Mineral Rights

Recently, the Minerals & Petroleum Development Act set a time frame within which companies must commit to a plan for developing their mineral rights or risk seeing them awarded to new entrants. What impact has this on their market value?

2.1	The market value of unused 'old order' mineral rights should …	1.	Increase in value	
		2.	Remain the same	
		3.	Decrease in value	
2.2	By what percentage might the value change?	4.	Insert a percentage figure in the box	%
2.3	Please briefly explain why this is so.			

3. Alternatives to the Revenue-based Royalty

Concerns have been expressed about the impact on mining of the proposed revenue-based royalties…

3.1	Assuming some additional contribution to the fiscus to be inevitable, what would be your preference for this in terms of enhancing shareholder value?	1.	Revenue based Royalty, as proposed by Govt.	
		2.	Increased rate of Secondary tax on companies	
		3.	Sliding scale of royalties based on profitability	
		4.	Improved collection of existing taxes	
		5.	Other (please specify in space below)	
3.2	Please briefly explain your choice.			

Thank you for your contribution. How may I contact you to share the results of the research?

Name	Company
Phone	e-mail

Appendix 3 Example Economic Profit Model

Stillwater										
Income Statement		1994	1995	1996	1997	1998	1999	2000	2001	2002
		US$	US$	US$	US$	US$	US$	US$	US$	US$
Revenues		54 934	51 335	56 214	76 877	106 723	152 747	225 232	277 381	275 599
Commissions paid		0	0	0	0	0	0	0	0	0
COGS - On-mine costs		0	0	0	0	0	0	0	0	0
COGS - concentrating		0	0	0	0	0	0	0	0	0
COGS - Smelting costs		0	0	0	0	0	0	0	0	0
COGS - Refining		0	0	0	0	0	0	0	0	0
COGS - (Increase)/decrease in metal inventories		46 041	-45 864	-50 175	-67 948	-66 793	-81 451	-103 902	-134 430	-171 015
COGS - Transfer (from)/to metal lease liability		0	0	0	0	0	0	0	0	0
COGS - Other		0	0	0	0	0	0	0	0	0
General & Admin		-768	-1 974	-2 532	-3 479	-5 102	-7 305	-9 753	-22 342	-14 205
Depreciation of non-operating assets		0	0	0	0	0	0	0	0	0
Amortisation of operating assets		-5 232	-5 749	-8 699	-11 658	-11 642	-13 557	-17 623	-23 722	-38 990
EBITA		**2893.0**	**-2252.0**	**-5192.0**	**-6208.0**	**23186.0**	**50434.0**	**93954.0**	**96887.0**	**51389.0**
Amortisation of goodwill										
Operating Income		**2893.0**	**-2252.0**	**-5192.0**	**-6208.0**	**23186.0**	**50434.0**	**93954.0**	**96887.0**	**51389.0**
Interest & dividend income		221	2 795	2 138	1 073	1 354	1 048	1 095	1 900	903
Interest expense		-320	-431	-1 461	-3 608	-2 774	-137	0	0	-17 601
Gain on disposal FA / W'down securites		0	0	0	0	0	0	0	0	0
Other net (expenditure)/income		0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12658.0	5938.0
Royalty expense		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earnings before tax		**2794.0**	**112.0**	**-4515.0**	**-8743.0**	**21766.0**	**51345.0**	**95049.0**	**86129.0**	**40629.0**
A. Current tax (excl STC)		-243	-44	1 736	3 366	-8 380	-14 174	-27 150	-20 325	-8 945
B. Secondary Tax on Companies (STC)										
C. Deferred tax/tax normalisation										
Income from associate (after-tax)										
Minority interest										
Income before E/O items		**2551.0**	**68.0**	**-2779.0**	**-5377.0**	**13386.0**	**37171.0**	**67899.0**	**65804.0**	**31684.0**
Extraordinary Items		-568.0	0.0	13861.0	0.0	0.0	0.0	-6435.0	0.0	0.0
Net income for the year		**1983.0**	**68.0**	**11082.0**	**-5377.0**	**13386.0**	**37171.0**	**61464.0**	**65804.0**	**31684.0**
Accumulated profits b/fwd		-7761.0	-5778.0	-5710.0	5372.0	-5.0	13381.0	50552.0	112016.0	177820.0
Dividend paid - prior year										
Dividend paid - current year										
Transfer to ND reserves										
Effect of accounting policy changes										
Movement on dividend payables										
Accumulated Profit at year end		-5778.0	-5710.0	5372.0	-5.0	13381.0	50552.0	112016.0	177820.0	209504.0

Balance Sheet			1994	1995	1996	1997	1998	1999	2000	2001	2002
Assets											
Operating cash		WC	0	714	16 389	4 191	49 811	2 846	18 219	14 911	28 163
Excess cash & marketable securities		NON	77 234	23 933	17 060	13 468	0	0	2 636	0	0
Accounts receivable		WC	0	0	71	6 926	21 762	26 248	0	21 773	18 647
Finished Goods			*0*	*18 450*	*13 522*	*7 380*	*9 333*	*11 658*	*42 625*	*42 944*	*52 058*
Consumable stores & raw materials			*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Work in progress			*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Inventories - total		WC	0	18 450	13 522	7 380	9 333	11 658	42 625	42 944	52 058
Other current assets		WC	0	1 237	1 221	1 349	1 492	3 013	2 943	4 745	7 828
Gross PPE (Mining)		*FA*	*76 264*	*115 784*	*187 802*	*191 254*	*312 023*	*505 040*	*602 110*	*774 036*	*794 019*
Gross PPE (Other)	*[Leased]*		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Accum Dep. & Amort. of operating assets		*FA*	*0*	*0*	*0*	*0*	*-64 467*	*-76 788*	*0*	*0*	*0*
Net PPE			76 264	115 784	187 802	191 254	247 556	428 252	602 110	774 036	794 019
Goodwill											
Environmental Trust fund											
Other intangible assets (Deferred tax asset)			0	640	798	1 989	2 980	1 945	7 732	1 417	5 779
Other operating assets	Prepayments		0	1 417	3 047	2 662	3 003	4 876	2 761	8 395	7 720
Investments & advances	Assoc	NON	0	0	0	0	0	0	0	0	0
Other non-operating assets	Non-mining		0	0	0	0	0	0	0	0	0
Total assets			**153 498**	**162 175**	**239 910**	**229 219**	**335 937**	**478 838**	**679 026**	**868 221**	**914 214**
Liabilities & Equity											
Short-term debt			0	460	1 463	1 982	2 425	2 628	1 970	9 008	21 461
Accounts payable			9 427	4 751	5 039	2 709	11 980	20 157	21 710	21 539	14 310
Dividends payable (excl STC)			0	0	0	0	0	0	0	0	0
Non current liabilities			0	2346	2528	2283	0	0	0	0	0
Non current liabilities (other)			0	978	3 922	1 904	3 312	5 299	6 504	10 901	9 736
Long term debt			1 715	8 713	62 563	61 513	58 992	84 404	157 256	257 777	200 792
Other operating liabilities	(non int-bearing)										
Deferred Tax			0	8 441	15 320	11 782	19 009	29 042	55 457	71 887	80 615
Retirement-related provisions			0	1909	2289	1972	8241	9882	18061	14218	17088
Other/ongoing provisions			0	2 272	3 120	3 682	3 971	4 322	17 454	7 768	10 998
Minority interest											

Stillwater										
Historical Invested Capital		1994	1995	1996	1997	1998	1999	2000	2001	2002
Where invested?										
Operating current assets		0	20401	31203	19846	82398	43765	63787	84373	106696
Operating current liabilities	(TAX)	-9427	-5729	-8961	-4613	-15292	-25456	-28214	-32440	-24046
Operating working capital		-9427	14672	22242	15233	67106	18309	35573	51933	82650
Net PPE		76264	115784	187802	191254	247556	428252	602110	774036	794019
Other assets net of other Liabs		0	2057	3845	4651	5983	6821	10493	9812	13499
Operating invested capital before good		**66837**	**132513**	**213889**	**211138**	**320645**	**453382**	**648176**	**835781**	**890168**
Cumulative goodwill w/o, amortisec	##	0	0	0	0	0	0	0	0	0
Operating invested capital after goodw		**66837**	**132513**	**213889**	**211138**	**320645**	**453382**	**648176**	**835781**	**890168**
Excess cash & marketable securities		77234	23933	17060	13468	0	0	2636	0	0
Capital work in progress										
Environmental trust fund		0	0	0	0	0	0	0	0	0
Investments and advances		0	0	0	0	0	0	0	0	0
Non-mining assets		0	0	0	0	0	0	0	0	0
Total investor funds		**144071**	**156446**	**230949**	**224606**	**320645**	**453382**	**650812**	**835781**	**890168**
Where from?		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shares & share premium		148134	138015	138294	141397	214626	272552	288598	291570	352041
Retained earnings & reserves		-5778	-5710	5372	-5	13381	50552	112016	183553	207173
Total common & preferred equity		**142356**	**132305**	**143666**	**141392**	**228007**	**323104**	**400614**	**475123**	**559214**
Cumulative goodwill w/o, amortisec	##	0	0	0	0	0	0	0	0	0
Deferred tax		0	8441	15320	11782	19009	29042	55457	71887	80615
Dividends payable		0	0	0	0	0	0	0	0	0
STC in respect of dividends payable		0	2346	2528	2283	0	0	0	0	0
Other/ongoing provisions		0	2272	3120	3682	3971	4322	17454	7768	10998
Adjusted equity		**142356**	**145364**	**164634**	**159139**	**250987**	**356468**	**473525**	**554778**	**650827**
Minority interests		0	0	0	0	0	0	0	0	0
Debt		1715	9173	64026	63495	61417	87032	159226	266785	222253
Retirement-related provisions		0	1909	2289	1972	8241	9882	18061	14218	17088
Total investor funds		**144071**	**156446**	**230949**	**224606**	**320645**	**453382**	**650812**	**835781**	**890168**

Historical NOPLAT		1994	1995	1996	1997	1998	1999	2000	2001	2002
Reported EBITA		2893	-2252	-5192	-6208	23186	50434	93954	96887	51389
Adjustment for retirement-related liability		0	151	91	112	366	18	0	0	1230
Incr/(Decr) in other/ongoing provisions		0	2272	848	562	289	351	13132	-9686	3230
Adjusted EBITA		2893	171	-4253	-5534	23841	50803	107086	87201	55849
Tax on EBITA	see be	-252	825	1961	2347	-9068	-13928	-26837	-22864	-11585
Increase in deferred tax		0	8441	6879	-3538	7227	10033	26415	16430	8728
NOPLAT		**2641**	**9437**	**4588**	**-6725**	**22000**	**46909**	**106664**	**80767**	**52992**
Tax on EBITA										
A. Prov income tax -"Current tax (excl ST		-243	-44	1736	3366	-8380	-14174	-27150	-20325	-8945
B. Prov tax - "Secondary tax on Companie		0	0	0	0	0	0	0	0	0
C. Provision for deferred tax		0	0	0	0	0	0	0	0	0
Tax on interest income		19	1098	822	413	521	289	313	448	199
Tax on income from associates rec'd gros		0	0	0	0	0	0	0	0	0
Tax/(shield) on other income/(expense)		0	0	0	0	0	0	0	-2987	1307
Tax shield on royalty expense		0	0	0	0	0	0	0	0	0
Tax shield on interest expense		-28	-169	-562	-1389	-1068	-38	0	0	-3875
Tax shield on retirement-related interest		0	-59	-35	-43	-141	-5	0	0	-271
Tax on EBITA		-252	825	1961	2347	-9068	-13928	-26837	-22864	-11585
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reconciliation to net income										
Net income		1983	68	11082	-5377	13386	37171	61464	65804	31684
Add: Increase in deferred taxes		0	8441	6879	-3538	7227	10033	26415	16430	8728
Add: Increase in ongoing provisions		0	2272	848	562	289	351	13132	-9686	3230
Add: Extraordinary items		568	0	-13861	0	0	0	6435	0	0
Add: Minority interest		0	0	0	0	0	0	0	0	0
Add: Amortisation of Goodwill		0	0	0	0	0	0	0	0	0
Less: Income from associates (AFTER TA		0	0	0	0	0	0	0	0	0
Adjusted net income		2551	10781	4948	-8353	20902	47555	107446	72548	43642
Add: Other income/(expense) after tax		0	0	0	0	0	0	0	9671	-4631
Add: Royalty expense (after tax		0	0	0	0	0	0	0	0	0
Add: Interest expense after tax		292	262	899	2219	1706	99	0	0	13726
Add: Interest expense on RRL after tax		0	92	56	69	225	13	0	0	959

Stillwater									
Historical Free Cash Flow	1994	1995	1996	1997	1998	1999	2000	2001	2002
Operating Cash flows									
NOPLAT	2641	9437	4588	-6725	22000	46909	106664	80767	52992
Depreciation	0	0	0	0	0	0	0	0	0
Amortisation of op.assets	5232	5749	8699	11658	11642	13557	17623	23722	38990
Gross cash flow	7873	15186	13287	4933	33642	60466	124287	104489	91982
Increase in operating cash	0	-714	-15675	12198	-45620	46965	-15373	3308	-13252
Increase in accounts receivable	0	0	-71	-6855	-14836	-4486	26248	-21773	3126
Increase in inventories	0	-18450	4928	6142	-1953	-2325	-30967	-319	-9114
Increase in other current assets	0	-1237	16	-128	-143	-1521	70	-1802	-3083
Increase in PPE (net of disposals)	-5877	-39520	-72018	-3452	-56302	-180696	-173858	-171926	-19983
(Increase) in accounts payable	2624	-4676	288	-2330	9271	8177	1553	-171	-7229
(Increase) in dividend payable ##	0	0	0	0	0	0	0	0	0
(Increase) in non-interest bearing liabilities	0	2346	182	-245	-2283	0	0	0	0
(Increase) in other current tax liabilities	0	978	2944	-2018	1408	1987	1205	4397	-1165
(Increase) in other liabilities	0	0	0	0	0	0	0	0	0
Depreciation	0	0	0	0	0	0	0	0	0
Amortisation of operating assets	-5232	-5749	-8699	-11658	-11642	-13557	-17623	-23722	-38990
Gross investment	-8485	-67022	-88105	-8346	-122100	-145456	-208745	-212008	-89690
Free cash flow before goodwill	-612	-51836	-74818	-3413	-88458	-84990	-84458	-107519	2292
Amortisation of goodwill	0	0	0	0	0	0	0	0	0
Investment/(write-off) in Goodwill	0	0	0	0	0	0	0	0	0
Free cash flow after goodwill	-612	-51836	-74818	-3413	-88458	-84990	-84458	-107519	2292
C/I Environmental Trust fund	0	0	0	0	0	0	0	0	0
C/I other intangible assets (non-currrent R	0	-640	-158	-1191	-991	1035	-5787	6315	-4362
C/I Other operating assets	0	-1417	-1630	385	-341	-1873	2115	-5634	675
C/I investments and advances	0	0	0	0	0	0	0	0	0
C/I Other non-operating assets	0	0	0	0	0	0	0	0	0
Interest & dividend income after tax	202	1697	1316	660	833	759	782	1452	704
Income from associate (after tax)	0	0	0	0	0	0	0	0	0
Other net (expenditure)/income after tax	0	0	0	0	0	0	0	-9671	4631
After-tax royalty expense	0	0	0	0	0	0	0	0	0
Extraordinary items	-568	0	13861	0	0	0	-6435	0	0
(Increase)/Decrease in marketable securiti	-55161	53301	6873	3592	13468	0	-2636	2636	0
Cash flow available to investors	**-56139**	**1105**	**-54557**	**33**	**-75489**	**-85070**	**-96419**	**-112421**	**3940**
	0	0	0	0	0	0	0	0	0
Financing flows									
After-tax interest expense	292	262	899	2219	1706	99	0	0	13726
Adjustment for retirement-related liability	0	92	56	69	225	13	0	0	959
Minority interest	0	0	0	0	0	0	0	0	0
Dividends paid - prior year	0	0	0	0	0	0	0	0	0
Dividends paid - current year	0	0	0	0	0	0	0	0	0
Decrease/(increase) in short-term debt	0	-460	-1003	-519	-443	-203	658	-7038	-12453
Decrease/(increase) in long-term debt	75	-6998	-53850	1050	2521	-25412	-72852	-100521	56985
Decrease/(increase) in retirement related l	0	-1909	-380	317	-6269	-1641	-8179	3843	-2870
Decrease/(increase) in minority interest	0	0	0	0	0	0	0	0	0
Decrease/(increase) in preference shares	0	0	0	0	0	0	0	0	0
Decrease/(increase) in share capital	-56506	10119	-279	-3103	-73229	-57926	-16046	-8705	-52407
Total financing (outflow)/inflow	**-56139**	**1105**	**-54557**	**33**	**-75489**	**-85070**	**-96419**	**-112421**	**3940**

Historical Economic profit	1994	1995	1996	1997	1998	1999	2000	2001	2002
ROIC (before goodwill) [beg of period I	**4.2%**	**14.1%**	**3.5%**	**-3.1%**	**10.4%**	**14.6%**	**23.5%**	**12.5%**	**6.3%**
WACC	16.7%	12.0%	11.1%	11.0%	10.8%	10.6%	11.2%	8.2%	7.3%
Spread	-12.5%	2.1%	-7.7%	-14.2%	-0.4%	4.0%	12.4%	4.2%	-1.0%
Invested capital (beginning of year)	63584	66837	132513	213889	211138	320645	453382	648176	835781
Spread x invested capital (begin. of year)	-7959	1393	-10164	-30273	-815	12955	56018	27460	-8135
NOPLAT	2641	9437	4588	-6725	22000	46909	106664	80767	52992
Capital Charge	10600	8045	14751	23548	22815	33954	50646	53307	61127
Economic profit	-7959	1393	-10164	-30273	-815	12955	56018	27460	-8135
ROIC (after goodwill) [beg of period IC	**4.2%**	**14.1%**	**3.5%**	**-3.1%**	**10.4%**	**14.6%**	**23.5%**	**12.5%**	**6.3%**
WACC	16.7%	12.0%	11.1%	11.0%	10.8%	10.6%	11.2%	8.2%	7.3%
Spread	-12.5%	2.1%	-7.7%	-14.2%	-0.4%	4.0%	12.4%	4.2%	-1.0%
Invested capital (beginning of year)	63584	66837	132513	213889	211138	320645	453382	648176	835781
EP = Spread x invested capital (begin. of	-7959	1393	-10164	-30273	-815	12955	56018	27460	-8135

Stillwater									
Historical Operating Ratios	1994	1995	1996	1997	1998	1999	2000	2001	2002
Adjusted EBITA/revenues									
Commissions/revenue	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
COGS/revenues	83.8%	89.3%	89.3%	88.4%	62.6%	53.3%	46.1%	48.5%	62.1%
Other costs/revenue	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.6%	-2.2%
Market development /revenue	1.4%	3.8%	4.5%	4.5%	4.8%	4.8%	4.3%	8.1%	5.2%
Depreciation expense/revenue	9.5%	11.2%	15.5%	15.2%	10.9%	8.9%	7.8%	8.6%	14.1%
Adj retirement-related liability/revenue	0.0%	-0.3%	-0.2%	-0.1%	-0.3%	0.0%	0.0%	0.0%	-0.4%
Incr. Provisions/revenue	0.0%	-4.4%	-1.5%	-0.7%	-0.3%	-0.2%	-5.8%	3.5%	-1.2%
Adj.EBITA/revenue	5.3%	0.3%	-7.6%	-7.2%	22.3%	33.3%	47.5%	31.4%	20.3%
Operating Margin	5.3%	-4.4%	-9.2%	-8.1%	21.7%	33.0%	41.7%	34.9%	18.6%
Return on invested capital (beg of yr)									
Net PPE/revenue	128.1%	148.6%	206.0%	244.3%	179.2%	162.1%	190.1%	217.1%	280.9%
Working capital/revenue	-12.4%	-18.4%	26.1%	28.9%	14.3%	43.9%	8.1%	12.8%	18.8%
Net other assets/revenue	0.0%	0.0%	3.7%	5.0%	4.4%	3.9%	3.0%	3.8%	3.6%
Revenues/invested capital	0.86	0.77	0.42	0.36	0.51	0.48	0.50	0.43	0.33
Pre-tax ROIC	4.5%	0.3%	-3.2%	-2.6%	11.3%	15.8%	23.6%	13.5%	6.7%
Cash tax rate (tax on EB	8.7%	-5414.6%	207.9%	-21.5%	7.7%	7.7%	0.4%	7.4%	5.1%
After tax ROIC	4.2%	14.1%	3.5%	-3.1%	10.4%	14.6%	23.5%	12.5%	6.3%
After tax ROIC (after goodwill)	4.2%	14.1%	3.5%	-3.1%	10.4%	14.6%	23.5%	12.5%	6.3%
Economic Profit/Revenue	-14.5%	2.7%	-18.1%	-39.4%	-0.8%	8.5%	24.9%	9.9%	-3.0%
Economic Profit/NOPLAT	-301.3%	14.8%	-221.5%	450.1%	-3.7%	27.6%	52.5%	34.0%	-15.4%
Incremental IC	63 584	3 253	65 676	81 376	-2 751	109 507	132 737	194 794	187 605
RONIC	4.2%	208.9%	-7.4%	-13.9%	-1044.2%	22.7%	45.0%	-13.3%	-14.8%
Progressive RONIC			2.8%	-6.2%	13.1%	17.2%	26.7%	13.4%	6.5%
Compound RONIC			1.4%	-2.1%	3.1%	3.2%	4.0%	1.8%	0.8%
Revenue growth rate	9.5%	-6.6%	9.5%	36.8%	38.8%	43.1%	47.5%	23.2%	-0.6%
Adjusted EBITA growth rate		-94.1%	-2585.0%	30.1%	-530.8%	113.1%	110.8%	-18.6%	-36.0%
NOPLAT growth rate		257.3%	-51.4%	-246.6%	-427.1%	113.2%	127.4%	-24.3%	-34.4%
Invested capital growth rate	5.1%	98.3%	61.4%	-1.3%	51.9%	41.4%	43.0%	28.9%	6.5%
Net income growth rate	-135.2%	-96.6%	16197.1%	-148.5%	-348.9%	177.7%	65.4%	7.1%	-51.9%
Progressive IC growth	5.1%	108.4%	236.4%	232.1%	404.3%	613.0%	919.4%	1214.5%	1300.0%
Compound IC growth	5.1%	44.4%	49.8%	35.0%	38.2%	38.7%	39.3%	38.0%	34.1%
Inventory/revenue	0.0%	35.9%	24.1%	9.6%	8.7%	7.6%	18.9%	15.5%	18.9%
Coverage (adjusted EBITA/interest)	9.0	0.4	-2.9	-1.5	8.6	370.8	#DIV/0!	#DIV/0!	3.2
Cash coverage (Gross CF/interest)	24.6	35.2	9.1	1.4	12.1	441.4	#DIV/0!	#DIV/0!	5.2
Debt/NBV	1.2%	7.1%	28.7%	29.1%	21.7%	21.4%	27.2%	33.6%	26.9%
Debt/Mkt.Val									
Average ROE	1.4%	0.1%	7.7%	-3.8%	5.9%	11.5%	15.3%	13.8%	5.7%
NOPLAT/REVENUE	5%	18%	8%	-9%	21%	31%	47%	29%	19%
Cumulative investment rate	2407%	553%	795%	2152%	661%	407%	244%	243%	262%
IC+Cum.EP	58 878	125 947	197 159	164 135	272 828	418 520	669 332	884 397	930 649
Assumptions	1994	1995	1996	1997	1998	1999	2000	2001	2002
copy Col.D into row to restore formula									
Effective tax rate ##	8.7%	39.3%	38.4%	38.5%	38.5%	27.6%	28.6%	23.6%	22.0%
Average debt (beg+end)	1 753	5 444	36 600	63 761	62 456	74 225	123 129	213 006	244 519
Interest rate paid (pre-tax) ##	18.3%	7.9%	4.0%	5.7%	4.4%	0.2%	0.0%	0.0%	7.2%
IC	66 837	132 513	213 889	211 138	320 645	453 382	648 176	835 781	890 168
Rate of growth of IC	5%	98%	61%	-1%	52%	41%	43%	29%	7%
Spread	-13%	2%	-8%	-14%	0%	4%	12%	4%	-1%
Cumulative economic profit	-7 959	-6 566	-16 730	-47 003	-47 817	-34 862	21 156	48 616	40 481
Mkt Cap (Equity+Debt)	1 753	766 694	748 657	839 853	1 010 158	1 328 627	1 217 223	1 253 500	795 884
Period	8	7	6	5	4	3	2	1	
Compound RONIC	6.5%	5.7%	6.9%	9.6%	5.0%	1.2%	-14.0%	-14.8%	
	1331.8%	671.8%	416.2%	421.6%	277.6%	196.3%	137.3%	106.5%	
Compound Growth in IC	39.5%	33.9%	31.5%	39.1%	39.4%	43.6%	54.1%	106.5%	
Column number	7	9	11	13	15	17	19	21	23