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# Evaluation of Zambia's Mineral Taxation Regimes: A Case Study of Lumwana Mine

by

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# Declaration

To the best of my knowledge and belief this dissertation contains no material previously published by any other person except where due acknowledgement has been made. This dissertation contains no material that has been accepted for the award of any other degree or diploma in any other University.

Signed: _____ Date: _____

**WEBBY BANDA**

# Publications

The following publications have been made during the period of the Masters research.

1. **Banda, W.,** and Besa, B. (2016). '**Economic Appraisal of Zambia's Mineral Taxation Regimes**,' *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, Vol. 18, No. 1, pp.279–296. ISSN (Online): 2313–4402; ISSN (Print): 2313–4410.

2. **Banda, W.,** and Besa, B. (2016). **'Review and Restructure of Zambia's 2008 Mining Windfall Tax,'** a paper accepted to the *2016 Engineering Institution of Zambia (EIZ) Symposium*, 22nd – 23rd April 2016, Avani Victoria Falls, Livingstone, Zambia.

3. **Banda, W.,** and Besa, B. (2016). **'Modeling the Impact of Royalty Tax on the Mining Industry: A Case Study of Zambia,'** paper submitted to the '*Journal of Natural and Applied Sciences (JONAS)*' (Accepted).

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# Abstract

There has been a lot of outcry from the public that Zambia's mineral tax reforms, with an aim to optimize revenue benefits from the mines, have not yielded the desired results. This has mainly been attributed to the weak design of its legislated mineral taxation systems. Due to this underlying reason, this research aims at evaluating Zambia's mineral taxation regimes with an objective of assessing their robustness so as to ultimately determine that which is sturdiest in design. This research brings forward a well compiled methodology of evaluating mineral taxation regimes. It also possesses the potential of acting as a future reference of optimizing Zambia's mineral taxation.

The evaluation was based on Lumwana Mine and encompassed five criterions. These included neutrality, progressivity, revenue raising potential, government risk and investor perception of risk. These measures were selected as criteria for evaluation because they best capture and define the revenue generating objective of a taxation regime. The evaluation framework employed spreadsheet modelling and was anchored on two state of affairs which include the status quo and worst case scenario.

The research has reviewed that the Post-2015 mineral taxation system is the most robust in design. This is because of its robust tax structure which exhibits proper synergy and harmonization of its taxation instruments. To the contrary, the 2008 tax regime is the weakest in design. This has been attributed to its weak tax structure that demonstrates a blending incapacitation of its taxes. Overall results indicate that Zambia's mineral taxation systems except the 2008 regime are relatively robust in capturing mining revenue.

It can be concluded that it is not a single tax that affects a mineral fiscal regime but the lump sum of all taxes and how they harmonize with each other. This is because the advantage of one tax instrument can douse the disadvantage of another and vice versa. The study recommends that there is need to review and optimize the Post-2015 mineral taxation system, increase the institutional capacity of Zambia Revenue Authority (ZRA) and strengthen the Zambia Extractive Industry Transparency Initiative (ZEITI).

# Dedication

This dissertation is dedicated to my late father

**Mr. Christopher Banda**

For showing me the value of education, the importance of perseverance and for working so hard to make sure that I go to school.

I also dedicate this dissertation to my mother **Mrs. Ainess Tembo Banda** who has rendered perpetual support and encouragement in good and hard times.

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# Acronyms

| Abbreviation | Description |
|---|---|
| AETR | Average Effective Tax Rate |
| ARR | Accounting Rate of Return |
| APT | Arbitrage Pricing Theory |
| CAPM | Capital Asset Pricing Model |
| CE | Certainty Equivalent |
| CEV | Certainty Equivalent Value |
| CV | Coefficient of Variation |
| CIT | Corporate Income Tax |
| CPI | Consumer Price Index |
| CSO | Corporate Social Organization |
| CSR | Corporate Social Responsibility |
| DA | Development Agreement |
| DCF | Discounted Cash Flow |
| DCR | Democratic Republic of the Congo |
| EATR | Effective Average Tax Rate |
| EITI | Extractive Industry Transparency Initiative |
| ENPV | Expected Net Present Value |
| EPS | Equal Probability Sampling |
| FDI | Foreign Direct Investment |
| FINDECO | Finance Development Corporation |

| | |
|---|---|
| FTP | First Trigger Price |
| GDP | Gross Domestic Product |
| GRZ | Government of the Republic of Zambia |
| ICCM | International Council on Mining and Metals |
| INDECO | Industrial Development Corporation |
| IMF | International Monetary Fund |
| IRR | Internal Rate of Return |
| LME | London Metal Exchange |
| MDA | Mineral Development Agreement |
| METR | Marginal Effective Tax Rate |
| MINDECO | Mining Development Corporation |
| MNE | Multinational Enterprise |
| NCCM | Nchanga Consolidated Copper Mines |
| NFCA | Non-Ferrous Company Africa |
| NPV | Net Present Value |
| OECD | Organization For Economic Cooperation and Development |
| PAYE | Pay As You Earn |
| PPI | Producer Price Index |
| RADR | Risk Adjusted Discount Rate |
| RCM | Roan Consolidated Mines |
| ROR | Rate Of Return |
| ROM | Run-Of-Mine |
| RST | Roan Selection Trust |

| | |
|---|---|
| SADC | Sothern African Development Community |
| SI | Statutory Instrument |
| STP | Second Trigger Price |
| TAD | Technical Affairs Department |
| TTP | Third Trigger Price |
| UK | United Kingdom |
| VAT | Value Added Tax |
| VPT | Variable Profit Tax |
| WACC | Weighted Average Cost of Capital |
| ZCCM | Zambia Consolidated Copper Mines |
| ZIMCO | Zambia Industrial Development Corporation |
| ZRA | Zambia Revenue Authority |

# Chapter 1

## 1.0 Introduction

### 1.1 Preamble

Zambia is a landlocked country located in the southern part of Africa. The country has very little to show for a century of mining in terms of generated public revenue despite the abundant mineral resources it possesses. This has been attributed to the fact that mining taxation systems have not been sound in design to capture the desired revenue.

Taxation can be defined as a system of levying financial charges on legal entities. This emphasizes the point that taxation is a compulsory and legal exercise. The Government of the Republic of Zambia (GRZ) can epitomize economic growth of the country by amassing wealth from the mining sector through mineral tax and channeling the generated income to developmental projects, such as health care, education facilities and road infrastructure. Mining, has therefore, become an important industry providing the major platform for tackling poverty and growing the economy.

Mineral tax systems should ensure adequate payments to the society and investor. Although this should be the case, many countries have not been duly compensated for their extracted minerals. To the contrary, countries such as Chile, Canada, Sweden and Botswana have received maximum benefit from their mineral resources because of the efficient design of their tax systems coupled with good political management of generated mining revenue. An effective and efficient mineral tax regime should seek to compensate the loss of wealth to the land owner and at the same time it should be internationally attractive. If a mineral tax regime is not attractive or competitive an investor has a choice of looking elsewhere. The basic tools of taxation are becoming increasingly similar over time as nations look beyond their boarders to harmonize their industrial sectors with the global economy. According to Manley (2013), a mining tax regime can only be successful if it

possesses four properties these include compensation of the loss of wealth to the land owner, reasonable attraction to investors, flexibility to change in true profits and administrative feasibility.

Mining projects are affected by the level of taxation. It is for this reason that the level of mining tax should be considered as an important element in determining where to invest. Level of tax is a critical factor in all stages of mining because it determines the success or failure of mining projects. Overtaxing the mines today has the potential of discouraging the development of existing and new mining projects which later results in low tax payments in the future. High mineral taxes inhibit investment in four stages (Kambani, 2013):

(i) Development of new projects will be put to halt;

(ii) Development of existing projects will be slowed down or also put to halt;

(iii) There is failure to maintain plant facilities; and

(iv) Lastly, there is closure of mining operations.

An important issue related to the level of mining taxation is the definition of the tax base. Two questions are usually asked concerning the mining tax base and these include:

(i) Does the government want many mines that are lightly taxed?; or

(ii) Does the government want few mines that are heavily taxed?

These questions have sparked a lot of debate in the area of resource conservation as a focus of sustainable development. One may argue that having many mines that are lightly taxed helps widen the tax base and aids in reducing the up surging risk associated with low revenue generation resulting from dwindling mineral prices and a shriveled portfolio of mining investment. To the contrary, one may also argue that having few mines that are heavily taxed helps preserve resources for our future generation. Thus, the importance of properly defining the tax base cannot be over emphasized because it helps governments achieve their revenue raising objective. The key policy questions that must be asked relating to this objective are, whether some mines must be heavily taxed than others?, or whether the tax system should be uniform?, or whether a separate tax system should be designed for each mine or class of mines? In taxation theory, there is no single best

taxation system. Therefore, when designing one, governments should look at the unique factors that shape their state.

There has been a lot of public pressure on the Zambian Government that the country is not getting maximum revenue from the mines. In a bid to subside this pressure, various mineral tax reforms have taken place ranging from frequent revisions in tax rates and introduction of new taxes. Despite these mineral tax reforms, the public still has the perception of low gain in mining revenue.

### 1.2 Problem statement

In the last two decades many underdeveloped countries have embarked on mineral tax reforms that included raising mineral taxes and restructuring their tax systems. Zambia is one such country that has undergone changes in its mining taxation system in recent years. These reforms have been motivated by pressure mounted on successive governments by the electorate that the country is not receiving a fair share of revenue from the extracted minerals. Against this backdrop, mining firms have claimed that mining revenue that is channeled to the government in form of mineral tax remittance is sufficient. This is attributed to the fact that most mining companies are operating under conditions of high cost amid volatile copper prices.

Zambia has undergone a transition of six mineral tax reforms since the privatization of its mines in 1997 and 2000. These have been listed as follows (Amended from Manley, 2013):

(i) **The Development Agreements (DAs):** These were agreements signed with individual mines at privatization between 1997 and 2007;

(ii) **The 2008 tax regime:** Tax regime used from April 2008 to March 2009;

(iii) **The 2009 tax regime:** Tax regime used from April 2009 to March 2012;

(iv) **The 2012 tax regime:** Tax regime used from April 2012 to December 2014;

(v) **The 2015 tax regime:** Tax regime used from January 2015 to June 2015; and

(vi) **The Post-2015 tax regime:** Tax regime that was brought into effect in July 2015.

In January 2015, the Zambian Government implemented the 2015 tax regime and abandoned the 2012 tax system. The newly implemented regime proposed to replace the former *two tier* system of collecting Corporate Income Tax (CIT) and mineral royalty from mining companies, with a perceived simplified mining tax structure based on a single mineral royalty tax at a significantly higher rate. The government's rationalization for introducing the 2015 royalty regime was the need to have tax policies that instigate a win-win situation by tackling the inherent weaknesses that existed in the 2012 system. The government maintains that prior to the introduction of the 2015 tax regime, the mineral fiscal system was prone to tax planning schemes of transfer pricing, hedging manipulations and trading through shell companies which are not directly linked to the core business of mining.

However, the tax system implemented in January 2015 generated conflicts of interest between the investors and government. The investors claimed that the new tax reform would force them out of business. This fiscal reform led to some mines wanting to pull out their investment from Zambia, one such mine was Lumwana Mine owned by Barrick Gold Corporation. In response to these conflicts the government reverted to the two tier system by reducing royalty rate to 9% and 6% for open pit and underground mining operations, respectively. The implementation of this tax system was followed by other structural fiscal adjustments as will be discussed in Chapter 2.

Although a vast number of mineral tax reforms have taken place, there is still an outcry from the electorate that Zambia's mineral taxation reforms have not yielded the desired results in terms of revenue generation (Zambian Economist, 2015). This has been attributed to the weak design of the mineral taxation regimes that have been legislated over time. In the midst of all these outcries and tax reforms, debate has emanated among the citizens with regards to the robustness of the mineral taxation systems. In this context, this research aims at undertaking an evaluation of Zambia's mineral taxation regimes with an objective of assessing their robustness so as to subsequently uncover the tax system that is sturdiest in design. The task of unearthing the most robust tax system is pursued because different groups of citizens have made varying assertions about which tax regime is superiorly robust in design amid other taxation systems. However, these assertions have not been validated because no study has been carried out to ascertain the robustness of one taxation regime over another using sound proven evaluation criteria.

## 1.3 Research objectives

The primary objective of this research is to undertake an evaluation of Zambia's mineral taxation regimes with the focus of assessing their robustness so as to ultimately determine the regime that is most robust in design in terms of capturing mining revenue. This research uses Lumwana Mine as case study based on five key evaluation criterions. These include revenue raising potential, neutrality, progressivity, government risk and investor perception of risk.

The specific objectives of this study are to:

(i) Develop projected cash flow models for the case study mine using mineral taxation regimes as a basis;

(ii) Undertake a scenario analysis of the mineral tax evaluation criteria based on the status quo and worst case scenario; and

(iii) Rank the mineral taxation regimes in terms of their robustness employing the five evaluation criterions as a basis.

## 1.4 Research questions

This section presents the research questions that can be generated from the objectives of the study.

The primary question that can be generated is:

(i) Are the mineral taxation regimes sound in their design based on the five evaluation measures?

The following are the secondary questions that can be derived from the primary question:

(a) Which tax regime is most neutral in design?

(b) Which tax regime has the highest revenue raising potential?

(c) Which tax regime is the most progressive in design?

(d) Which tax regime has the least government risk?

(e) Which tax regime has the least bearing on investor perception of risk?

(f) Which tax regime is most robust in design in terms of capturing mining revenue?

(g) Lastly, what is the ranking order of robustness of the tax systems?

### 1.5 Justification and significance of the study

Zambia is highly dependent on mining despite the existence of other sectors such as agriculture. This over dependency occurs against the backdrop of stifled mining tax revenue. The electorate attribute this to the weak design of Zambia's legislated mining taxation systems. They claim that the various instituted tax reforms have not been robust in design to capture the desired mining revenue. However, this claim has not been authenticated. Therefore, this study aims at adding to the existing body of knowledge by validating this claim. In economics, a robust taxation regime is one that captures maximum amount of mining revenue by dispensing the burden of taxation in an equitable manner. This must however be complemented with propagation of economic efficiency. No study has been undertaken in this context. Therefore, this dissertation aims at bridging this gap in literature.

This research study comes with the following benefits:

- It will help validate the claim of Zambia's mineral taxation regimes of either being weak or robust in design in terms of capturing mining revenue;
- It can be used as a future reference of optimizing Zambia's mineral taxation where the most robust tax system can act as a starting point in the optimisation process; and
- It brings forward a well compiled methodology of evaluating mineral taxation regimes.

### 1.6 Scope of the research

This study is concerned with the evaluation of Zambia's mineral fiscal regimes and is limited to the following:

(i) Large scale surface mining;

(ii) The copper mining sector;

(iii) Evaluation of Zambia's mineral taxation regimes;

(iv) Direct taxes only, this is because other taxes are difficult to evaluate because of their complicated structure (i.e. multiple rates and exemptions); and

(v) Evaluation of five mineral taxation regimes (2008, 2009, 2012, 2015 and Post-2015 tax system). This research does not undertake an evaluation of the DA tax regime. This is because different mines were provided with different fiscal terms by the Zambian Government and some of these terms have not been made available to the public.

The closely related issues to this research include optimization of mineral fiscal regimes, study of the use of collected mining tax revenue by the government and study of the administrative efficiency of tax authorities in collecting mining tax revenue. However, these issues are not within the scope of this research and therefore will not be pursued.

### 1.7 Dissertation Structure

The outline of this dissertation is as follows:

**Chapter 1** serves as an introduction to this research study. It details the research objectives and presents the arising research questions. Secondly, it elaborates the major significance and motivation of the study. Finally, the Chapter is concluded by highlighting the justification and scope of the research.

**Chapter 2** looks at the fiscal overview of Zambia's mineral taxation. This Chapter is intended to provide background information on Zambia's mineral sector and mining taxation in general. The Chapter begins by reviewing mineral tax reforms. This is pursued so as to garner a broad understanding of facts surrounding these fiscal structural adjustments. Subsequently, the Chapter reviews mineral tax incentives and tax planning schemes that are prevalent to the Zambian mining jurisdiction. This is proceeded by a quick highlight of the macroeconomic benefits of mining in Zambia.

**Chapter 3** reviews literature on mining taxation. It makes an assessment of the different topics directly and indirectly related to the topic of study. The Chapter embarks on this endeavor by discussing objectives and theory of taxation. This provides the basis for evaluating Zambia's mineral taxation regimes by deducing the most suitable conceptual framework of this research. It subsequently analyses the criteria that can be used to evaluate resource taxation regimes. This is followed by a clear and concise elaboration of project evaluation techniques. This has been pursued because most of the tax evaluation techniques that are employed in the resource industry are anchored on project evaluation methods. Finally, the Chapter ends with a discussion on discount rate selection, inflation analysis and risk.

**Chapter 4** looks at the conceptual framework and research methodology that have been employed to realise the objectives of the study. The conceptual framework was designed so as to ground or contextualize the research methodology in known tax theory. The discussion on conceptual framework is proceeded by an explication of the data collection techniques. Type of research, sources of data and sampling methods are subsequently pursued. This is followed by a clear and concise elaboration of the analytical framework that has been employed to evaluate Zambia's mineral taxation regimes. Finally, a discussion of software application and ethical issues closes this Chapter.

**Chapter 5** is solely devoted to presenting and analysing the raw data of the research. It presents the research findings and answers questions posed in Chapter 1. The genesis of this Chapter is focused on developing projected cash flow mine models. This sets out the benchmark for the evaluation process. This is then proceeded by an elaboration of the tax computational framework. This framework encompasses those taxes that have been used as center of evaluation. Lastly, the Chapter ends with a quantitative evaluation of Zambia's mineral taxation regimes based on five key evaluation measures, that is, neutrality, progressivity, revenue raising potential, government risk and investor perception of risk.

**Chapter 6** garners the findings of this dissertation and highlights the contribution to the field of mining taxation particularly focusing on the Zambian mining industry. Results have accordingly been summarized and concluded with suggested recommendations. Some areas requiring further research are also identified.

# Chapter 2

## 2.0 Mineral Fiscal Overview in Zambia

### 2.1 Introduction

The purpose of this Chapter is to undertake a review of mineral fiscal policies in Zambia. It addresses a myriad of mineral taxation issues, including an overview of the legislation of the mining sector, instruments of mineral tax policy and economic allocative efficiency of these instruments. This provides a theoretical bedrock for examining the efficacy of Zambia's mineral tax policy.

### 2.2 Overview of Zambia's mining sector

Zambia, like many African countries, is richly endowed with vast amount of mineral resources. It is the second largest producer of copper in Africa after the Democratic Republic of the Congo (DRC) (Copper investing news, 2015). Significant deposits of iron, coal and gold also exist within its geographical confines. In addition, a number of industrial minerals, including talc, limestone and gravel sands are produced in commercial quantities. Zambia's endowment of mineral resources can be attributed to its unique geographical positioning. Although Zambia has a wide range of mineral deposits, the mineral sector has been dominated by copper mining which has dwarfed the exploitation of other mineral resources. The copper resource is traditionally hosted in the Neoproterozoic rocks of the Katanga region, some amount of this resource has also been found in the thrust zone of North Western Zambia.

## 2.3 Reformation of Zambia's mining sector legislation

Zambia has continued to rely on mining activities for its development ever since copper mining started in 1928. The country has a long history of mining spanning over 100 years (Ministry of Mines, Energy and Water Development, 2013). Over these years, several ownership structures have taken place. In 1969, the mining companies were nationalized to form the Zambia Consolidated Copper Mines (ZCCM). In the 90s, there was an attempt to liberalise the Zambian economy. This saw the privatization of ZCCM assets and licensing of more mining companies. The sector, in 2000, reverted to private ownership leaving the government to retain the role of the legislator and regulator. However, it should be made clear that the privatisation of the mines was not the sole wish of the Zambian Government but rather, there was persistent pressure from the World Bank and International Monetary Fund (IMF) for Zambia to undertake structural reforms to its mineral sector before it could receive any donor funding (Lungu, 2009).

The privatisation of the mines in 1997 and 2000 was followed by the revocation of the Mines and Minerals Act of 1972. This revocation was followed by an introduction of the 1995 Act. The former Act guided the running of the nationalized mining sector. The 1995 Act on the other hand provided particular incentives for mining companies to invest in the mineral sector (Lungu, 2009). These incentives included duty free importation of mining equipment and extended period of loss carry forward. This Act also permitted the government to enter into DAs with individual mining companies.

Upon privatizing ZCCM, new investments poured into the sector and mineral commodity prices also went up resulting in increased revenue accruing to the private sector but no corresponding improvements in the country's mineral tax revenue. This necessitated the review of the Act in order to balance revenue inflow between private hands and the government. This saw the revocation of the 1995 Act to implement a more competitive, reasonable and well-balanced fiscal framework that ensured the nation of receiving a fair return of revenue from the mineral sector. In 2008, the 1995 Act was repealed to implement the 2008 Mines and Minerals Act, which resulted in a new fiscal and regulatory framework which led to the:

(i) Revocation of the Development Agreements (DAs);

(ii) Upward revision of the tax rates applicable to the mining sector; and

(iii) Implementation of a uniform tax structure across the mining sector under existing tax laws.

This framework was implemented to facilitate equal distribution of mineral wealth between the government and mining companies. In its continued stride to regulate the sector, the Zambian Government implemented new measures by enacting the following Statutory Instruments (SI):

(i) **SI 34 of 2012** – Compelling mining right holders to submit annual reports and annual programs of future operations;

(ii) **SI 17 of 2013** – To tax transfer of mining rights and to increase the statutory fees to reduce speculative tendencies brought by low fees; and

(iii) **SI 32 of 2013** – To monitor balance of payment in a transparent and accountable manner.

However, in July 2015 the Zambian Government repealed and replaced the 2008 Act with the 2015 Mines and Minerals Development Act. The following list provides the motivation for change[1]:

(a) To revise the law relating to exploration for, mining and processing of, minerals;

(b) To provide health and environmental protection in mining operations; and

(c) To provide for the establishment of the mining appeals tribunal.

## 2.4 Mining tax reform in Zambia

There has been a lot of literature that has been presented on mineral tax reforms. However, this literature has been descriptive rather than analytical (Appiah, 2013). The protocol applied to evaluating the success or failure of these tax reforms has not been well documented. Mineral tax reform in a country like Zambia has been motivated by pressure mounted on successive governments by the public citing that the country is not receiving a fair share of mineral tax revenue. It is important to note that revenue sufficiency is a fundamental standard which ought to be achieved by any tax system. Appiah (2013) noted that there are few developing countries that can adopt tax reforms that offer great loss in revenue no matter how desirable they might be from

[1] See http://www.parliament.gov.zm/sites/default/files/documents/acts/The%20Mines%20and%20Minerals% 20Act, %202015.pdf.

other perspectives. However, Goode (1987, cited in Appiah, 2013), argues that it is hard to gain serious consideration for any revenue neutral reform proposal.

Zambia has undergone a transition of six mineral tax reforms since the privatization of its mines in 1997 and 2000. These include (Amended from Manley, 2013)[2]:

(a) **The Development Agreements (DAs)** – Tax regime used at the time of privatization;

(b) **The 2008 regime** – Tax regime used between April 2008 to March 2009;

(c) **The 2009 regime** – Tax regime used between April 2009 to March 2012;

(d) **The 2012 regime** – Tax regime used between April 2012 to December 2014;

(e) **The 2015 regime** – Tax regime used between January 2015 to June 2015; and

(f) **Post-2015 regime –** Tax regime that was brought into effect in July 2015.

The key features of these taxation regimes are presented in Table 2.1

[2] The 2015 and Post-2015 regime have been compiled by the Author.

**Table 2.1: Key features of Zambia's mining fiscal regimes (Amended from Manley 2013)**

| Type of Tax | | DA | 2008 | 2009 | 2012 | 2015 | POST-2015 |
|---|---|---|---|---|---|---|---|
| **Profit based tax** | | | | | | | |
| Company income tax (% of profit base) | | | | | | | |
| *Mineral processing and tolling (%)* | | 35 | 35 | 35 | 35 | 30 | 35 |
| *Mining operations (%)* | | 25 | 30 | 30 | 30 | 0 | 30 |
| Variable Profit Tax (VPT) in effect? | | No | Yes | Yes | Yes | Yes Industrial minerals | Yes |
| **Profit tax base details** | | | | | | | |
| Capital depreciation allowance | | 100 | 25 | 100 | 25 | 25 | 25 |
| Loss carry forward (maximum years) | | 5-10 | 10 | 10 | 10 | 10 | 10 |
| Allowed debt to equity ratio | | 2:1 | 3:1 | 2:1 | 2:1 | 3:1 | 3:1 |
| **Revenue tax types** | | | | | | | |
| Mineral royalty (%) | *Underground Mining* | 0.6 | 3 | 3 | 6 | 8 | 6 |
| | *Open cast Mining* | 0.6 | 3 | 3 | 6 | 20 | 9 |
| Windfall tax in effect? | | No | Yes | No | No | No | No |
| **Other tax types** | | | | | | | |
| Customs duty | | **Exempted in most cases** | | | | | |
| Export duty (on copper anodes) | | No | **15% but with some waivers** | | | | |

### 2.4.1 Development Agreements

These were legal mineral tax agreements signed between the Zambian Government and individual mines at privatization on a project by project basis whose terms have not been made available to the public for scrutiny. These agreements were negotiated between 1997 and 2000. Those agreements, signed in 1997, had higher rates than those signed in 2000 (Manley, 2013). In 2003, an agreement between the state and mining firms was reached which saw an implementation of equal rate payment of CIT and royalty tax by the mines (Manley, 2013).

There has been a lot of speculations as to why the Zambian Government signed the DAs. One material reason lies in the fact that Zambia was coming from a background of low copper prices and hence loss making mines. This being the case, it was imperative that the Zambian Government

embarked on the signing of these agreements so as to attract Foreign Direct Investment (FDI) which in turn was supposed to dispense capital necessary for economic progression and growth. While this is true, another reason to this signing stemmed from the fact that IMF was exerting perpetual pressure on Zambia for it to privatize the mines. This privatization process paved way for the signing of mining agreements on a case by case basis with the mining companies. These individualized mining agreements are what is being termed as Development Agreements. The following gives a summary of the key features associated with the tax regime that was applied after 2003.

(i) **Mineral royalty tax** – Royalty tax stood at 0.6% for both underground and surface mining. This tax was an ad valorem tax levied on the value of metal or recoverable metal sold. The value of sales was calculated using the traded price between mining companies rather than a defined metal price from an acclaimed metal exchange.

(ii) **Corporate Income Tax (CIT)** – CIT was levied at a rate of 25% on the net profit base. The three fundamental deductions for the purpose of calculating income tax were, capital expenditure incurred during the year (100% depreciation rate), mineral royalty payments, price participation payments and accumulated loss carry forward. The loss carry forward period differed among mining firms but a period of 15-20 years was generally applied. Losses from hedging could also be treated as part of the normal operating cost incurred by the mining company.

(iii) **Other taxes and other fiscal terms** – Withholding tax for most mines was pegged at 0%. Equally, Value Added Tax (VAT) was zero rated. This means it was exempted on capital goods and other input material. Custom duty was rated at zero percent. This was deliberately instituted with the primary purpose of increasing foreign exchange earnings. Additionally, there was 100% retention of foreign currency. This meant that mining companies could not repatriate funds for the dual purpose of servicing debt and paying their shareholders. This fiscal term helped relieve problems in the foreign exchange market by subduing pressure on the Kwacha.

Table 2.2 shows the fiscal terms of the DAs pertaining to four mining companies, that is, Konkola Mine, Mopani Mine, Non-Ferrous Company Africa (NFCA) and Chambishi Metals

**Table 2.2: Fiscal terms of Development Agreements (Fraser and Lungu, 2007)**

| Fiscal Term | Name of Mining Company/Year of Agreement | | | |
|---|---|---|---|---|
| | Konkola Copper Mine (2000) | Mopani Copper Mine (2000) | NFCA Ltd (1998) | Chambishi Metals (1998) |
| Royalty Tax Rate | 0.6% | 0.6% | See footnote[3] | 0.6% |
| Provision for Capital Investment deductions | 100% | 100% | 100% | 100% |
| CIT | 25% | 25% | 35% | 35% |
| Provision of Carry Over Losses | Can Carry Forward Losses | Can Carry Forward Losses | Can Carry Forward Losses | Can Carry Forward Losses |
| Customs Duty | 0% | 0% | 0% | 0% |
| VAT | Refund on Net Input VAT- 0% | Refund on Net Input VAT- 0% | Refund on Net Input VAT- 0% | Refund on Net Input VAT- 0% |
| Foreign Currency Retention | 100% | 100% | 100% | 100% |
| Withholding Tax | On Dividends 0% | On Dividends 0% | On Dividends 0% | On Dividends 0% |
| Stability Period | 20 years | 20 years | 15 years | 15 years |

Although the DAs did not extract the maximum benefit of mineral wealth from the mining sector, it could be argued that the low tax rates and low exposure to risk helped attract large amounts of capital into Zambia (Manley, 2013). This is evidenced in Figure 2.1 depicting the historical capital expenditure with correlation to copper prices from 1990 to 2009.

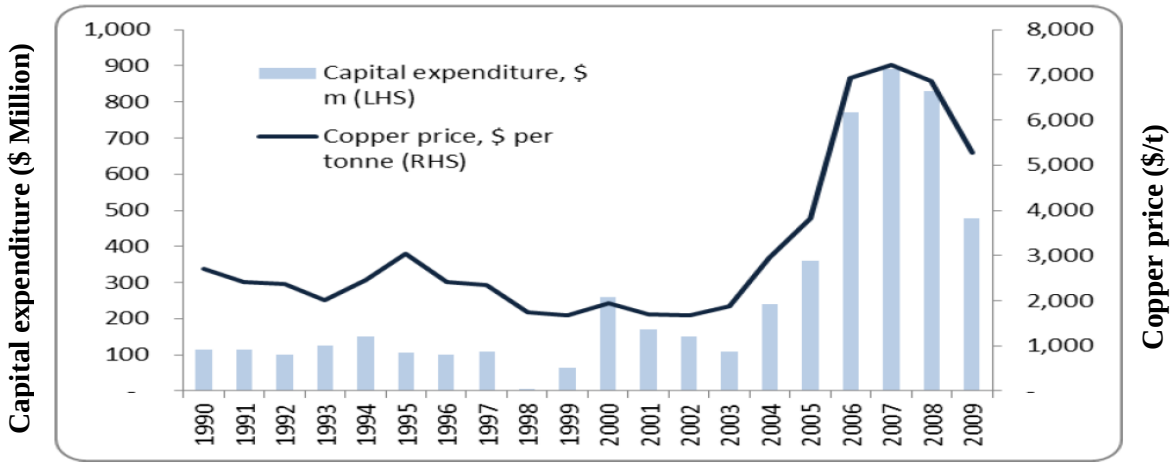


**Figure 2.1: Historical copper prices and capital expenditure (Manley, 2013)**

[3] The NFCA Development Agreement stated that the company will pay royalty at the prevailing rate. This is not clear, it might mean 0.6% (what most mining companies remitted) or 3% (rate in mining act).

Another positive benefit derived from the DA regime is that it helped eliminate the fiscal burden on the Zambian Government (Manley, 2013). Before the DAs, as mentioned earlier, copper prices were low and copper mines were making huge losses of up to one million dollars a day and because of this, government had to borrow huge funds to recapitalize the mines and finance the payment of ZCCM workers (Lungu, 2009). This put a lot of financial pressure on the Zambian Government and was forced to privatize.

However, positive change in economic conditions caused the public to mount pressure on the government to renegotiate the DAs. This forced the government to discard the DA regime to implement a uniform tax system across the mining sector. This was consistent with the aim of implementing a well-balanced regulatory framework.

### 2.4.2 The 2008 mineral tax regime

The 2008 mineral tax reform was undertaken due to pressure mounted on the government to renegotiate the DA regime. The implementation of the 2008 mineral tax regime led to a substantial change in the mining tax structure of Zambia.

The following gives a summary of some of the key features associated with the 2008 regime;

(i) **Corporate Income Tax (CIT)** – CIT was increased from 25% to 30%. The principal deductions for the purpose of calculating the profit tax base were altered. These alterations included losses could only be carried forward for a maximum of ten years, depreciation allowance was reduced from 100% to 25% and losses from hedging could not be deducted from taxable income. Additionally, the deduction of mineral royalty from taxable income was maintained.

(ii) **Mineral royalty tax** – The mineral royalty tax was increased from 0.6% to 3%. In addition, the gross and norm value of sales was calculated using the quoted price on the London Metal Exchange (LME) or any acclaimed metal exchange as authorized by the Commissioner General.

(iii) **Variable Profit Tax (VPT)** – A 15% VPT was introduced. This tax was to be applied above a certain threshold of profit, below this threshold CIT was to hold. The tax was

applied when the ratio of taxable profit to gross sales exceeded 8%. However, the VPT was not applied to income that was subjected to windfall tax in that charge year. The aim of this tax was to make the tax regime more progressive (Manley, 2013). However, Conrad (2012) argues that the ratio of taxable profits to gross sales is marginally related to the standard notion of excess profit and thus does not convey any economic sense in as far as progressivity is concerned.

To understand this assertion, Conrad (2012) expressed the ratio as unity less the ratio of average cost (AC) to price (P) for any given level of production (Q). Equations 2.1, 2.2 and 2.3 illustrate this derivation.

$$\frac{\text{Taxable Income}}{\text{Gross sales}} > 0.08 \qquad [2.1]$$

$$\frac{(P*Q)-(AC*Q)}{(P*Q)} > 0.08 \qquad [2.2]$$

$$1 - \frac{AC}{P} > 0.08 \qquad [2.3]$$

**Where:**

P is the unit price of the recoverable metal ($/t);
Q is the production level of the recoverable metal (t); and
AC is the average cost of production ($/t).

From Equation 2.3, it can be deduced that the ratio is dependent on the proportionality increase of average cost (AC) to unit price (P). It is possible to have high mineral prices in times of good economic conditions but as long as the firms average cost is relatively high there is possibility of rendering this tax inapplicable. Thus, it can be concluded that this tax does not necessarily bear the concept of progressivity.

The variable profit tax rate is calculated using Equation 2.4 (Zambia Revenue Authority (ZRA), 2008).

$$VPT_R = 30\% + \left[15\% - \left(\frac{1.2\%}{C}\right)\right] \quad [2.4]$$

**Where:**

$VPT_R$ is variable profit tax rate (%); and

C is the ratio of taxable income to gross sales.

(iv) **Windfall tax** – A windfall tax was introduced which acted like a variable rate royalty (Manley, 2013). This Windfall tax was similar to the price participation agreements in the DA era. Unlike the price participation agreements, windfall tax was not deducted from taxable income for the purpose of calculating CIT. Figure 2.2 shows the structure of the 2008 windfall tax on copper sales.

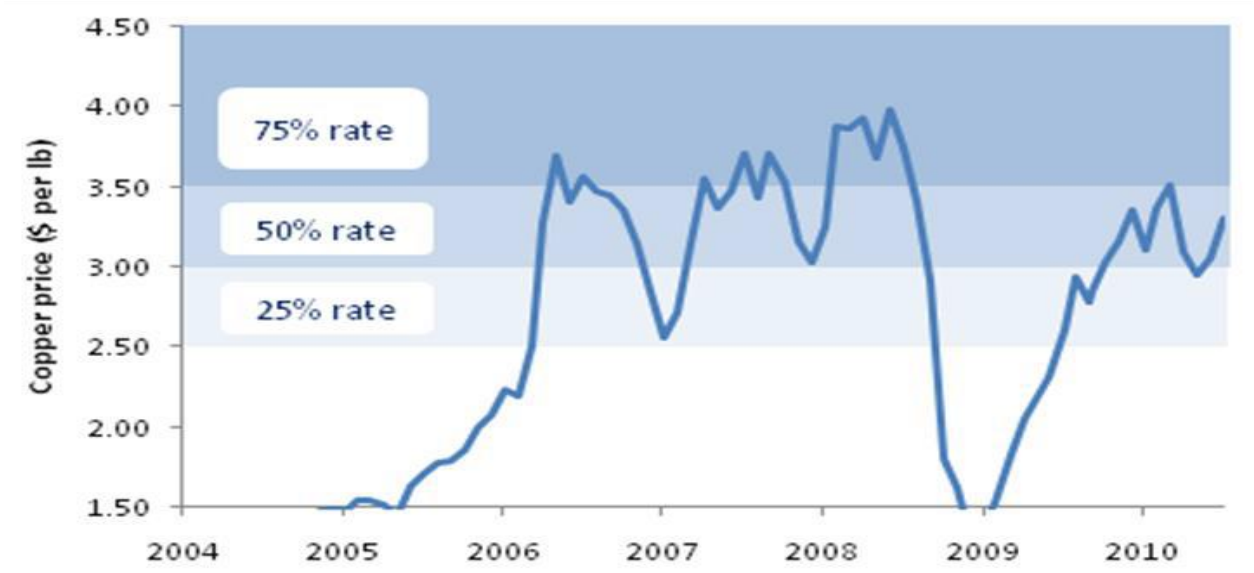


**Figure 2.2: Structure of the 2008 windfall tax on copper sales (Manley 2013)**

### 2.4.2.1 Criticisms of the 2008 windfall tax

The structure of the 2008 windfall tax faced two main criticisms (Economic Association of Zambia, 2008). Firstly, it was not treated as a deductible expense for the purpose of computing CIT. This meant that in times of high mineral prices mining firms had to pay windfall tax and at

the same time a relatively high CIT. This increased the financial burden of mining companies above normal. Secondly, the rates were set too high, or alternatively the trigger prices were set too low. This added to an increase in the financial burden of mining companies.

In addition to the two criticisms, the 2008 tax regime lamped two supernormal profit taxes (i.e. windfall tax and VPT) which made the tax system to be excessively progressive than necessary. If government's tax conception was progressivity, it should have traded between windfall tax and VPT instead of implementing both. These taxes increased the Effective Average Tax Rate (EATR) beyond normal.

Due to some of these pitfalls, the 2008 tax regime was discarded and a new tax system was implemented.

### 2.4.3 The 2009 and 2012 mineral tax regimes

The 2008 mineral tax regime was applied for a duration of one year. There are a number of reasons as to why the 2008 tax regime was abolished. Firstly, the tax system was revoked because of the inherent weaknesses of its design as discussed in the previous section. The other reason for its cancellation was because the mining companies failed to recognize it as a legitimate tax system. This is because mining companies were distressed with the Zambian Government for breaking the fiscal stability clauses signed at privatization promising them not to alter the tax structure for a period of 15-20 years. Lastly, the implementation of the 2008 tax system was followed by a global financial crisis which saw copper prices fall sharply (Manley, 2013). This forced most mines to cut down their labour force by laying off workers. Government responded to this by revoking the 2008 tax regime to implement a new tax system. The changes to the 2008 tax regime were announced in the 2009 budget. Some of these changes included tax depreciation was regressed to 100%, windfall tax was eliminated and losses from hedging were considered a principal deduction from net income when calculating CIT.

The 2009 mineral tax regime was revoked due to change of government. The newly elected government implemented the 2012 tax regime with an aim of maximizing mineral tax collection. The changes made to the preceding tax regime were announced in the 2012 budget, which included

royalty tax was increased from 3% to 6% and loss from hedging was not to be treated as a deductible expense for the purpose of calculating CIT.

### 2.4.4 The 2015 and Post-2015 mineral tax regime

In January 2015, the Zambian Government discarded the 2012 mineral tax regime to implement a single tier tax system based on mineral royalty. The former tax system was thrust aside because government wanted to maximize revenue collection from the mines by combating tax planning schemes of transfer pricing, hedging manipulation and debt repayment abuse that existed in the 2012 regime. The 2015 regime was based on a single tax component, royalty, hence the name *single tier*. Key changes that were made to the 2012 tax system included:

(i) **Mineral royalty** – This tax was increased from 6% to 8% for underground mining and 6% to 20% for open cast mining as final tax;

(ii) **Corporate Income Tax (CIT)** – Mining CIT was scrapped off and mineral processing CIT was reduced from 35% to 30%; and

(iii) **Variable Profit Tax (VPT)** – The VPT was scrapped off but maintained for industrial minerals.

However, the 2015 tax system generated conflicts of interest between mining investors and government. The investors claimed that the new tax reform would force them out of business. In response to these conflicts the government reverted to the two tier system by implementing the Post-2015 regime. The following are the key changes that were made to the 2015 regime.

(i) **Mineral royalty** – This tax was reduced to a rate of 9% and 6% for open cast and underground mining operations respectively;

(ii) **Corporate Income Tax (CIT)** – This tax was regressed to 30% for mining operations and 35% for mineral processing. Deductions of loss carry forward was to be limited to 50% of taxable profits; and

(iii) **Variable Profit Tax (VPT)** – The VPT was reintroduced on income earned from mining operations. This was charged at 15% when income exceeded 8% of gross sales.

## 2.5 State participation in mining activities

Government participation in mining activities has shifted from full engagement during nationalization to docile engagement at re-privatization. Prior the latter, Zambia's interest in the mining sector was represented by ZCCM Ltd. This parastatal was formed by a gradual process of nationalization and corporate concatenation which began in the early 1970s. Nationalization of key foreign owned enterprises was initiated by the Mulungushi reforms of 1969. Under these reforms, the government declared its intention to increase equity holding in a number of foreign owned firms. These firms were to be controlled by the corporate parastatal named Industrial Development Corporation (INDECO). In 1969, the state acquired a 51% stake in Zambia's two main copper producing companies: Roan Selection Trust (RST) and Rhodesian Anglo American Corporation. The former became known as Roan Consolidated Mines Ltd (RCM) and the latter became known as Nchanga Consolidated Copper Mines Ltd (NCCM). The other corporations that were formed for the sole purpose of nationalization include Finance and Development Corporation (FINDECO) and Mining Development Corporation (MINDECO). In 1971, these two corporations together with INDECO were combined to form an omnibus parastatal known as Zambia Industrial Development Corporation (ZIMCO). The country's former president Kenneth Kaunda presided over the corporation as chairman of the board.

After nationalization, copper prices started plummeting, oil prices increased and the effects of using mining as a sole revenue generation house started showing. Copper production dropped from 720,0000 tonnes in 1969 to a mere 250,000 tonnes in 2000. This fall in production is attributed to the fact that ZCCM was a cash cow that was constantly milked without corresponding investment in machinery and production ventures. There was basically a re-focus of management away from production for profit to production aimed at guaranteeing employment and the delivery of social services (Limpitlaw, 2011). The ensuing economic problems in the Copperbelt led to the two nationalized mining companies being amalgamated to form ZCCM which consisted of five Copperbelt mining divisions. These include Nkana in Kitwe, Konkola in Chilabombwe, Nchanga in Chingola, and Mufulira and Luanshya in towns sharing their name. Due to persistence of economic challenges, ZCCM was disbanded and sold off as separate business packages to the private sector. Unbundling ZCCM into business packages was aimed at promoting diversity in ownership so as to minimize economic and political risks. The privatization process was targeted

at transferring majority interest from state hands to the private sector. This led to the transformation of ZCCM into an investment holding company with minority interest in the privatized business packages. Privatization of ZCCM aimed at achieving the following (Wikipedia, 2016):

(i) Diversify ownership of Copperbelt assets and erode ZCCM liabilities and third party debts;

(ii) Promote Zambian participation in the ownership and management of mining assets;

(iii) Ensure that ZCCM realized value for its assets and retained a significant minority interest in principal mining operations; and

(iv) Transfer control of and operating responsibilities for ZCCMs operation to private sector mining companies as quickly as practicable.

After re-privatization of the mining industry, FDI ballooned leading to a gradual increase of production. Figure 2.3 shows the production of copper from 1963 to 2011.

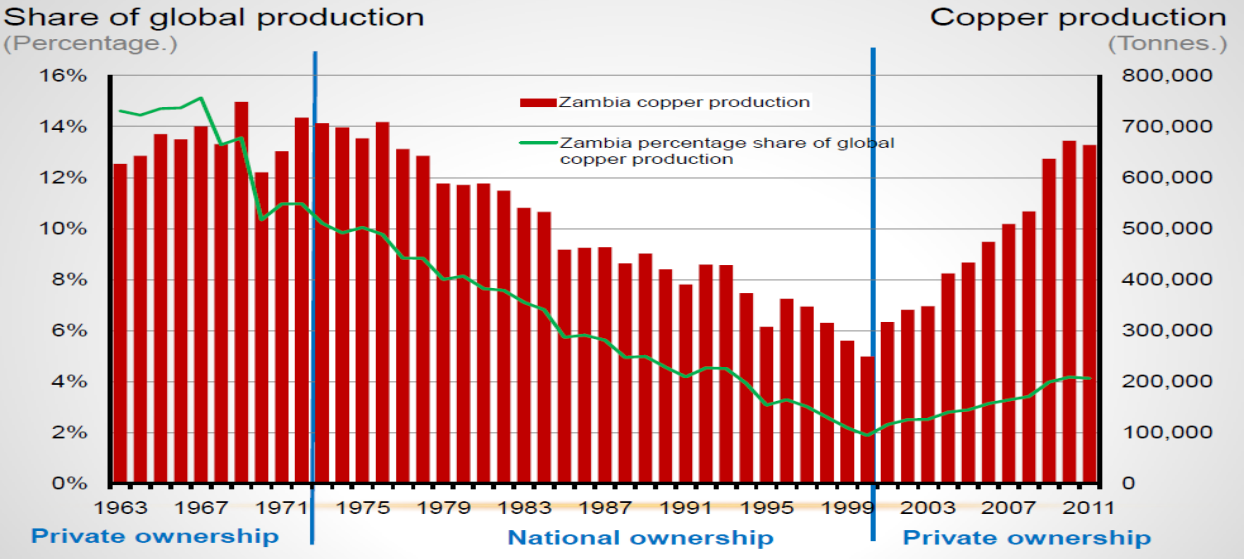


**Figure 2.3: Copper production on the Zambian Copperbelt (ICMM, 2014)**

Like Zambia, most governments prefer to hold equity in profitable mineral projects so as to secure a higher take in form of dividend payout and capital gains yield. There are also non-economic reasons that motivate governments to engage in equity participation. These include: a desire to increase the sense of ownership; to facilitate the transfer of technology and know-how; and to provide more direct control over project development (Baunsgaard, 2001).

Notwithstanding these advantages, it must be mentioned that equity participation can exert immense pressure on government finances. Baunsgaard (2001) recognizes this in times where cash calls arise[4]. Another disadvantage associated with equity participation is that it conceives conflicting interest from government as a regulator and as an equity holder. Baunsgaard (2001) notes that governments are better off solely taxing and regulating a mineral project rather than be directly involved as an equity participant. As a matter of concern, many investors regard the requirement to provide equity as a strong dissuasion against investment. This can subsequently translate into the lowering of other taxes. In light of these factors, Zambia is an equity holder and at the same time a regulator which administers taxation. This has a duo-gain for the state in that it is able to share in dividends and capital gains while accruing a substantial amount of revenue into its coffers through taxation. According to Baunsgaard (2001), equity participation can take several forms, including:

(i) **Paid up equity on concessional terms** – This is where the government acquires its equity share at a below market price;

(ii) **Paid up equity on commercial terms** – This places the government on similar footing with the investor;

(iii) **Carried interest** – This is where the government pays for its equity out of production proceeds including an interest charge;

(iv) **Tax swapped for equity –** This is where the governments share of equity is obtained through a reduced tax liability for the investor;

(v) **Equity in exchange for non-cash contributions** – This is where the equity share is obtained as a result of making non-cash contributions, for instance by the government providing infrastructure facilities; and

(vi) **Free equity** – This is a bit misleading because it results in some, more or less transparent, offsetting reduction in other taxes.

[4] Cash calls are the ongoing requirement for joint venture partners to contribute their share of development costs.

## 2.6 Instruments of mineral tax policy

The main objective of mineral tax policy is to extract the maximum possible revenue from the mineral sector. The revenue that is generated is channeled by the host state to various national projects including health care, education, road construction and other infrastructure development. The objective of maximum revenue generation must however be consistent with a retention of investment in the sector.

The optimum level of mining taxation is that which maximizes the Net Present Value (NPV) of mineral tax revenues. This point lies between the extreme minimum and maximum tax rate as depicted in Figure 2.4.

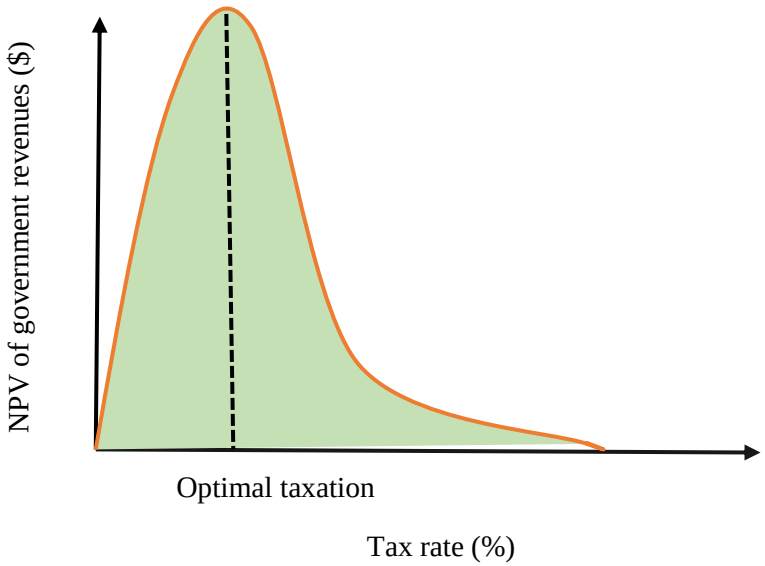


**Figure 2.4: Government tax revenue as a function of tax rate (Otto et al., 2006)**

Different mineral tax policies offer different trade-offs. This asserts that there are no fiscal terms that can satisfy all guidelines of an ideal tax regime. For instance, a tax system that has a high degree of neutrality offers high risk to the government in terms of providing stable revenue inflow. It is for this compelling reason that the government has to clearly define its conception of mineral taxation so as to gain the maximum revenue benefits from mining. In order to attain this, a high degree of wisdom is required from political leaders. The subsections that follow give a brief highlight of some of the instruments of mineral tax policy that apply in the Zambian Jurisdiction.

### 2.6.1 Corporate Income Tax (CIT)

The rate of CIT levied on mining enterprises in Zambia has been consistent over the past years. However, in January 2015, there was an abrupt alteration of the rate, in which CIT was scrapped off to implement a single tier tax system based on mineral royalty. This reformation was undertaken so as to combat mineral tax planning schemes and to promote stability of revenue inflow from the mineral sector.

Over the past years, a CIT rate of 30% has been imposed on mining companies in Zambia. This rate closely matches that applied by a majority of jurisdictions in the Southern African Development Community (SADC) region. For instance, countries like Tanzania, South Africa and DRC apply a CIT rate whose magnitude closely matches that applied in the Republic of Zambia.

It is important to note that, it is not the solitary non-unilateral alteration of a single tax that promotes fiscal stability in the mineral sector but the non-unilateral alteration of the entire tax regime.

### 2.6.2 Mineral royalty

Mineral royalty is a fixed payment by an investor to the host state acting as a compensation for the extraction and depletion of mineral resources. The Zambian Mines and Minerals Development Act of 2008 defines mineral royalty as "a payment received as a consideration for the extraction of minerals". Mineral royalty has undergone several upward adjustments over the years. These adjustments have been motivated by the need to extract maximum revenue from the mineral sector. Mineral royalty is levied on the basis of the 2015 Mines and Minerals Act. However, due to the alteration in tax structure, this Act has undergone reformation.

The mineral royalty type applied in Zambia is the ad valorem tax based on the value of sales. There are two types of bases on which this tax is levied, these include the norm and gross value of sales. Norm value applies to precious and base metals whilst gross value applies to industrial, energy and gemstone minerals.

Norm and gross value can be defined as follows (ZRA, 2015):

(i) **Norm value** – The monthly average cash price per metric ton of metal quoted on an authorised exchange market (i.e. LME) multiplied by the quantity of the metal or recoverable metal sold; and

(ii) **Gross value** – The realised price for a sale free on board at the point of export from Zambia or point of delivery within Zambia.

### 2.6.3 Windfall tax

Windfall tax also known as additional profit tax is a form of mineral royalty where the applied tax rate fluctuates with the price of the mineral commodity. Windfall tax in Zambia was first introduced in 2008 and was revoked the same year and has never been applied thereafter. This was due to the inherent technical errors in its design as explained earlier. Like Zambia, many African countries including Ghana have repealed the windfall tax (Appiah, 2013). This has mainly been attributed to the technical lapses in its design.

### 2.6.4 Variable Profit Tax (VPT)

A VPT can be defined as a tax in which the tax rate varies according to some measure of profitability (Manley, 2013). This tax was initially implemented in the same year as windfall tax. This move was intended to make the 2008 tax regime more progressive by collecting high revenue when mineral prices were high. This tax was designed to be applied above a certain threshold of profit while applying a CIT below this threshold. It is for this reason, that the VPT is also known as an excess profit tax.

### 2.6.5 Withholding tax

Withholding tax is tax that is held at source. This tax is levied on investment income rather than earned income. Individuals remitting payments of investment income are required to deduct withholding tax and only pay the net margin to the recipient of the income.

Withholding tax in Zambia was first introduced in 1971on management and consultation fees, interest, royalties and public entertainment fees (ZRA, 2015). This withholding tax has over the years been extended to include rents, dividends, commissions and payments to non-resident contractors at a rate between 10%-20%. However, in the case of the mining industry, dividends are subjected to a zero withholding tax. Arguably, this acts as an incentive for FDI.

### 2.6.6 Employee payroll tax

An employee payroll tax is a profit based tax levied on income earned by an individual. This tax provides substantial revenue inflow into government coffers. This is because the mining industry employs a vast number of skilled and unskilled personnel's who are subjected to this tax. This subsequently widens the tax base of the host state and increases income for other developmental projects.

The system of collecting employee payroll tax is known as Pay As You Earn (PAYE). This system can be defined as a method of deducting tax from employees' emoluments in proportion to what they earn. Under this system the employer is empowered to:

(i) Calculate the tax payable by every employee;

(ii) Deduct tax due from emoluments; and

(iii) Remit tax deducted to ZRA.

The amount of tax deducted by an employer from any pay under this system depends on: employee's gross pay; applicable tax rates; and a statutory deduction (contribution to an allowable pension scheme).

## 2.7 Economic allocative efficiency of mineral taxes

An economically efficient tax regime is one that promotes redistribution of resources of the economy to their most productive use to produce the ever-changing mix of goods and services that the society requires and at the lowest possible unit cost (Guj, 2012). In the mining context, an economic allocative efficient tax is one that does not distort an investor's decision concerning

exploration, development and exploitation of a mineral resource. Thus, a tax that is economic allocative efficient asserts that which is neutral. In theory of public finance, a neutral tax is one that does not distort an investor's decisions that would have been made in its absence. In practical terms, a non-neutral tax gives rise to either over or sub-optimal exploitation of the mineral resource (Guj, 2012).

In mining, production based taxes display a high propensity of economic allocative inefficiency. This is because the introduction or increment of these taxes increases the fixed cost and total cost of production, and as a consequence the cut-off grade[5] used in determining the commercially exploitable ore reserves. In order to offset the financial burden introduced by these taxes, an investor is forced to mine a lower number of high grade blocks of ore. This reduces the economically exploitable reserves and life span of the mine. Thus, it can be concluded that the higher the economic inefficiency of a tax, the lower the exploitation of ore reserves and the shorter the productive life span of the mine.

To the contrary, a profit based tax is economic allocative efficient, this is because it dwells on the concept of economic rent[6]. The effect of this tax only sets in when a mining enterprise makes a profit. This asserts that the tax only becomes effective after the breakeven point. As a result the breakeven point as a critical mining parameter is unaffected. This eliminates the necessity to change the cut-off grade. Eliminating the necessity to change the cut-off grade eradicates the motivation to employ high grading[7] as a possible mining technique.

### 2.8 Mineral tax incentives

Mineral fiscal regimes often include measures that allow the taxpayer to enjoy tax benefits. These measures are implemented with a purpose of encouraging FDI in the mineral sector. This section

[5] Cut-off grade is the minimum grade economically mineable.

[6] Economic rent also known as resource rent is the surplus of revenue after netting off all operating cost and a minimum return on capital from gross revenue. Minimum return on capital are funds pumped into the business in order to sustain its operation. This concept is discussed in detail in Chapter three.

[7] High grading is a mining technique which is focused on mining high grade blocks of ore as opposed to low grade blocks.

explains four tax incentives that are generally applied in the Zambian context. These include tax holidays, tax depreciation provision, custom duty exemption and carry forward loss provision.

### 2.8.1 Tax holidays

Tax holiday is a tax incentive which involves the temporal or permanent reduction of a certain type of tax. This tax incentive is usually granted so as to provide a relief to cash flow problems which a mining firm can face at the start of the production cycle (Manley, 2013). Tax holidays reduce the tax incidence of a project thus shrinking the payback period and exponentially reducing risk. This encourages FDI in the mineral sector. Most tax jurisdictions impose tax holidays on a short term basis as opposed to long term. This calls for the reason as to why tax holidays should be termed as short term tax incentives.

### 2.8.2 Tax depreciation

Depreciation can be termed as the wear and tear of an asset due to constant use. There are two types of depreciation, these include accounting and capital allowance depreciation. The type directly linked to taxation is capital allowance depreciation also known as tax depreciation. Capital allowance depreciation is a form of tax relief and can be defined as an amount written off capital expenditure (Mulolani, 2014). However, capital allowances are not given on all types of capital expenditures. Some of the qualifying expenditures in Zambia include implements, plant machinery and industrial buildings.

Capital allowance is treated as an allowable deductible expense for the purpose of computing taxable business profit. Thus, the higher the capital allowance the lower the taxable income and tax incidence. This compelling reason makes tax depreciation a substantial tax incentive for the mining industry. High capital allowances encourage investment. It is for this reason that many countries allow accelerated depreciation (e.g. South Africa). When depreciation is accelerated it reduces taxable income thus leading to accelerated return on an investment.

### 2.8.3 Carry forward loss

Many mining jurisdictions including Zambia allow mineral enterprises to carry forward their losses to the next year. This act reduces taxable income and thus reduces the tax incidence in that year. If losses are substantial or if they accumulate over a number of years the company may only start paying full company tax several years after it starts making a profit (Manley, 2013). According to Manley (2013), tax only becomes payable once there is a non-zero value of cumulative profit. Table 2.3 shows the loss carry forward rule. From this table it can be seen that the mining company only starts paying full company tax in the sixth year, where there is a non-negative cumulative profit.

**Table 2.3: Loss carry forward rule (Manley, 2013)**

| Year | Profit/loss ($) | Cum profit/loss ($) | Taxable income ($) |
|---|---|---|---|
| 1 | -100 | -100 | 0 |
| 2 | -50 | -150 | 0 |
| 3 | 0 | -150 | 0 |
| 4 | 50 | -100 | 0 |
| 5 | 100 | 0 | 0 |
| 6 | 100 | 100 | 100 |
| 7 | 100 | 200 | 100 |

### 2.8.4 Custom duty exemption

Mining companies are exempted from custom duty on plant, equipment and machinery. In likeness with other tax incentives, custom duty exemption is exercised so as to attract FDI in the sector. Many mining jurisdictions including Zambia exempt mineral enterprises from customs duty with an aim of relieving cash flow problems so as to encourage expansion of existing projects.

## 2.9 Tax planning schemes

This section describes four tax planning schemes undertaken by mining companies to reduce tax incidence. These include:

(a) Transfer pricing manipulation;

(b) Debt repayment abuse;

(c) Misreporting of grade and production values; and

(d) Hedging manipulation.

These tax schemes mostly affect the cost factor of the mining profit function. Thus, they have greater impact on profit based tax regimes than those based on revenue (Manley, 2013).

### 2.9.1 Transfer pricing manipulation

Globalisation has increased the capability of corporations to place their business activities anywhere in the world. This has generated into increased cross border, intra-group trade accounting for almost 30% of the world's transactions[8]. The need for Multinational Enterprises (MNEs) to determine the financial performance of its business entities which are treated as independent profit centers has motivated them to charge transfer prices for their transactions. This makes transfer pricing an imperative and lawful business activity.

Transfer pricing can be defined as the pricing of intra-entity, cross border transactions. Transfer prices between associated entities differ from those between independent parties. This is because transfer prices are not only governed by market forces but by forces of common interest between associated entities. For instance, a parent mining company operating in a high tax jurisdiction would deliberately sell its mineral product at a high price to its related party in a low tax zone so as to save funds which would have been potentially lost through mining taxation. However, a different scenario would exist when the two trade parties are independent, as these would trade on an arm's length basis.

When transfer pricing does not conform to the norms of international taxation, it is more generally called *mispricing*, *incorrect pricing* or *pricing abuse*. To avoid transfer mispricing, most jurisdictions implement stiff pricing guidelines. The most common applied guidelines are those

[8] See United Nations Tax Committee's Subcommittee paper on transfer pricing. Available at http://www.un.org/esa/ffd/tax/2011_TP/TP_Chapter1_Introduction.pdf.

affiliated with the Organization for Economic Cooperation and Development (OECD). Transfer pricing is an open ended international taxation problem needing close monitoring from the side of tax authorities.

### 2.9.2 Debt repayment abuse

Many tax jurisdictions allow interest on debt as a deductible expense for the purpose of calculating corporate tax. However, mining companies may use this as a strategic benchmark for gaining an advantage in business. For instance, a parent enterprise operating in a high tax jurisdiction can borrow a high interest loan from its subsidiary operating in a low tax zone. This act transfers proceeds from the high to the low tax zone, thus saving huge sums of money that would have been lost through tax. To combat this, most tax jurisdiction implement thin capitalization rules. These rules provide a limit to how much debt mining companies can accumulate by clearly indicating how much debt an enterprise can hold with respect to its equity (i.e. debt to equity ratios).

### 2.9.3 Misreporting of grade and production values

Many multinational mining companies misreport grade and production values with a view of reducing the tax burden. They do this in three ways (Manley, 2013):

(a) Misreport the tonnage or volume of Run-Of-Mine (ROM) ore mined;

(b) Misreport grade values; and

(c) Misreport or failing to report the by-products contained in the ore.

Due to some of these schemes, the revenue authority must employ mineral experts with the technical know-how of combating these problems. These experts must be geologists, mining engineers, metallurgists and mineral economists who are trained in issues of grade analysis, excavation, processing, smelting, refining and most importantly taxation of mineral material. To accomplish this, close cooperation between the government and mining houses must be exercised.

### 2.9.4 Hedging manipulation

Mining companies face stochastic prices for their commodities than firms in other industries. Mining ventures reduce this volatility by purchasing derivative contracts such as options and futures. Options can be defined as contracts that give the buyer the right not the obligation to buy and sell an underlying asset at a certain price and within a specified period of time. Options differ from futures in that the latter obliges the seller to sell and a buyer to purchase an underlying asset at a certain price and within a specified period of time while the former provides the liberty not the mandate to sell or buy. These contracts (futures and options) provide a lock down on future prices of a commodity to a certain value thus reducing the exposure of a mining investment to risk.

Hedging in its original sense is not a tax planning scheme but a legitimate and imperative business activity to be used by companies to limit their exposure to risk. However, it is used to the advantage of MNEs to reduce their tax incidence. For instance, a parent enterprise operating in a high tax jurisdiction can deliberately lose funds to its subsidiary operating in a low tax jurisdiction through hedging manipulation. This action transfers funds or income from the parent company to its subsidiary thus saving a large sum of money which would have been lost through mineral tax. Hedging manipulation is another form of transfer pricing and all measures must be taken to eliminate it, as this leads in reduced government tax revenue. Eliminating hedging when calculating tax has the benefit of easing the administrative burden of the revenue authority.

## 2.10 Macroeconomic impact of mining in Zambia

Mining like any other business venture should contribute to the public development of a country. Zambia's mineral sector has played and continues to play a pivotal role in the macroeconomic growth of the state. Between 2006 and 2011 the contribution of the sector to GDP has averaged about 3.8%, while mining tax revenue as a ratio of GDP was recorded at about 3% in 2011 (Ministry of Mines, Energy and Water Development, 2013).

The goal of any government is to ensure that every citizen gets the maximum benefit of wealth derived from the mineral sector. However, this must be consistent with the need to attract and retain investment. This is why government policy should be tailored to delivering a win-win

situation that will secure maximum benefits for the nation and appropriate returns to the investor. The common statement on taxation states, "*The art of taxation consists in so plucking the goose as to obtain the largest amount of feathers with the least possible amount of hissing*"[9]. This statement asserts that the mining investor must be taxed as much as possible so as to obtain maximum amount of revenue but this must be consistent with the concept of resuscitating his/her business operations.

The subsections that follow give a brief highlight of the positive macroeconomic externalities of the Zambian mineral sector. These include foreign exchange earnings, employment, government revenue, local infrastructure and linkages to other sectors.

### 2.10.1 Foreign exchange earnings

Mining is one of the largest export industries in Zambia and hence one of the largest contributors to foreign exchange earnings. However, the shift of modern mining from labour to capital intensive techniques of production has offset this benefit. This is because the shift has motivated the importation of capital intensive machinery thus making mining one of the largest users of foreign exchange.

Like any other business venture, mining enterprises have the obligation of remitting profits to their shareholders in form of dividends. Since, most shareholders of mining companies are non-residents of Zambia, funds are usually repatriated to their native states. This act consumes foreign exchange.

Mining is a capital intensive business venture which requires excessive disposal of finances for its start up. There are two common sources of funding in the mining industry. These include equity and debt. The latter involves a payback for the use of borrowed funds. This translates into mining companies repatriating its profits to pay its debts. This act in likeness with that of repatriating funds to settle dividends has the same effect of consuming foreign exchange.

[9] Attributed to Colbert, J.B., (1619-1683), Louis XIV's Controller-General of Finance.

To regulate these acts, some countries impose foreign exchange controls which limit capital outflows and repatriation of profits. However, the implementation of such controls is uncommon in a majority of jurisdictions because it is recognized as a strong disincentive of FDI.

### 2.10.2 Employment

Employment improves the social-economic status of every noble citizen. Mining plays a focal role in the labour sector, by employing a vast number of local inhabitants both skilled and unskilled. Over the years, the Zambian mining sector has deployed 60,000 direct jobs on the labour market (Ministry of Mines, Energy and Water Development, 2013). The impact of these jobs with regards to the social-economic wellbeing of Zambian citizens has been wide spread. This is attributed to the fact that mining employees support other financially deprived individuals.

However, it must be mentioned that deployment of labour in the Zambian mining sector has over the years decayed. This is attributable to the shift in technology by mining firms. In the past years, mining was traditionally labour intensive but due to high labour cost coupled with the high technological advance modern mining is now reliant on automated machinery. Figure 2.5 shows employment levels in the mining and other non-mining sectors from 1961 to 2009.

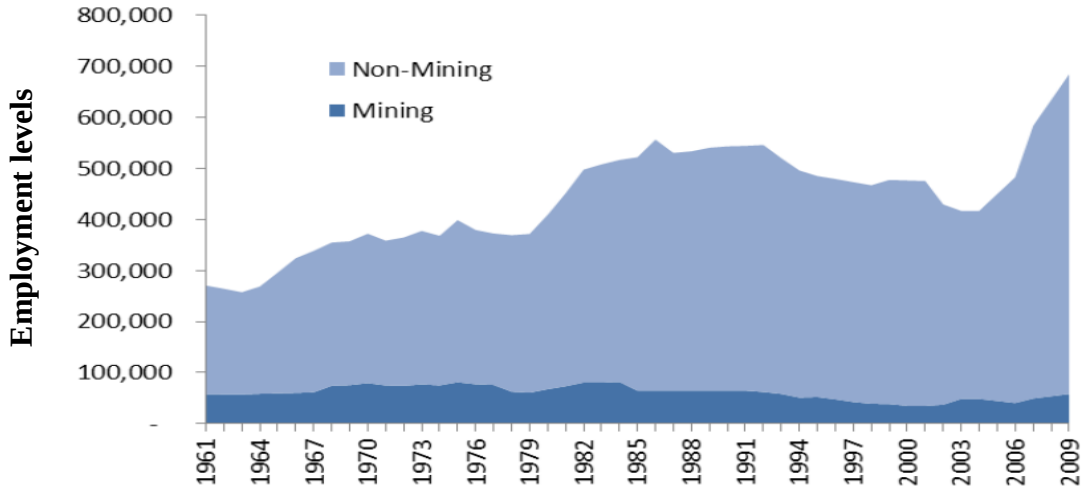


**Figure 2.5: Mining and other formal sector employment levels (Central Statistical Office, 2014)**

### 2.10.3 Government revenue

Mineral revenue is the utmost positive macroeconomic externality in mining dependent economies. The mineral sector in Zambia has provided vast amount of revenue to the national treasury through remittance of various taxes by mining firms.

Mining depletes the mineral stock of a country. It is, therefore, imperative that every Zambian benefits from these diminishing resources. The benefits of mining can only trickle down to every Zambian citizen when wealth is rationally distributed through the budget system. Table 2.4 shows mining tax revenue figures over a span of six years from 2009.

**Table 2.4: Mining tax revenue in million Kwacha (ZRA, 2014)**

| | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** |
|---|---|---|---|---|---|---|
| **Pay As You Earn (PAYE)** | 586.65 | 740.81 | 999.15 | 1,162.56 | 1,440.04 | 1,402.58 |
| **Export Duty** | 15 | 2.4 | 1.9 | 3.5 | 8.21 | 22.4 |
| **Mineral Royalty** | 242.19 | 392.69 | 867.98 | 1,458.60 | 1,760.73 | 1,766.88 |
| **Company Tax** | 209.72 | 1,258.78 | 2,473.86 | 2,610.32 | 1,084.72 | 1,473.50 |
| **Total** | 1,053.56 | 2,394.68 | 4,342.89 | 5,234.98 | 4,293.7 | 4,665.36 |

From Table 2.4, it has been shown that mining revenues have grown considerably. There are five fundamental indicators that could explain this (Manley, 2013):

(i) High mineral prices;

(ii) High mineral tax rates;

(iii) High mineral production;

(iv) Efficient tax administration; and

(v) Implementation of efficient tax regimes.

However, out of the five fundamental indicators, efficient tax administration and implementation of effective mineral tax regimes are difficult to justify. Justification of these two indicators or drivers requires an in depth study. Though mineral tax revenue has increased substantially, a key question that must be asked is whether this revenue has fully compensated the host state for the loss of mineral wealth.

### 2.10.4 Linkages to other sectors

Mining like any other business venture is directly or indirectly linked to other sectors. Thus, it can be deduced that success of other businesses may be reliant on mining. For instance, businesses dealing in local supply of drilling and blasting accessories depend on the continued progression of mining operations for their survival. Additionally, the mineral sector has deployed a myriad of jobs in the labour sector. This can be explained by the principle that a positive expansion in the mineral sector increases the aggregate demand of employment on the labour market. Therefore, it is imperative that the host state boosts up mining activities as this leads to a direct or indirect growth of other sectors thus leading to the macroeconomic growth of the country as a whole.

### 2.10.5 Local infrastructure

Mining enterprises are very cognizant of the fact that their operations and future viability are dependent on the sustainable livelihoods of the local community they operate in. Due to this recognition, these enterprises are motivated to take an active role in improving the quality of life of the local population through Corporate Social Responsibilities (CSRs). One of the CSRs undertaken by these corporations is construction of local infrastructure such as schools, housing, clinics, water supplies and recreation facilities. However, much of this infrastructure is built within the mining area. This asserts that the macroeconomic benefit of local infrastructure from mining is not wide spread. While Zambia can benefit from these CSRs, it should be emphasized that mining revenues collected by the government can also be used to finance the erection of such infrastructure (Manley, 2013).

Corporate Social Responsibility (CSR) programs undertaken by mining firms should not be made obligatory by the Zambian Government as this would reduce the amount of mineral tax remitted.

This is attributed to the fact that CSR programs when made mandatory would impact negatively on the investor's cash flow. This has the potential of sparking the motivation for mining companies to indulge in tax planning schemes so as to save monies that would be potentially lost through corporate social expenditure.

### 2.11 Drivers for a stable mineral fiscal regime

Mining is a risky business venture which involves projecting after-tax returns. In order to achieve this, it needs to forecast how much tax will be remitted to the host government. However, there is no surety that the current tax burden will hold even in the next foreseeable future. This uncertainty of future tax incidence increases the financial risk of the mining firm. To reduce this risk and increase surety of future tax incidence, mining firms engage themselves in fiscal stability agreements with the host state. These agreements promote a stable fiscal regime which acts as a desideratum of FDI. There are two fundamental drivers of a stable fiscal regime these include fiscal stability clauses and flexible fiscal terms. The former encompasses bilateral agreements between the host state and investor. The latter solely depends on implemented tax policies. The subsections that follow, briefly highlight these drivers.

#### a) Fiscal stability clauses

Fiscal stability of mineral policies is an anchor and driver of economic growth in the mining sector. Zambia and the rest of African developing countries constitute high levels of political, economic and social risk, hence the need for fiscal stability by mining firms. On the other hand, the host state attracts FDI in the mineral sector through stable fiscal terms. Due to the former and latter statements, it can be deduced that the inclusion of fiscal stabilization clauses in mining contracts is indispensable both on the side of the host state and mining firms.

The clamor for high economic rent by host states has led to frequent reformation of mineral tax policies. This clamor has been sparked by pressure from the electorate that host countries are not extracting the maximum revenue benefit from there non-renewable mineral resources. The initial spark of the perception of low gain in mining revenue by the electorate can be attributed to the implementation of non-progressive mineral fiscal policies by governments. The enactment of such

policies are driven by the need to combat tax planning schemes and to promote stability of mineral revenue influx to host states.

The imperativeness of fiscal stability clauses on the side of mining firms cannot be over emphasized. This is because mining projects have a high affinity to social, political and economic risks which are characterized by huge capital injection and long financial gestation periods. Due to this aforementioned reason, fiscal stability is of utmost importance in investment contracts because it provides a platform for predictable cash flows for repatriation of funds and repayment of debt (Smith, 2012). Fiscal stability on the side of the host government generates a positive external benefit because it is a desideratum of FDI. This FDI translates in macroeconomic growth of the economy as it increases employment, consumer spending and foreign exchange earnings. Host governments yearn for FDI in the mineral sector because they do not have the financial muscle, technical expertise and other technology to exploit their mineral resources (Smith, 2012).

Like any other contract, fiscal stability contracts are imperfect. To reduce this imperfection governments can engage in *renegotiation contracts*[10] with mining investors. This type of fiscal contract has been adopted by the Government of Liberia in its Mineral Development Agreement (MDA) to respond to profound changes in circumstances (Smith, 2012).

There are several challenges to fiscal stability in mining investments. These challenges are driven by transitional, corrupt and inept governments who undertake unilateral alterations of fiscal terms so as to gain selfish interests. Host states rarely commit to the same taxation policies because there is usually a change of government before the life span of the mining project ends. Each successive government that resumes office has a different conception of mineral taxation and hence undertakes unilateral alteration of mineral tax policies. Unilateral alteration of fiscal terms by the government distorts investors' cash flows thus affecting the profitability and commercial viability of mining enterprises. This unilateral alteration of fiscal terms questions the very essence of fiscal stability assurance (Smith, 2012). During the Zambian DA era, fiscal stability clauses were signed with individual mining companies. These stability clauses acted as a form of freeze clauses in which the host state was limited or prevented from unilaterally altering the fiscal terms. The box

[10] These are fiscal stability contracts that provide the ability of revocation in circumstantial adverse conditions

below provides a practical example of this type of clause between the GRZ and Mopani Copper Mines owned by Glencore Corporation.

The Fiscal Stability clause between Mopani Copper Mines and the Government of Zambia

The following is an extract from Clause 16.1 of the Development Agreement between Mopani Copper Mines (referred to in this contract as the 'Company') and the Zambian Government (referred to as 'GRZ').

*16.1.... GRZ undertakes that it will not for the Stability Period*

*Increase corporate income tax or withholding tax rates applicable to the Company (or change the basis of calculation which would result in a decrease of deductions or decrease allowances available to the Company in computing its liability to such Taxes) ...*

*Otherwise amend the Value Added Tax (VAT) and corporate tax regimes applicable to the Company...*

*Impose new taxes or fiscal imposts...*

*Provided that in the case of Clause 16.1 (b) and Clause 16.1 (c) amendments may be made which taken together do not have a material adverse effect (compared with what the position would have been but for the amendments) on the Company's Distributable Profits or the dividends received by its Shareholders ... or the amounts received by lenders to it ...*

*GRZ further undertakes that for the Stability Period, it will not:*

*... (b) Increase:*

*the rate of royalty referred to in Schedule 8 from the levels set out therein*

**Source: Manley (2013)**

**b) Flexibility**

The panacea to unilateral alteration of mineral fiscal terms by the host government is the implementation of an adaptable or progressive mineral fiscal regime. A progressive tax regime is one which captures maximum mineral revenue in times of high mineral prices and captures a relatively low amount of revenue in times of low mineral prices. This type of taxation regime helps

douse the electorate's perception of low gain in the mineral sector hence reducing the motivation for structural reformation.

### 2.12 Extractive Industry Transparency Initiative (EITI)

EITI is a global multi-stakeholder initiative comprising of various participants, including governments, Civil Society Organizations (CSOs) and companies in the extractive industry. It acts as an intermediary in the reconciliation of payments remitted by mining companies and revenue received by the government. EITI was launched by the United Kingdom (UK) with an aim of providing transparency and accountability in managing revenue generated from natural resources. The EITI is based on the belief that effective, efficient and prudent use of natural resources contributes to the economic growth of resource rich countries (Stephens, 2014). Civil society groups in many countries continue to mount pressure on governments to implement the EITI. In fact civil society groups are the co-creators of the EITI in a majority of countries.

Zambia joined the EITI in May 2009 and became fully compliant on 19th September 2012 (Stephens, 2014). To date four annual EITI reconciliation reports have been produced. Despite the endorsement of the EITI, Zambia's civil society groups demand this to be complemented with the mandatory disclosure of payments made by the extractive industry. There a lot of benefits which Zambia derives from being a member of the EITI. These include:

(i) Reduced corporate risk thus increasing FDI in the extractive industry. This in turn enhances national development;

(ii) Acts as a tool for fighting corruption;

(iii) Influences government policy with an aim of maximizing revenue generation from natural resources;

(iv) Prevents conflict based on natural resources. This generates political and economic stability and ultimately a favorable investment climate; and

(v) The EITI creates a platform for public engagement.

Despite these benefits the EITI is limited in some cases. This is due to the following factors:

(i) **EITI data is inexact and unverifiable** – EITI data collected is unverifiable and imprecise in some cases, this limits the use of this data in international comparison analyses;

(ii) **EITI does not reveal whether a country is getting the maximum revenue from its extractive industry** – This is due to the fact that most data is imprecise and unverifiable; and

(iii) **EITI is not an obligatory initiative –** EITI is not a mandatory initiative this means implementing countries have the freedom of deciding what to include in their EITI reports. This acts as a deterrent because other vital information is left out limiting the application of EITI data in international comparison analyses.

To become a candidate and ultimately a compliant member state of the EITI, an implementing country must meet its standard. An EITI standard is a set of seven requirements that countries need to meet in order to be recognized as candidate and ultimately compliant states. One of such requirements includes the publication of an audited report reconciling payments made by oil, gas and mining companies and revenue received by the government. An independent validator must certify the EITI process and produce a report to the EITI international Board. If all EITI indicators are met, the board will designate the country as an EITI compliant state. At present there are 41 implementing countries of which 25 are EITI compliant. The other 16 countries have only managed to achieve EITI candidate status.

## 2.13 Summary

This Chapter has reviewed that the mineral sector has been a major source of economic growth for Zambia. It has also demonstrated that the mining industry possesses a symbiotic relationship with other business sectors. Thus, it can be concluded that mutual success of these entities depends on the synergic relationship they exhibit. The study has revealed that tax planning schemes are deterrent to the macroeconomic growth of the host state as they narrow its tax base, hence resulting in contracted revenue generation. In addition, it has been deduced that implementation of a progressive tax regime and signing of fiscal stability clauses enhances stability of mineral fiscal

terms thus augmenting FDI in the sector. Lastly, this Chapter has described how being a compliant member of the EITI can make governments transparent and accountable in managing tax revenue derived from natural resources.

# Chapter 3

## 3.0 Literature Review

### 3.1 Introduction

This Chapter addresses an overview of the theoretical literature on mineral taxation. It establishes the basis and sets out the framework for evaluating Zambia's mineral taxation regimes. It begins by providing background information on a myriad of mineral taxation issues that have a direct bearing on this study. It deals with the review of the work done in four general areas, that is, theory of taxation, selection of discount rates, tax and project evaluation criteria, and risk in mineral projects.

### 3.2 Objectives of taxation

It is only appropriate that a discussion of taxation should begin with an assessment of its general functions. Taxation can be defined as mandatory payments made by a liable legal entity to the state. Similarly, Raja (1999) describes taxation as transfer payments made by the private sector to the state. However, in the mining industry, taxation policy goes beyond this basic objective of providing revenue into government coffers. The following are the main objectives of taxation particularly in the mining industry.

#### (a) Extraction of rent

Nakhle (2004) describes taxation as an instrument of capturing economic rent emanating from the exploitation of scarce resources. One common tax instrument designed to achieve this purpose is the resource rent tax. Hogan (2008) justifies this tax based on the presence of resource rent which can be defined as a return to the mineral resource. It must be mentioned that the proper design of

a fiscal regime is of key importance in ensuring that the owner of the resource receives an appropriate share of economic rent (Baunsgaard, 2001).

**(b) Financing public expenditure**

The primary purpose of taxation is to provide revenue to the government. Nakhle (2004) describes taxation as a principle means of financing public expenditure. The government conveys this expenditure to championing social-economic development by providing services such as health care, education and infrastructural development. According to Pfister (2009), taxation provides governments with the required funds to build infrastructure on which economic progression and growth are based. From activating theory of taxation, taxes are now meant to enable governments meet there many responsibilities. In other words, taxation may be induced for the purpose of promoting capital formation and economic growth (Sundharam and Andley, 2003).

**(c) Re-distribution of mineral wealth**

Taxation may deliberately be designed to effect the redistribution of wealth among individuals (private wealth) or from private to public control. In the mining industry, this occurs between the mineral producer and government (Nakhle, 2004). In this circumstance, the government collects tax revenue on behalf of citizens and distributes it through the budget system. Manley (2013) recognizes budgeting as a key instrument of conferring Zambian mineral benefits on all citizens not just to those residing in the mining area. The decision to redistribute wealth is generally undertaken on the basis of dispensing social value and is usually predicted by economic judgement.

**(d) Regulatory medium**

Taxes are sometimes imposed to influence social behavior that is considered detrimental to the society. From an industrial point of view, the objective may be to induce certain behavior so as to meet certain objectives. For instance, taxes may be imposed on waste emissions to minimize air and water pollution. According to Nakhle (2004), many proposals have been posited for the use of taxes to control pollution emanating from the use of unclean energy. For instance, green taxes on

carbon dioxide have been legislated to mitigate pollution and damage to the environment (Nakhle, 2004).

In addition to this regulatory medium function, taxation policy can be used to penalize activities that are not beneficial to the state (mere extractive activities) and incentivize those that bring about maximum social benefit (value addition and local manufacturing leading to industrialization) to the economy. Taxation is viewed as a powerful policy instrument of achieving the dual purpose of securing a transfer of resources to the public sector and influencing the private sector to operate consistently with planned objectives.

**(e) Induction of business stability**

Taxes may be deliberately induced with an objective of bringing about business stability so as to maintain full employment conditions (Sundharam and Andley, 2003). During a business depression, low rate of taxes will leave more income with the people and help raise demand and hence resuscitate business activity. On the other hand, high tax rates may be used to subdue inflationary pressure on prices. This condition occurs in times of economic boom. Therefore, tax policy may be used as a regulatory medium of attaining price stability and maintaining full employment. Pfister (2009), recognizes this fact by acknowledging that taxation can be used to create a favorable business environment where wealth is generated. In domestic terms, this can be created by protecting local businesses from international corporations through protective duties. This in turn helps maintain local demand and full employment levels.

Taxation can further be used to alleviate economic problems such as the *Dutch disease*, where resource sectors negatively impact other sectors of the economy by reducing international competitiveness (Nakhle, 2004).

## 3.3 Theory of taxation

Taxation theory hinges on the concepts of efficiency and equity. Any taxation regime should be able to satisfy these two extremes to the maximum. The first approach which is efficiency is a welfare concept that is based on the notion of Pareto optimality. The second approach, equity, is

materially concerned with the distribution of tax burden among various taxpayers. The subsequent subsections give a detailed explanation of these two concepts.

### 3.3.1 Efficiency of taxation

Economists over time have traditionally analysed taxes from the notion of economic allocative efficiency. This concept derives its material core content from welfare economics and is based on the concept of Pareto optimality. Church (1981) defines Pareto optimality as the allocative pattern where the gains by one individual should not result in the loss of welfare of other individuals.

According to Nakhle (2004), the criterion of efficiency is satisfied when resources in the economy are allocated in accordance with tastes and preferences of citizens. This from the view point of Swan (1984) is defined as the social optimal position. However, it must be noted that taxation creates distortions in the allocation of resources away from the socially optimal point. Church (1981), posits that these distortions can only be done away with if taxation falls on economic rent.

Although the concept of economic allocative efficiency is of material significance, Atlay (2000) argues that this concept has been the main point of departure from the economic theory of optimal taxation. Raja (1999) recognizes complexity in this concept by highlighting the difficulties in providing a proper contradistinction between private and social optimal levels of efficiency. The concept of efficiency is usually combined with the notion of neutrality as will be discussed in Section 3.6.1.

### 3.3.2 Theories of equity

The payment of taxes to the government with the purpose of financing public-sector expenditure is an eminent financial burden on the society. This is because taxes affect the economic wellbeing of every individual and the profit position of every business organization. The amount of money burden of taxation refers to the amount of money income transferred from the people to the government by means of taxes (Sundharam and Andley, 2003). Thus, the real burden of taxation can be defined as the amount of financial sacrifice imposed on a community. Similarly, it entails the volume of goods and services or value of money raised. On an individual basis, the true

sacrifice imposed by taxation is measured in terms of forgone necessities and luxury. However, it must be mentioned that a person earning a higher income is faced with a lower sacrifice when compared to low income earners paying the same tax. Similarly, the real sacrifice or burden of taxation will be greater on earned income rather than unearned income (Sundharam and Andley, 2003)[11]. To this extent, the real burden of taxation can only be kept to a minimum if unearned income is taxed more than earned income.

The concept of real burden of taxation suffers from the pitfall of being incomplete. This is because while taxation imposes a financial burden on a society, expenditure by government bestows benefits on the same society. Thus, when evaluating the real burden of taxation the benefits pipelined by public expenditure should be taken into account.

The real burden of taxation is closely associated with the concept of equity. In public finance, equity addresses the question as to whether the tax burden is spread fairly among various taxpayers (Guj, 2012). This concept is not merely an issue in pure economic analysis but also extends to social philosophy. There are two dimensions to this concept, that is, horizontal equity and vertical equity. Firstly, horizontal equity is the idea that people with similar ability to pay taxes should pay the same amount of tax or incur the same tax burden[12]. According to Elkins (2006), the concept of horizontal equity demands that individuals in a similar situation should face similar tax burdens. This is the reason why this dimension of equity is also known as the *equal treatment of equal's* principle, implying that people that are equal must be treated equally for taxation purposes. According to Guj (2012), horizontal equity is materially concerned with whether taxpayers that generate the same amount of economic rent are taxed at the same rate.

In contrast to the first dimension, vertical equity usually refers to the idea that people with greater ability to pay taxes should pay more. This dimension of equity is closely associated with the concept of proportional and progressive taxation[13]. Generally, equity is built on the premise that

[11] This is because unearned income does not constitute any expensed effort.

[12] This is related to the principle of tax neutrality or the idea that the tax system should not discriminate between similar things or people, or unduly distort behavior.

[13] This concept of taxation is closely associated with redistribution of wealth.

all productive members of the society should contribute to its preservation. This should be done by members paying a fair share through taxation.

There are two prominent principles that have been put forward to devise an equitable tax system. These include, the *benefit principle* and the *ability to pay approach*.

### 3.3.2.1 Benefit principle

According to this principle, citizens should remit taxes in proportion to the benefits they receive from the services rendered by the government. This principle establishes that there is a *quid pro quo* relationship between the taxpayer and the government. The government confers benefits on citizens by providing them with what is known as social goods. In exchange of these goods citizens have to pay taxes. Equity in taxation demands that individuals should remit taxes in proportion to the benefits conferred on them by the government. To this extent, the benefit principle individualizes the obligation to pay and also the amount to pay. According to Sundharam and Andley (2003), the benefit principle has two implications:

(i) Benefit is used as justification for taxation; and
(ii) It serves as a standard for apportioning tax burdens.

The benefit principle can be interpreted from two viewpoints, that is, the cost of service principle and the value of service principle. The cost of service principle states that every person should be charged tax according to the cost of services rendered of which he or she is a beneficiary. However, this principle has no practical bearing because it is difficult to determine the cost of some services e.g. the cost of service of law and order rendered by armed forces and police. The cost of service principle can only apply in those cases where tax is paid out of prices e.g., supply of electricity, water, railway or postal services. On the other hand, the value of service concept is philosophically inclined to the notion that every citizen must pay taxes according to the monetary worth of the services he or she has received from the government.

According to Sundharam and Andley (2003), the benefit principle has the following two prominent advantages:

(i) Justifies the imposition of taxes used in paying for the benefits;

(ii) Combines both the income and expenditure sides of the budget process and thus simultaneously diagnoses or determines both public services as well as tax shares; and

(iii) As benefits accrue to the society, taxation is seen as a device of supporting government services.

In spite of these merits, the drawbacks of the benefit principle are far too many and include:

(i) It is difficult to measure the benefits received by an individual from services rendered by the government. Today, the state has increasingly assumed the function of welfare and has inclined itself to the provision of social goods. These goods are not quantifiable and cannot be apportioned separately for different individuals or groups of individuals, these include national defense, police and education. In other words, government expenditure on these non-quantifiable goods is incurred on common indivisible benefits.

(ii) In recent years, governments have entered into the welfare field attempting to provide all sorts of services with the objective of increasing the welfare of the general masses of the community. This has negated the application of the quid pro quo concept because the poor do not remit any tax and thus should not benefit from the services rendered by the government.

(iii) The benefit principle when applied blindly will lead to great injustice. For example, the benefit derived by a pensioner does not apply coherently or consistently with the benefit principle. This is because according to this principle it is expected that the old age pensioner pays back to the government by way of taxes.

(iv) The benefit principle would mean the same per capital burden for the poor and rich. However, it is believed that the poor benefit more from the services rendered by the state. Hence, the need to contribute more than the rich. This will be outrageous as it would lead to economic injustice on the part of the poor.

(v) The benefit principle cannot solve the problem of distribution of income and stabilization of the economy.

(vi) The benefit principle has a limited application in that it is applied to special or direct services made available to individuals on a voluntary basis.

(vii) The benefit principle is based on the assumption that the complex activities of the state can and should be calculated and assessed against each person on the basis of individual benefits conferred or derived. This assumption is unrealistic and does not recognize the theoretical and practical difficulties of achieving this.

(viii) The benefit principle militates against the concept of taxation. This is because taxation is a compulsory payment made to support state activities and not for the return of any good or service rendered. That is, there is no quid pro quo relationship between the state and the taxpayer.

#### 3.3.2.2 Ability to pay principle

This principle is based on the concept that people who possess income or wealth should contribute to the functioning of the government in terms of providing basic services. According to this principle, the rich have a greater ability to pay taxes and thus must pay more than the poor. This principle has received more attention than the benefit principle. This is so because the benefit principle does not offer protection to the poor and thus does not propagate the notion of economic justice for all.

The ability to pay principle recognizes the fact that taxation must be based on sacrifice. That is, all taxpayers must incur an equal sacrifice of their income when taxation is instituted. Thus, it can be deduced that this principle is based on progressive taxation, meaning that, income that is greater in amount must be subjected to high tax burdens. The core concept of this principle stems from the notion of vertical equity, which asserts that, unequals should be treated unequally, meaning every taxpayer should be made to contribute according to his or her ability or faculty to pay.

Advocates for the ability to pay principle have sought to justify it based on three platforms (Sundharam and Andley, 2003):

(i) **Sacrifice interpretation of the ability to pay principle** – A tax system is equitable when the sacrifice of tax incurred by each individual is equal. When taxpayers do not incur an equal sacrifice in terms of the forgone income due to taxation, it results into great economic injustice.

(ii) **Diminishing marginal utility of income** – This concept is derived from the general principle of diminishing marginal utility[14]. The law of diminishing marginal utility of income states that successive increase in additional income will result in lower utility of income. From a conceptual view point, income is meant to satisfy human wants. The most important being basic necessities. Next in order are conventional necessities which in turn are followed by comforts and luxuries. As one propagates from basic necessities to conventional necessities and then on to comforts and luxuries, the intensity of satisfaction of human wants also decreases. This means that successive increments in income leads to a decrease in the satisfaction of human wants. Thus, it is only rational for tax to be imposed on larger incomes as the burden or sacrifice imposed will not be greatly felt. This also calls for a greater amount of income to be left with lower income groups through the application of minimal taxation.

(iii) **Faculty interpretation** – This entails that after a taxpayer meets all his/her basic necessities of life, the income that is left represents his/her tax paying capacity. According to the faculty interpretation, that part of income that can bear heavy tax burdens is known as *economic surplus*. That which does not represents income can be termed as income necessary in maintaining production efficiency. Taxation of economic surplus can be justified from two dimensions. Firstly, the taxing of economic surplus does not lead to a distortion of taxpayer behavior. That is, the decisions that were made before taxation will continue to propagate in the same fashion when that taxation is legislated[15]. Secondly, economic surplus can be justified on the basis of economic growth. For economic progress,

[14] This is a principle in economics which states that an additional increase in the consumption of a good or service produces less additional satisfaction than the previous increase.

[15] This concept adheres consistently and systematically to the notion of neutrality.

it is important that a high proportion of economic surplus be channeled into productive investment. Otherwise, it would be used for unproductive consumption and investment.

It must be noted that the above three points justifying the ability to pay principle somewhat exposes its weakness. Firstly, the sacrifice interpretation of the ability to pay principle is subjective. Equally the law of diminishing marginal utility of income is subjective and does not encapsulate saving and investment in its definition. Saving and investment is essential for individual citizens and the entire society as a whole because it determines economic progression and growth. Thirdly, the faculty interpretation possesses practical difficulties in its application as it is difficult to calculate economic surplus.

There are two approaches to the ability to pay principle and these include the subjective and objective approach.

**(a) Objective approach**

This approach of the ability to pay principle is materially concerned with diagnosing the appropriate base of taxation which will be employed in measuring the ability to pay correctly. According to this approach, there are three main indices that can be used to measure this base. These include income, expenditure and property.

**(i) Income**

Income has been accepted as the best single measure of a man's ability to pay. This is because a person's income during a period determines what is to be consumed or added to wealth. In taxation, gross income is unsuitable for measuring the ability to pay. This is because it encapsulates or encompasses cost elements. To this extent, net income is considered as the best measure, as it reflects income over and above costs. Levying tax on gross income erodes or consumes the capital of an individual and thus produces production inefficiencies. This will subsequently lead to reduced consumption of goods and services in the market place. Many classical writers gave a clear distinction between subsistence income and taxable income. They argued that taxable income should be that which is over and above subsistence income. It is for this reason why they must be

advocacy for the complete exemption of low and middle income groups. This should be complemented with an imposition of proportional taxation on higher income brackets.

Late age economists have distinguished between earned income and unearned income. Earned income refers to income from services and unearned income represents income arising out of capital. The former represents a double sacrifice in that it reflects the loss in enjoyment from the use of income and the pain of having suffered in vain to earn such income.

Although income is a superior measure of the ability to pay it needs to be supplemented with other indices such as expenditure and wealth. This is because society has become increasingly complex. Hence, the need to apply various indices.

### (ii) Consumption expenditure

Consumption has been considered as the most rational base of taxation in measuring the ability to pay. This is because consumption reflects the true utility or satisfaction derived from income. However, consumption is not a single best measure of expenditure. This is because it fails to recognize saving and investment as important components of expenditure. Saving by its true nature increases the capital stock of a country and thus adds to the investment or productive capacity of a society. If a person consumes more than his income he must be made to pay a higher tax. Imposition of expenditure tax on consumption is materially significant in those developing countries where there is high consumption and low rate of capital accumulation. This tax is superior over income tax because it is solely dependent on consumption and excludes savings. This in turn stimulates capital formation. Thus, it is suffice to say that expenditure tax discourages consumption and encourages investment. A recent implementation of the expenditure tax was made in India but was however discarded because of its failure. It proved difficult to administer and the revenue that was collected from it was minimal.

### (iii) Property or wealth

In earlier societies, wealth was considered as a superior measure of the ability to pay than income. This is because in addition to wealth being a source of income it provided security and insurance

against risk. However, the development of the money economy and progress of industrial society has necessitated and initiated a shift from property to income as an index of ability to pay. Additionally, it has been posited that wealth is not a litmus test of the ability to pay and thus should be treated as a supplementary index. The following are the inherent weaknesses of property as an index of the ability to pay (Sundharam and Andley, 2003):

- Property is not an equitable measure because property of the same nature may not yield the same amount of income. This is because income from property varies from zero to large amounts depending on the location, use etc.
- Property may or may not generate income in a particular year.
- If in any year there is no income or there is actually a deficit, tax on property in that year will fall on the capital value of the property.

Notwithstanding these weaknesses, property as index of ability to pay gives the holder an additional source of tax paying capacity which is not reflected by net income (Sundharam and Andley, 2003).

**(b) Subjective approach**

Subjective approach is concerned with interpreting the ability to pay principle in terms of sacrifice incurred by the taxpayer. A tax system based on the ability to pay principle should result in equal sacrifice by all taxpayers. The equal sacrifice principle can be interpreted in three ways. These include, the equal absolute sacrifice; equal proportional sacrifice and equal marginal sacrifice.

**(i) Equal absolute sacrifice**

This interpretation of equal sacrifice implies that the total loss of utility as a result of tax payment should be equal for all taxpayers. If there are two taxpayers with different incomes, the one who earns more will pay more tax and the one who earns less will pay less tax, *but the sacrifice to both as a result of tax should be equal*.

Suppose there are two taxpayers in a community, that is, taxpayer G and H. If U stands for total utility, Y stands for income and T stands for tax amount, then (Y-T) indicates income after tax. Thus, equal absolute sacrifice can mathematically be expressed as:

$$U(Y) - U(Y-T)G = U(Y) - U(Y-T)H \quad [3.1]$$

Cancelling out like terms, gives:

$$U(Y-T)G = U(Y-T)H \quad [3.2]$$

**(ii) Equal proportional sacrifice**

Equal proportional sacrifice implies that the total loss of utility as a result of tax payment should be proportional to the total income and must be equal for all taxpayers. Under this interpretation of equal sacrifice, the taxpayer with a higher income will pay more tax and that with a lower income will pay less tax. However, the ratio of sacrifice to income will be the same for all taxpayers. This can mathematically be expressed as:

$$\frac{Sacrifice\ to\ taxpayer\ G}{Income\ of\ G} = \frac{Sacrifice\ to\ taxpayer\ H}{Income\ of\ H} \quad [3.3]$$

Alternatively, Equation 3.3 can be expressed as:

$$\left\{\frac{U(Y)-U(Y-T)}{U(Y)}\right\}G = \left\{\frac{U(Y)-U(Y-T)}{U(Y)}\right\}H \quad [3.4]$$

**(iii) Equal marginal sacrifice**

This concept of equal sacrifice implies that the marginal loss of utility for all taxpayers must be the same. That is, the instantaneous sacrifice incurred as a result of paying tax must be equal

for all taxpayers. Individuals in high income brackets exhibit lower marginal utility when compared to low income earners. This calls for them to pay more tax and bear the most burden.

Equal marginal sacrifice is built on the principle of minimum sacrifice meaning that an individual must be taxed in such a manner that translates into the lowest aggregate sacrifice of the community as a whole. It is for this reason, why this concept is also known as the *least aggregate sacrifice principle*. Equation 3.5 mathematically interprets the equal marginal sacrifice concept.

$$MU(Y-T)G = MU(Y-T)H \qquad [3.5]$$

Alternatively, Equation 3.5 can be expressed as:

$$\left\{\frac{dU(Y-T)}{d(Y-T)}\right\}G = \left\{\frac{dU(Y-T)}{d(Y-T)}\right\}H \qquad [3.6]$$

The above three concepts of equal sacrifice can be explained using the graphical representation shown in Figure 3.1.

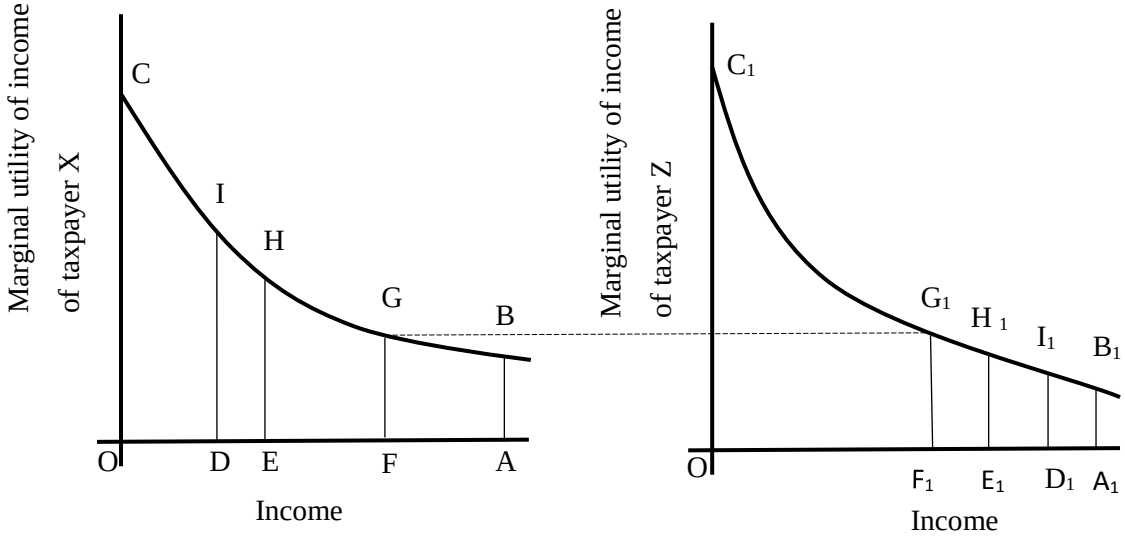


**Figure 3.1: Graphical representation of equal sacrifice**

Figure 3.1 tries to explain the situation under which the tax burden is to be distributed between taxpayer X and Z based on the three rules of equal sacrifice as already discussed. In this figure, the left diagram shows the marginal utility of the low income taxpayer X and the right diagram shows the marginal utility of the high income taxpayer Z.

Under the equal absolute sacrifice principle, taxpayer X has income equal to OA and pays DA amount of tax, while taxpayer Z has income equal to $OA_1$ and pays $D_1A_1$ amount of tax. Thus, the total loss of utility or sacrifice incurred by taxpayer X is DABI and that incurred by Z is $D_1A_1B_1I_1$. According to this principle of equal sacrifice, the total loss of utility of the two taxpayers as a result of tax payment is such that:

$$DABI = D_1A_1B_1I_1 \qquad [3.7]$$

Under the equal proportional sacrifice principle, the taxpayer X will pay EA amount of tax and taxpayer Z will pay $E_1A_1$. According to this principle, the loss of utility of taxpayer X and Z as a result of tax payment must be proportional to the total utility derived from pre-tax income and subsequently must be equal. Thus:

$$\frac{EABH}{OABC} = \frac{E_1A_1B_1H_1}{OA_1B_1C_1} \qquad [3.8]$$

Under the equal marginal sacrifice principle, taxpayer X pays FA amount of tax and taxpayer Z pays $F_1A_1$. Here, the marginal sacrifice of the taxpayer X and Z is equal because FG = $F_1G_1$. Additionally, the total sacrifice of X and Z (FABG + $F_1A_1B_1G_1$) is kept to a minimum. Thus:

$$OFGC = OF_1G_1C_1 \qquad [3.9]$$

According to the concept of equal marginal sacrifice, the post-tax incomes shall be equalized at the point where OF = $O_1F_1$.

## 3.4 Economic rent

Economic rent is a topic of utmost importance in understanding taxation policy and hence needs to be pursued. This section embarks on this endeavor by undertaking a critical review of the concept of economic rent as applied in other studies particularly in the case of mineral resources. It commences with a definition of economic rent and elaborates the different types of rent.

### 3.4.1 Definition of economic rent

Otto et al. (2006) defines economic rent as payment or monetary return to the owner of a factor of production. Similarly, Daniel et al. (2008) defines economic rent as surplus revenue over and above all costs of production including a company's required rate of return. Consequently, economic rent can be defined as "a bonus, a financial return not required to motivate desired economic behavior" (Raja, 1999, p.2). It must be mentioned that this concept does not only apply to the minerals industry but also extends to industries where factors of production are present.

Otto and Cordes (2002) posited that economic rent is a vital instrument for motivating investors to invest. Dietsche at al. (2009) notes that resource rents can be taxed away without altering an investors current decisions on consumption and production. This being the case, resource rents represent a justifiable base for taxation. Thus, it is suffice and rational to conclude that economic rent based taxes adhere coherently and systematically to the concept of neutrality.

Otto at al. (2006) recognizes the importance of not confusing rents with wages, profits or interest which are a compensation for the rendered services of labour, entrepreneurship and capital. The authors note that taxing these factors of production erodes the incentive for owners of these resources to provide their services to the market. This subsequently distorts behavior and performance of the economy. Figure 3.2 shows the graphical definition of economic rent as posited by Hogan (2008). From Figure 3.2, economic rent can be defined as the total revenue over and above costs of exploration, development and production, inclusive of a minimum return on capital.

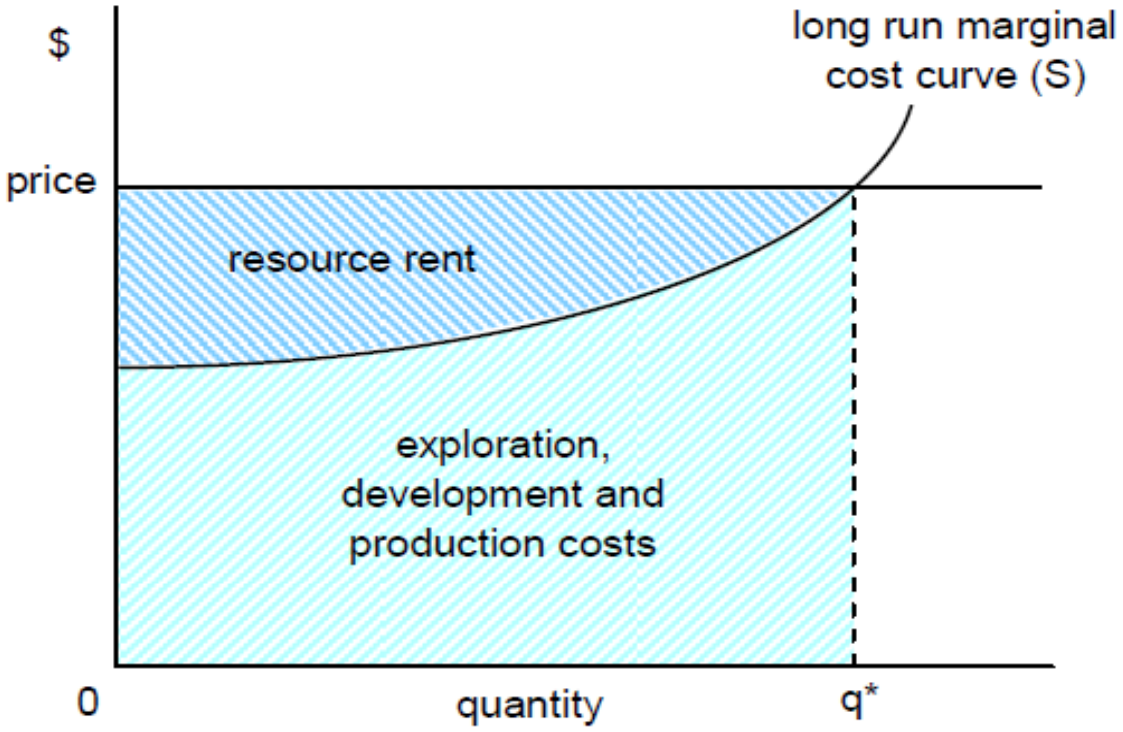


**Figure 3.2: Graphical definition of resource rent (Hogan, 2008)**

### 3.4.2 Types of economic rent

Several types of rent have been put forward in literature. These need to be highlighted and understood as they are of material significance to taxation policy. There are four main types of rent. The proceeding subsections give a clear and elaborate discussion.

#### 3.4.2.1 Ricardian or differential rent

A British economist by the name of David Ricardo was the first to explore the concept of economic rent using the fertility principle of agricultural land (Otto et al., 2006). According to this concept, land in the most fertile class can produce a certain quantity of food at a lower cost than land in the second most fertile class. This logic and reasoning applies to less fertile classes of land. Figure 3.3 graphically illustrates the concept of Ricardian rent.

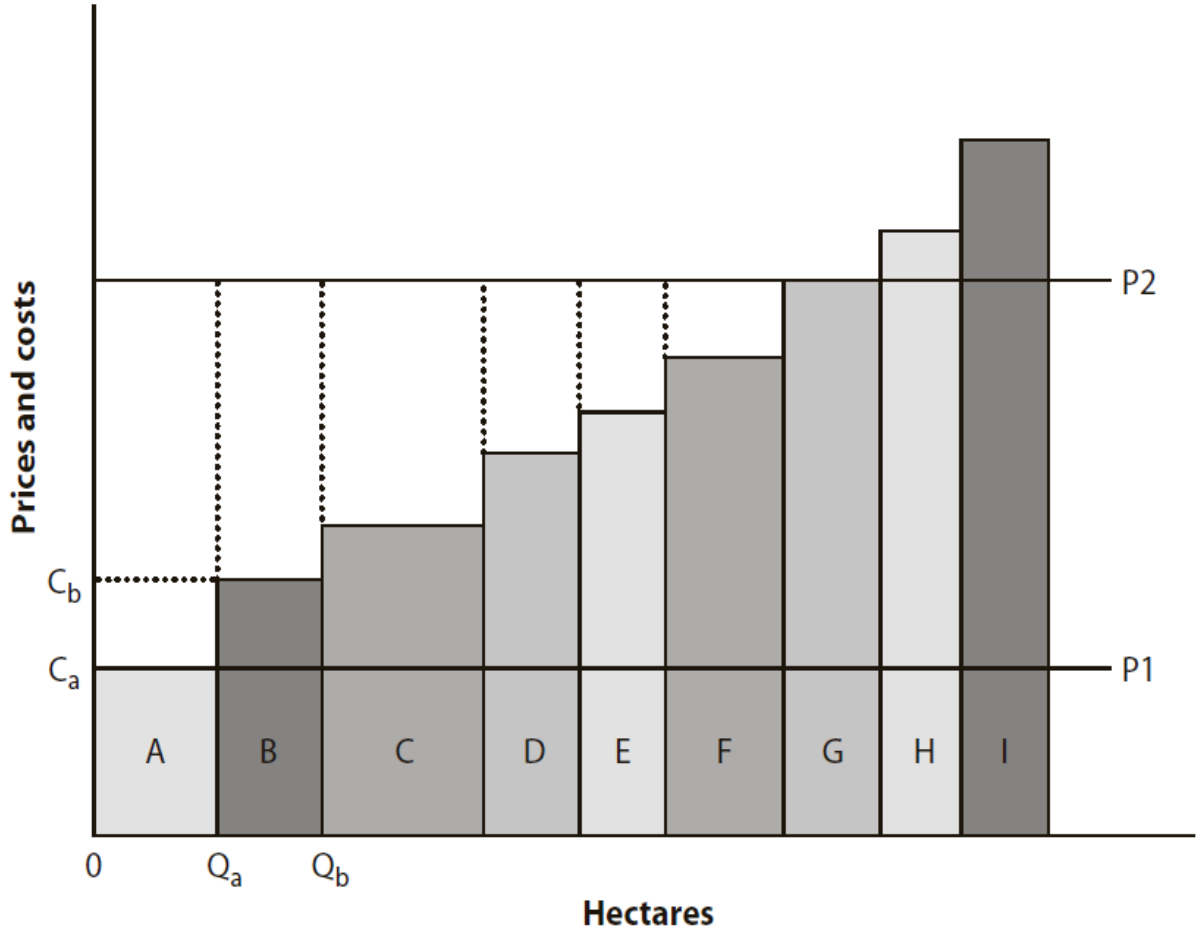


**Figure 3.3: Principle of Ricardian rent (Otto et al., 2006)**

The most fertile land A has the capacity to produce food equal to $0Q_a$ and its cost per unit of output is equal to $0C_a$. The production capacity of the land in the second most fertile class B is equal to $Q_aQ_b$ and its unit cost is $0C_b$. Similarly, this extends to land C up to I.

As the population of the society grows, the demand of food subsequently increases. Once all of the best land in class A is under cultivation, farmers will start cultivating the next best land in class B. As the population expands further, low quality (i.e. less fertile) and hence more costly tracts of land will be brought under cultivation and full production. For this to happen, price must be above the unit cost of production of these lands. If the production grows to include land in class G, the market price of the agricultural produce will rise to price P2. At this price, the owners of land in Classes A through F will be enjoying *Ricardian rent.* Land G which does not earn economic rent is termed as the marginal land.

This concept can further be extended to apply in the context of mineral deposits. Just like agricultural land, mineral deposits possess different levels of quality. Quality in relation to mineral deposits represents grade and depth of ore deposit, nature of mineralization, easy reach to ocean transportation and all other factors affecting production costs (Otto et al., 2006). From Figure 3.3, column A represents the highest quality mine as reflected by the lowest unit cost of production. This reasoning extends to columns B up to I.

If the demand of the mineral material grows and it is deemed that production from mines A to G will satisfy this demand, then the market equilibrium price of the mineral will be P2. Mines A through F will be earning economic rent, whereas, mine G will just be covering production costs. Mine G in this circumstance is termed as the marginal mine.

Thus, it is suffice to conclude that Ricardian rent which is also known as pure rent emanates because the quality of the mineral deposit that is being exploited is superior to that of the marginal mine reflected by a high unit cost of operation (Otto et al., 2006).

#### 3.4.2.2 Hotelling or scarcity rent

This type of rent arises from the natural scarcity of the resources which limits available output (Nakhle, 2004). According to Dickson (1999, p.2), scarcity rent represents "forgone future profits as a result of extraction today". Similarly, Otto et al. (2006) refers to scarcity or hoteling rent as the NPV of future profits that are lost because of extracting marginal mineral resources to produce an additional unit of output today rather than leaving the resource in the ground for future exploitation. The marginal producer will remain in business only when the market price is above the variable cash costs (C1 cash costs) to cover the opportunity costs, otherwise the producer's profitability is foregone by quitting production today and saving mineral resources for future exploitation. These opportunity costs represent Hotelling rent or scarcity rent or user costs.

#### 3.4.2.3 Quasi rent

Quasi rent reflects a mines return on its capital and other fixed costs. This rent only exists in the short term (Otto et al., 2006). It can be defined as the difference between total revenue and total

variable cost. If an operation is no longer able to cover average production costs, it is unlikely to be shut down, but this should occur in the context where returns remain above average variable costs.

According to Dietsche at al. (2009), firms would need to be able to keep quasi rents so as to fully recover production costs in the long run. In principle, this means rent that exists above an operations average variable costs in the short term should not be taxed.

#### 3.4.2.4 Other rents

According to Otto et al. (2006), these rents arise from many sources. They are associated, for example, with cyclical volatility of price changes or other factors. These rents should practically be above an operations full production costs. High prices generate these rents in the short run but in the long run this would be offset by periods of low prices (Dietsche at al., 2009). This is the more reason why these rents should not be taxed.

## 3.5 Taxation instruments

This section reviews the theoretical underpinnings of taxation instruments commonly applied in the mining sector. The review consists of both direct and indirect taxes.

### 3.5.1 Corporate Income Tax (CIT)

CIT is a combined outcome of revenue and operating cost. This characteristic makes this tax instrument prone to tax planning schemes. This is attributed to the fact that mining companies can easily manipulate both or either one of the two quantities with an aim of reducing the corporate profit and subsequently the tax burden.

Despite this shortfall, CIT is economic allocative efficient (Guj, 2012). This means the same exploration and production activities would take place whether the tax is legislated or not.

Similarly, Goldsworthy and Zakharova (2010) describe income tax to be less distortionary[16] (neutral). This is because it is directly related to the concept of economic rent. In theory of taxation, any tax that has a direct bearing on economic rent limits the distortion of investor decisions. From the view point of the IMF, taxation creates distortions and the main objective of tax policy is to design a system that maximizes revenue generation and at the same time abates the level of associated distortions (Mackenzie et al., 1997). Income based tax systems satisfy this prerequisite of non-distortionary. However, these tax systems must be coupled with other mineral fiscal instruments in order to achieve the objective of maximum revenue generation.

Income tax computation allows depreciation, interest rates and other payments to be treated as deductible expenses. This reduces the tax incidence thus increasing the incentive for mining companies to invest.

### 3.5.2 Royalties

Mineral royalty can be defined as fixed payment to the government acting as a landlord for the extraction and exhaustion of mineral resources. Similarly, Cairns (1985) defines mineral royalty as payment exacted by the owner of the resource. Governments are usually the titleholders to mineral rights of deposits occurring deep underground (Daniel et al., 2008). Since mineral resources are non-renewable reserves, it is only rational for governments to receive a reward payment separate from income tax.

Goldsworthy and Zakharova (2010) describe royalty tax as being stable and relatively easy to administer. Similarly, Sunley and Baunsgaard (2001) acknowledge royalties to be an attractive source of revenue for the government because they are easier to administer than many fiscal instruments. Mining firms do not always generate taxable income (Artist, 2009). Royalty tax helps to cushion these times by extracting a fairly substantial amount of revenue from the mineral sector. This can be explained by the notion that royalties offer a stable revenue inflow to the treasury of the state irrespective of whether the mining firm is making a profit or not. Additionally, Manley

[16] A distortionary tax is one which distorts investor decisions when enacted.

(2013) describes royalty as being a useful tool in influencing the riskiness and timing of payments to the government.

Despite these benefits, royalties also face shortfalls. Guj (2012) describes mineral royalty as being relatively economic inefficient (i.e. non-neutral). This is because it is distortionary to investor decisions. Fixed royalty falls flat in terms of epitomizing the extraction of tax proceeds because it is inflexible to market price changes of mineral commodities. This motivates the unilateral alteration of fiscal terms by the host government thus discouraging FDI. Otto et al. (2000) claims that over the past century, there has been a trend to de-emphasize tax systems based on royalties and to switch to tax mechanisms that are profit based. However, Appiah (2013) claims many countries still retain royalties as a form of taxation.

Royalties hike the marginal cost of extracting minerals, as they are based on the value of production (Sunley and Baunsgaard, 2001). The imposition of royalties at rates higher than normal daunts current and future mining investment. This is because high rate imposition of royalty has capability of causing the operating profit of a mining firm to become negative even when the gross revenue is well above extraction cost (Nakhle, 2004). This later results in the spontaneous closure of a mining project.

Due to these demerits, a sliding scale royalty[17] has been introduced to help curb some of the irregularities of the fixed royalty. According to Nakhle (2004) such a tax possesses the benefit of a fixed royalty, which is the generation of early revenue and at the same time possesses the advantage of progressivity affiliated to CIT. In practice, ad valorem royalty options have been adopted in most jurisdictions with sliding scales based on profit, production, price or sales (Hogan, 2008). In relation with the sliding scale, the R-factor[18] is used to account for costs when levying royalty. This factor makes the fixed royalty progressive by applying different rates for different R-factors.

[17] Sliding scale royalty is a type of royalty tax whose rate changes with a sliding variable.

[18] Smith (2012) defines the R-factor as a ratio of investor's cumulative profit to cumulative losses (undiscounted).

Mineral royalty generally takes one of the following forms, (Guj, 2012):

(i) **Resource rent based tax** – This is royalty tax where a fixed monetary rate is applied on economic rent realised by a project;

(ii) **Accounting profit based tax** – This type of royalty tax applies a fixed monetary rate on accounting profit;

(iii) **Value based tax (Ad Valorem)** – With this type of royalty a fixed percentage is applied to the gross or norm value of sales;

(iv) **Unit based (Specific royalty) tax** – In this case, a fixed monetary rate is applied to a physical rather than a financial base e.g. \$/t or \$/$m^3$;

(v) **Hybrid royalty system** – This is a royalty tax which incorporates a minimum specific or ad valorem royalty component in an economic rent or profit based tax; and

(vi) **Other methods** – This involves the application of various bases.

Among the six mentioned forms of mineral royalty, the ad valorem and unit based have been applied globally. This is because they are easy to administer and enforce. The ad valorem tax which is levied on the value of sales is usually applied to precious and base metals. To the contrary, the unit based tax levied on volume or weight is mostly applied to minerals that are relatively homogeneous, such as industrial minerals (sand, limestone, gravel), or minerals that are sold in bulk including iron ore, coal and bauxite (Artist, 2009).

### 3.5.3 Variable Profit Tax (VPT)

This is an excess profit tax whose rate varies according to some measure of profitability or return on an investment (Manley, 2013). The VPT is applied above a certain threshold of profit while maintaining CIT below this threshold. Zambia imposes the VPT in concomitance with CIT. This is done with an aim of maximizing revenue generation in times of high mineral prices. However, variable profit taxes make little economic sense because they are based on ratios which rarely relate to the standard notion of excess profit (Conrad, 2012). Due to this fact, these tax schemes have become less applied in mining. Nevertheless, these taxes are still prevalent in oil and gas

jurisdictions. This is because variable profit taxes dwell on the concept of resource rent and are thus perceived to be fair by the public.

### 3.5.4 Windfall tax

Windfall tax acts like a variable rate royalty in which a percentage tax rate is applied on the gross or norm value of the mineral product sold. However, this rate changes with price fluctuation of the mineral commodity. This tax is usually applied above a certain defined trigger price quoted on an acclaimed metal exchange. It is therefore, imperative to ensure that this trigger price is not set too high as this renders the tax inapplicable. It is mainly due to this reason why most jurisdictions have revoked it as an applicable tax. Nevertheless, this tax has a high degree of superiority when compared to mineral royalty and CIT. This is attributed to the fact that it offers most of their advantages and precludes most of their demerits (Manley, 2013). For instance, this tax has a relatively high economic allocative efficiency when compared to the fixed royalty. This tax also possesses the advantage of relatively apportioning equal risk between the investor and government.

### 3.5.5 Value Added Tax (VAT)

This is a tax in which a fixed rate is applied on the difference in value between the final good and intermediate goods used to produce the final good. VAT is a destination consumption based tax and thus must be imposed in mining (Conrad, 2012). Manley classifies VAT as a rarely significant form of mining taxation. He attributes this to the fact that most mining companies are refunded by the tax authority. This refund occurs in the context of exports being zero rated. Manley (2013) points out that there are three reasons to this:

(i) If exports did not receive a VAT refund, the system would effectively be taxing inputs (i.e. capital);

(ii) VAT is intended to tax final consumption rather than production on a destination basis; and

(iii) Many governments strive to promote export industries in order to increase foreign exchange and subsequently harness economic growth.

VAT systems may possess a challenge for a weak administration which can face problems in the timely payment of refunds (Sunley and Baunsgaard, 2001). This situation is exacerbated by the magnitude of the VAT refund during the investment period. This is because this phase of the project cycle involves huge quantities of material input. A practical solution would be to zero rate exports and exempt VAT on capital goods and inputs. This should also be extended to domestic suppliers (Sunley and Baunsgaard, 2001). Conrad (2012) notes that if this is not enforced, mining companies will be in a perpetual credit position which means that refunds will have to be remitted on a monthly basis to investors. The exemption of VAT on inputs will eliminate the necessity for governments to refund and investors to remit VAT on inputs. However, the exemption must not extend to inputs that can be used by other sectors in the economy as this will pave way for tax evasion. If imports that are also produced domestically are exempted, this will provide an incentive for firms to purchase directly from foreign suppliers than from local producers (Sunley and Baunsgaard, 2001). This has an effect of stifling local demand and eventually the production capacity of the economy.

### 3.5.6 Brown tax

This is a tax that is levied as a fixed percentage on a projects net cash flow in each period (Nakhle, 2004). Under this tax system, cash rebates are provided to the firms when the cash flow is negative. In other words, Brown tax is a subsidy based tax which involves the payment of tax credits on annual cash losses. Hogan (2008) describes brown tax as a profit based royalty that provides a platform for assessing other policy options.

### 3.5.7 Resource rent tax

According to Hogan (2008), resource rent tax is a profit based royalty that approximates the Brown tax but avoids cash rebates in years were losses are incurred. This taxation instrument allows the government to collect a constant percentage of a projects positive net cash flow where losses (represented by negative cash flows) are accumulated at a threshold rate and offset against future profits. The accumulation process continues until the accumulated net cash flow is positive (Nakhle, 2004). No tax is remitted until the firm has recovered its costs inclusive of a minimum

rate of return which is compounded from year to year. According to Daniel et al. (2008), resource rent tax only kicks in once the firm earns a minimum rate of return on its capital.

Sunley and Baunsgaard (2001) note that if the resource rent tax is the only tax in the taxation system, the government revenue stream becomes back loaded. In the case of lower profitable projects, governments may not receive any revenue at all. Due to this underlying reason, the resource rent tax is usually integrated with a standard profit tax and mineral royalty. This mix of taxes provide stability of legislated mineral fiscal instruments. This is because while the royalty tax generates revenue at the kick of production, the profit based and resource rent tax provide additional revenue in highly profitable projects.

Sunley and Baunsgaard (2001) propose that operations need to be ring fenced for the resource rent tax to be efficient. The authors provide one exception to this rule by allowing unrecovered costs from an abandoned project area to be carried over to a project area that is active. This is done so as to prevent the impediment of exploration. In practice, resource rent taxes have a high degree of administrative inefficiency and very difficult to design. For instance, the selection process of the discount rate and tax rate is faced with huge difficulties. If these are set too high there is greater probability that it will never apply (Sunley and Baunsgaard, 2001). Equally if the discount rate is set too low, mining companies will engage in tax planning schemes and this will be difficult to detect in countries where there is weak tax administration. Oslensson et al. (2014) highlights this difficulty in choosing a suitable discount rate.

### 3.6 Evaluation criteria of mineral fiscal regimes

This section undertakes a literature survey of seven mineral tax evaluation measures that have a direct bearing on the design of an efficient mineral taxation system. These measures have been posited and advocated for, both by early and later writers of taxation theory.

#### 3.6.1 Neutrality

Daniel et al. (2008) describes a neutral tax as one that causes minimal disorder in private economic decisions that ought to have been made in its absence. Similarly, Garnaut and Ross (1983, cited in

Nakhle, 2004) defines a neutral tax as one that would diminish income but not affect decisions of production, consumption or trade. Several authors (Baunsgaard, 2001; Nakhle, 2004; Daniel et al., 2008) have described a neutral tax as one that leaves the pre-tax ranking of a project equal to its post-tax ranking. If project X is more attractive than project Y before tax is legislated, it should remain so after the tax is implemented (Watkins, 2001).

In the mining sector, a non-neutral tax can change decisions relating to production and development of projects. Watkins (2001) argues that taxation should neither disturb project ranking nor influence price or production decisions. However, there are instances were taxes can impact positive social change by correcting negative externalities despite being economic allocative inefficient.

Guj (2012, p.6) describes an economic allocative efficient tax system as one that "promotes reallocation of the resources of the economy to their most productive use to generate the ever changing mix of goods and services that society requires and at the lowest possible unit cost. In the mining context, the objective is to ensure that, as far as possible, the same exploration and production activities would occur whether a rent-collecting tax were in place or not". Thus, from this definition it can be concluded that any tax that is economic allocative efficient signifies that which is neutral.

Taxes usually offer a tradeoff between neutrality and other standard measures of taxation, for example, a tax that is neutral on one hand may not necessarily be administrative efficient on the other. Several studies have questioned neutrality as being a major factor of consideration in the design of a tax system (Nakhle, 2004).

### 3.6.2 Revenue raising potential

The presence of resource rent makes the mining sector a potential contributor to government tax revenue (Daniel et al., 2008). Government can capture economic rent by taxing the mineral sector as much as possible but this must be consistent with the need to attract and retain investment. However, Daniel et al. (2008) argues that it is difficult to tax economic rent satisfactorily because of the following:

(i) Possible presence of quasi-rents;

(ii) Inaccurate estimation of the economic rent base; and

(iii) Continued demand of incentives by mining companies to fuel their operations.

Different jurisdictions have dissimilar levels of risk. It is for this reason that the design of a mineral tax regime should be unique to each country. Similarly, Mohammed (2012) advocates compensation of investors according to their level of risk because what is fair in one domain may be unfair in another. This is attributed to the fact that different jurisdictions have different geophysical attributes, socio-political circumstances and resource potential.

Like any other tax evaluation criterion, revenue raising potential is dependent on other tax measures, these include neutrality, progressivity and investor perception of risk. For instance, a tax regime that has high investor perception of risk and high degree of neutrality will result in low FDI and thus stifled aggregate revenue from the mining sector. Similarly, a tax system that has a low degree of progressivity will result in low revenue generation. This occurs in the context of high mineral prices. In light of this, the opposite case holds.

For any government to succeed in its revenue raising objective, it must design an economically effective and efficient tax system that correlates with the administrative capacity of the tax authorities.

### 3.6.3 Progressivity

Progressivity[19] of a taxation system means a taxation regime is able to respond in a flexible manner to fluctuations in realized profits. Daniel et al. (2008) describes a progressive tax system as one in which the present value of government revenue rises with the pre-tax rate of return on an investment. Similarly, Mohammed (2012) describes a regime that is progressive as one that increases government take when the Rate Of Return (ROR) is high and gives financial relief to investors when ROR is low.

[19] See Daniel et al. (2008). For the remainder of this dissertation a tax regime that is progressive asserts that which is flexible or adaptable

A tax regime that is progressive to realized profits is deemed stable by the investor and thus adaptable (Daniel et al., 2008). This means adaptability has a direct bearing on investor perception of risk. The greater the adaptability of a tax regime the lower the perceived risk by the investor.

Notwithstanding this, progressive tax regimes affect many factors including distribution of risk between mining companies and the host state, public acceptance of financial results and investment incentives (Smith, 2012).

### 3.6.4 Investor perception of risk

Risk can be defined as the variability or dispersion of actual returns from expected returns. Mining projects face a high degree of risk when compared to other investment projects. This is because of their high entanglement with stochastic variables such as mineral price. A reduction of the negative perception of risk by the investor can induce investment which can result in increased taxable amount of economic rent. Some of the risks faced by mining investors include long payback period before initial investment can be recouped, unilateral alteration of resource fiscal terms by government (political risk), volatile mineral prices and technical risks associated with geology and technology.

Stability has an important bearing on investor perception of risk. A tax jurisdiction that offers a high degree of instability translates into high risk from an investor's perspective. Stability can be enhanced by signing of fiscal stability agreements between the investor and the state. However, Manley (2013) points out that these fiscal contracts are not fail safe. Additionally, enforcing these agreements is difficult and only a few cases have actually been brought before the courts of law in case of failure (Daniel and Sunley, 2008).

### 3.6.5 Government risk

Mineral prices are highly stochastic and as such, so is the revenue inflow to the mining project (Guj, 2012). This low revenue inflow translates in low cash flowing into government coffers in form of tax payments. Averting this syndrome requires governments to provide an enabling microeconomic environment for businesses to thrive. This can be achieved by reducing the risk

load of mineral enterprises. It must be mentioned, that risk associated with low revenue generation of resource projects is an important factor of concern to many governments of developing countries. Artist (2009) has assumed many government of being risk neutral. However, governments with limited access to capital markets and a lower number of mineral investments tend to be risk averse. Daniel et al. (2008) notes that governments depending on only one or two projects are unlikely to withstand price and volume fluctuations than governments having a diverse portfolio of mineral assets. This being the case, it is imperative for these risk averse governments to design mineral taxation regimes that are robust in yielding stable revenue inflow. In this context, a mineral tax regime that generates stable government revenue is perceived to have low inherent risk. This risk can be assessed by determining the value of Coefficient of Variation (CV). A higher value of CV implies great revenue instability whilst a low value signifies the opposite sense.

Different tax instruments offer different levels of revenue stability. For instance, a high degree of revenue stability can be achieved using fixed royalties. However, Guj (2012) describes fixed royalties as being economically allocative inefficient besides preventing governments from extracting an optimum share of economic rents when mineral commodity prices are high. Guj (2012) suggests that instead of using fixed taxes governments can reduce the impact of revenue instability by resisting temptations to overspend in times of high mineral prices. This can be achieved by adopting smoothing strategies such as creating sovereign equalization funds.

The timing of receipts, not just the stability and level is important (Daniel et al., 2008). Timing of receipts helps governments to undertake long term planning. Governments that have limited access to capital markets or as a result of being politically myopic prefer revenue to accrue in the early years of a project (IMF, 2012). However, deterring revenue collection on the other hand through the use of low royalty rates, accelerated depreciation and rent, reduces the perceived risk of investors (IMF, 2012). The timing of receipts can be assessed by constructing various measures such as determining the proportion of revenue inflow to the government for the first *n* years.

### 3.6.6 Administrative efficiency

A taxation regime has to adhere to the concept of administrative efficiency no matter its theoretical soundness. If a taxation system is too complex or complicated, it becomes difficult for the tax

authority to effectively administer (Manley, 2013). Hanefa (1996) adds that among others, the major factors that could potentially influence a taxpayer of being compliant are the tax administrative system, tax law fairness and tax law complexity. A complex taxation regime translates into huge compliance costs both from the perspective of governments and companies. It is for this reason why taxation regimes need to encapsulate taxes that are based on simple formulae.

Dickson (1999) contextualized administrative efficiency in terms of clarity and simplicity. The author adds that taxation must be imposed on a well-defined tax base that is simple, clear and easy to collect. Similarly, Artist (2009) states that it does not make any sense to have a theoretically ideal tax regime that is difficult to manage.

Watkins (2001) acknowledges transparency as a factor that is materially significant in enhancing tax administration. The author argues that more transparency in revenue collection by the government leads to better informed investors and less scope of manipulation and administrative discretion behavior. This in turn reduces the industry's investor perception of risk.

Another important dimension of administrative efficiency is the type of taxes encompassed in a taxation system. According to Otto et al. (2006), tax administration and tax evasion are two fundamental factors that are essential in determining the mix of taxes in a taxation regime. It must be mentioned that even though economic rent based taxes act consistently and coherently to the concept of economic allocative efficiency they are very difficult to administer. Otto et al. (2006) recognizes this fact and points out that profit- and income- based royalty tax schemes whose fundamental principle is built on the concept of economic rent are difficult to administer and thus must be handled by competent and well-funded tax administration systems.

### 3.6.7 International competitiveness

A robustly constructed taxation regime should rank favorably in terms of international attraction of investors. This occurs against the backdrop that although fiscal terms are not a primary tool of attracting foreign investment they play a significant role in coating the host state as a desideratum destination of investment.

Notwithstanding this, most authors have raised concern that much of the policy oriented literature of mineral taxation in the mid-1980s and 1990s placed great emphasis on international competitiveness of fiscal regimes. According to Dietsche et al. (2009), tax competition is a matter that is merely regional than global.

The rationale behind this emphasis stems from the fact that many countries were hit by economic crises. This made them open up their natural resource sector for foreign investment with an objective of increasing foreign exchange earnings and government revenue. To achieve this endeavor, competitive fiscal terms were considered to be a critical factor (Dietsche at al., 2009). According to World Bank (1996), many countries undertook structural reforms to their mining tax codes with the explicit focus of promoting foreign investment. This was aided by international institutions.

### 3.7 Interaction of evaluation criteria

There is usually inexorable trade-offs among neutrality, progressivity, revenue raising potential, administrative efficiency and risk of a fiscal system. This is because a tax system that has an inherent inclination to one or more mentioned criterions usually negates the application of other measures. This circumstance calls for sound political judgement among these trade-offs, as a unique best policy cannot be formulated (Daniel et al., 2008).

### 3.8 Indicators used in general analysis of taxation

This section presents the indicators commonly used in the general analysis of taxation. It expounds these indicators in terms of how they are applied to the specific context of mining.

#### 3.8.1 Average Effective Tax Rate (AETR)

The discrete choice between two or more mutually exclusive projects depends on the AETR. The AETR has been widely applied in the comparison analysis of different resource tax regimes. This parameter can be defined as the government take in a firms pre-tax cash flows. It is determined by

the ratio of tax payments made to the government to a measure of the tax base, either using data from financial statements (Collins and Shackelford, 1995) or using national accounts or other aggregate data (Mendoza et al., 1994). However, these measures have been criticized as being retrogressive in nature, this is because they tend to focus on taxes and income generated by past investment decisions (Daniel et al., 2008). In response to such criticisms, Devereux and Griffith (2003) have proposed a new framework of the AETR. This new framework is advantageous over past estimation because it is based on tax laws and thus forward looking. In addition, it can be defined for any level of pre-tax profits. According to Boadway and Keen (2008, p.34), "forward looking effective tax rates are those based on projections of future profit and interest rates".

A robust forward looking AETR has been developed in the resource industry, it is estimated as the ratio of the NPV of all tax payments made to the government to the NPV of all pre-tax cash flows of a project. It can be deduced that unity less AETR represents the proportion of cash flows that accrue to the company.

Although the concept of this measure is relatively easy to understand some issues are still blurry. One such issue is the use of the discount rate which may differ when viewed from the perspective of either the mining firm or government (Boadway and Keen, 2008).

### 3.8.2 Marginal Effective Tax Rate (METR)

Marginal Effective Tax Rate (METR) can be defined as the burden on an additional (last) dollar of income earned (Manley, 2013). Daniel et al. (2008) describes the METR as a ratio of the pre-tax rate of return minus the post-tax rate of return to the pre-tax rate of return for a marginal project. Another way of expressing this measure is unity less the ratio of post-tax rate of return to pre-tax rate of return. Similarly, Boadway and Keen (2008) describes the METR as an amount of the pre-tax rate of return for a marginal investment that accrues to the investor after being taken by the government in form of taxation.

METR can be viewed as an indicator of neutrality (Daniel et al., 2008). Boadway and Keen (2008) note that METR is a measure that is intended to capture the extent to which a tax system distorts the firms' decision making process.

There are several measures of METR, the difference being in the treatment of tax. Most measures only consider direct taxes as opposed to indirect taxes. This is because indirect taxes have complicated structures (multiple rates and exemptions).

Boadway and Keen (2008) have provided a relationship between AETR and METR. Equation 3.10 defines this relationship.

$$AETR = METR + \tau\gamma \qquad [3.10]$$

**Where:**

$\tau$ is the rate of Corporate Income Tax (CIT) (%); and
$\gamma$ is the ratio of net return on a marginal investment to the average pre-tax rate of return.

### 3.8.3 Pitfalls of AETR and METR

One evident pitfall associated with most AETR and METR estimates is that they ignore risk (Daniel et al., 2008). In international competitive analyses, they assume that all jurisdictions have the same level of country risk and this is evidenced by the use of the same discount rate in NPV calculations. This is not true in reality as different countries possess different levels of risk (both political and geological). This pitfall can lead to false results when it comes to ranking countries in terms of international attractiveness.

## 3.9 Project evaluation criteria

The mineral tax analysis approach applied in this study draws from standard procedures used by practitioners in the evaluation of petroleum investments and fiscal regimes. This section presents the theory of the project evaluation criteria that has been adopted in this study.

Evaluation of mineral resource projects in terms of taxation can be viewed from two points; from the government side, whose focus is to maximize the NPV of tax revenue and investor's side whose objective is to minimize the NPV of tax payments. Tax represents a critical cost in the resource

extractive industry (Artist, 2009). While this is true, tax payments also represent a major source of revenue for the government. Thus, an equal share of revenue between the government and investor is critical in securing a win-win situation between the two parties.

There are a number of mineral project evaluation techniques in use today. The obvious reason being that no one method is satisfactory or adequate for all practical purposes. This has been brought about by the pitfalls associated with each evaluation technique. Project evaluation techniques fall into two categories, these include non-discounted cash flow techniques and discounted cash flow techniques.

### 3.9.1 Non-discounted cash flow appraisal methods

Non-discounted cash flow techniques are appraisal methods that do not take into account the time value of money. This section briefly discusses two traditional, non-discounting methods which have been widely applied in business history, these techniques include the Accounting Rate of Return (ARR) and payback period.

#### 3.9.1.1 Accounting Rate of Return (ARR) criterion

The ARR is a widely applied non-discounting cash flow technique which can be defined as the ratio of the average accounting profit (i.e. profit after depreciation but before any allowance for taxation) to the average capital outlay (Abraham et al., 2008). Conversely, Shapiro (2005) describes the ARR as the ratio of average after-tax profit to average book investment. This ratio can thus be considered as a return on an investment. Ansari (2000) argues that ARR is not a project evaluation technique as it is based on accounting figures rather than cash flows. Pragmatically speaking, investors are solely dependent on cash flow figures to assess their projects. Thus, any figure that does not represent cash flow is insignificant and void to them (Kindlein, 2007). Once the ARR has been determined a simple accept/reject decision has to be made (Abraham et al., 2008). The acceptability rule of mutually exclusive projects using the ARR criterion is to accept a project that has the highest ARR provided it is greater than the predetermined target rate of return.

According to Abraham et al. (2008) and Kindlein (2007), the ARR has several advantages and these include the following:

(i) It is simple and easy to use;

(ii) It makes use of readily available accounting information; and

(iii) It generates a percentage rate of return which is a ratio commonly used by market analysts when measuring the profitability of a company.

According to Abraham et al. (2008) and Kindlein (2007), the ARR has the following disadvantages:

(i) It ignores the time value of money;

(ii) It fails to take into account the timing of earnings;

(iii) It is based on accounting profits rather than actual cash flows;

(iv) It fails to reflect the absolute size of an investment;

(v) It does not provide a standard measure of the capital employed or profit; and

(vi) It fails to distinguish differing lives of mutually exclusive projects.

#### 3.9.1.2 Payback period criterion

The second commonly applied non-discounting appraisal technique is the payback period. A payback period is the time required for a company to recoup its initial investment cost. Kambani (2013) defines the payback period as a measure of the return *of investment* rather than the return *on an investment.* For this reason the payback period provides a measure of project risk, provided the risk of investment loss is a function of time. This is common in projects which have very high uncertainty in the future. In the mining context, the payback period is measured from the point in time when mineral production commences. The acceptability rule of mutually exclusive projects using the payback method is to accept a project that has the highest speed of repaying the initial investment. This is very important for projects that possess very high future risk or uncertainty. A maximum payback criterion is established for an independent project evaluation. All investment

proposals for which the payback period is greater than this maximum are rejected. Maximum payback periods of two, three or four years are frequently used in practice in the mining industry.

As pointed out by Ansari (2000) and Shapiro (2005), the payback period possesses several advantages. These include:

(i) It is easily communicated to everyone, even to individuals without any financial background;

(ii) It provides a simple measure for project risk. The shorter the payback period, the less risky is the project;

(iii) The concept of this criterion encourages projects to payback within a short span; and

(iv) It uses readily available accounting information.

Despite these advantages the payback criterion suffers a lot of draw backs or pitfalls and these include (Kambani, 2013):

(i) The payback period does not take into account the time value of money;

(ii) The payback criterion does not take into consideration the distribution of cash flows beyond the payback cutoff;

(iii) The criterion does not take into consideration the timing of cash flows of different projects within the payout period; and

(iv) The maximum payback criteria of 2-4 years that is commonly used can lead to the rejection of handsome projects that offer an expected rate of return greater than the cost of capital. This later leads to under investment.

In order to offset some of these inherent weaknesses another variation of this method exists, this is known as the discounted payback technique. This method dwells on the concept of time value of money. Managers usually use the payback period criterion as the preliminary test of screening out projects. Any project that passes this preliminary test is subjected to further testing using sophisticated discount cash flow techniques.

### 3.9.2 Discounted Cash Flow (DCF) appraisal methods

These are techniques that combine the concepts of cash flow and time value of money for the economic analysis of investment opportunities. DCF techniques involve discounting future expected outcomes to one point value in time, the present. This section presents the theory of two long established DCF techniques that have found wide application in financial and accounting domains. These are the Net Present Value (NPV) and Internal Rate of Return (IRR) techniques[20].

#### 3.9.2.1 Net Present Value (NPV) criterion

The NPV is a DCF technique which can be defined as the summation of the present values of all expected cash outflows and inflows. Bromwich (1976) describes the NPV as a price at which the investor can sell the opportunity to someone else without being worse off. NPV converts an investor's future anticipated cash inflows and cash outflows to a particular point in time, the present. Gentry and O'Neal (1984) recognize the NPV as the best single technique for evaluating investment alternatives. Similarly, Abraham et al. (2008) describes NPV as being superior over other discounting cash flow methods.

Equation 3.11 shows the calculation of NPV.

$$NPV = \sum_{x=1}^{n} \frac{CF_x}{(1+i)^x} - CF_0 \qquad [3.11]$$

**Where:**

$CF_x$ is the cash flow in year x ($);
$CF_0$ is the cash flow in year 0 ($);
i is the discount rate (%); and
x is the year of occurrence of a certain cash flow.

[20] The breakeven price is another important profitability indicator that is essential for evaluation purposes.

The acceptability rule of investments using the NPV criterion is to accept those projects that yield a positive NPV and to reject those that yield a negative NPV. In the case of mutually exclusive projects the rule is to accept that project which yields the maximum positive NPV. According to Bromwich (1976) a project with a positive NPV covers the value of opportunity cost of external and internal funds.

The NPV method assumes the same discount rate for the purpose of ranking propositions (Artist, 2009). This is arguable in the sense that it asserts that managers are inflexible about their decisions. This assertion is not a likely possible outcome in reality. In addition to this disadvantage, the NPV method possesses a drawback when comparing projects of unequal lives.

### 3.9.2.2 Internal Rate of Return (IRR) criterion

The second DCF technique is IRR. This method or technique calculates the discount rate at which the initial capital outlay is equal to the net present value of future cash flows. It can also be defined as a discount rate that equates the NPV of a project to zero. Figure 3.4 shows the graphical representation of NPV as a function of discount rate. From this figure it can be deduced that the NPV decreases as the discount rate increases.

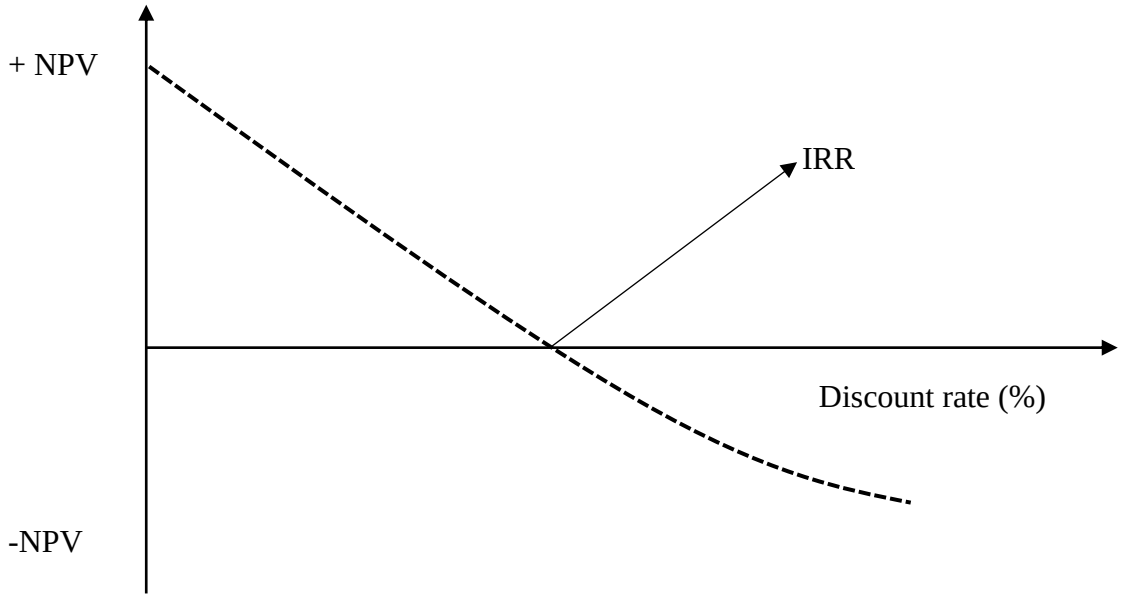


**Figure 3.4: Graphical representation of NPV as function of discount rate**

The IRR shown in Figure 3.4, can mathematically be defined as:

$$0 = \sum_{x=1}^{n} \frac{CF_x}{(1+IRR)^x} - CF_0 \qquad [3.12]$$

**Where:**

$CF_x$ is the cash flow in year x ($);
$CF_0$ is the cash flow in year 0 ($);
IRR is the Internal Rate of Return (%); and
x is the year of occurrence of a certain cash flow.

The acceptability rule of investment projects using IRR criterion is to accept projects which have an IRR greater than the hurdle rate. Often the hurdle rate is the opportunity cost of capital (Abraham et al., 2008). When using the IRR criterion, two investment alternatives are ranked one higher than the other when one project produces an IRR which is much higher than its cost of capital when compared to the other investment alternative (Kambani, 2013). While the calculation of the IRR can call for the solution of complex polynomial equations, there are several software packages that can speed up the generation of the solution (Abraham et al., 2008). The solution of the IRR can also be obtained manually through the mathematical technique of interpolation.
Ansari (2000) and Abraham et al. (2008) have provided a number of pitfalls of using the IRR criterion. These include:

(i) IRR on its own gives no information about a projects present value;

(ii) Possibility of giving different results due to the varying time pattern of cash flows;

(iii) It does not provide the effect of its acceptance on shareholders wealth;

(iv) Presents difficulties in ranking projects were the up-front outlay is different;

(v) It cannot be applied to problems associated with different economic life[21];

[21] Equipment replacement problems fall into this category of appraisal

(vi) Inability to account for an opportunity cost of capital (and hence discount rate) that changes over time; and

(vii) It has an unrealistic reinvestment assumption which assumes intermediate cash flows can earn a return equal to the projects IRR.

The other pitfall associated with the IRR is the possibility of having two or more IRRs, this occurs when there is change of sufficient magnitude in the sign of cash flows. These multiple IRRs do not make any economic sense. Abraham et al., (2008, p.251) agrees with this fact and states that "were multiple rates of return exist there are no mathematical or economic grounds for specifying any one IRR over another". An example of this in the extractive or mining industry occurs when cash flows occurring at the end of a projects life change substantially due to funds supplied in landscaping and other rectification activities, to restore the environment to its initial topography (Abraham et al., 2008).

In mining, multiple IRRs could also occur when an expansion option is phased into the project life of an investment. Bromwich (1976) provides further analysis and discussion of this multiple IRR phenomenon.

Although the IRR is not a superior technique for selecting investments, it possesses three renowned advantages. These include:

(i) It is easy to understand and communicate;

(ii) It accounts for the time value of money; and

(iii) It considers all cash flows involved in an investment project.

### 3.9.2.3 Criticisms of the discounted cash flow method

The DCF method of project evaluation has been criticized for applying the same discount rate throughout the project life of an investment. This asserts that managers are inflexible about the decisions made in the early life span of a project cycle. Due to this fact, the DCF method will understate or overstate the NPV of those projects that commit to flexibility in management decisions (Daniel et al., 2008). The DCF method implicitly assumes that managers are not active

about their investment decisions once the initial outlay verdict has been undertaken, regardless of how future cash flows unfold (Smith and McCardle, 1998). However, in reality managers react to changes in macroeconomic variables. For example managers of the extractive industry can react to changes in price of mineral commodities, tax policy reforms and alteration in other economic variables by expanding or narrowing production. For instance, a government that increases the ad-valorem or unit based tax can change a managers decision concerning production. The manager for instance can decide to offset the burden of this tax policy by high grading his/her blocks of ore. This in turn alters his/her production values.

Another criticism of using the same discount rate throughout the project life assumes that the project risk is compounded over time, which may not be gospel truth in all cases. This is especially true for resource extractive projects where the risk tends to drop as the project develops.

A further criticism of the DCF method is the use of the same discount rate to discount revenue and expenditure cash flows. Many argue that a separate discount rate must be used to discount each cash flow component. The different discount rates must be able to reflect the risk that is associated with each cash flow element (Daniel et al., 2008).

### 3.10 Discount rate employed in mining project assessment

A discount rate is a rate that is used to discount future expected cash flows. If cash flows are known with a high degree of certainty the discount rate only needs to account for the opportunity cost of capital to the firm. This opportunity cost of capital is represented by the risk free rate. However, in practice, cash flows are not known with a high degree of certainty and thus the discount rate must comprise of the risk free rate and a market premium that compensates the investor for taking or absorbing risk (Daniel et al., 2008). The discount rate that is adjusted for risk is known as the *hurdle rate*[22]. Daniel et al. (2008) describes the hurdle rate (cost of capital) as being a reflection of the firm's after cost of debt, financial leverage and cost of equity.

Investors are a risk averse party, for this reason they tend to use higher discount rates and advocate for shorter payback periods (Artist, 2009). By contrast, governments are considered a risk neutral

[22] The hurdle rate is the minimum acceptable return on an investment project that a firm requires.

party. Boadway and Keen (2008) notes that governments which attach a high weight to the well-being of future generations, enjoy relatively high income and fast economic growth, are not intensely risk averse. For many developing countries especially those dependent on just a few mining projects this may not be the case prompting the use of a high discount rate. Similarly, Andrews-Speed (1996) notes that countries having a lower income are likely to use a discount rate higher than that of the investor. Governments can sometimes face political risk in terms of their own longevity in office, this in itself will instigate or motivate the use of a higher discount rate than necessary.

Most governments hold passive equity in mining investments and thus do not participate in the risk faced by equity owners. Since governments such as that of the Republic of Zambia do not partake in any risk, it is only rational for them to use a risk free discount rate. Daniel et al. (2008) determined the hurdle rate in his analysis of the tax system in Mozambique by using a high discount rate that was adjusted upwards, to take into account the probability of failure (hedging against future uncertainties).

### 3.10.1 Hurdle rate computation

This section presents the theoretical background of different hurdle rate computation methods. The hurdle rate can be chosen to represent either the cost of equity or Weighted Average Cost of Capital (WACC). The application of either one of the concepts depends on the partiality of the investor towards the use of any one of the two methods. However, Arumugam (2007) claims that a good strategy is to apply the concept of the WACC.

#### (a) Cost of equity

Cost of equity is the required return by equity investors. The two components of a firm's equity are equity share capital and retained earnings (Arumugam, 2007). Ownership of both of these funds relies on the absolute discretion of the shareholders. The following provides a list of financial models that can be employed to compute the cost of equity:

- Capital Asset Pricing Model (CAPM);

- Gordons model; and
- Arbitrage pricing model.

### (i) Capital Asset Pricing Model (CAPM)

The CAPM is a financial model that relates the expected return of a firm's equity to risk. It is based on the concept that equity holders must be compensated with a high return for absorbing systematic risk[23] (non-diversifiable risk) but not for holding unsystematic risk[24] (specific or diversifiable risk). This is because unsystematic risk can be costless eliminated by investing in a wide range of stocks or assets through the process of diversification (Daniel et al., 2008). When an investor holds the market portfolio, each individual stock or security in the portfolio entails unsystematic risk, but through diversification, the investor's net exposure is just the systematic risk of the market portfolio (Arumugam, 2007).

The CAPM provides a linear relationship between the expected rate of return of a firm's equity (Cost of capital) and risk (Beta). Equation 3.13 developed by Sharpe (1964) defines this relationship.

$$E(r_i) = r_f + \beta_i[E(r_m) - r_f)] \qquad [3.13]$$

**Where:**

$E(r_i)$ is the expected rate of return (%)

$r_f$ is the risk free rate of return (%);

$\beta_i$ is the risk of the security *i* relative to the market index; and

$E(r_m)$ is the market expected rate of return (%).

[23] Systematic risk can be defined as a risk that is associated with the general market movement.

[24] Unsystematic risk is risk that is unique to a project, it is not associated with the co-movement of the market.

The CAPM consists of two premiums these include the time and risk premium. The time premium is represented by the risk free rate ($R_F$) which compensates the investors for placing money in an investment project over time (time value of money). The market risk premium on the other hand represents the reward or compensation to the investor for holding systematic risk.

Beta (β) is a measure of the risk factor associated with a particular project. It represents the toxicity or risk contribution of each project to a portfolio of investments. A positive beta in the CAPM signifies a project whose value increases with an increase in the value of the market and vice versa. Conversely, a negative beta represents a project whose value increases with a decrease in the market value and vice versa. Investors are less inclined to the acceptance of the former project than the latter because it offers a high level of toxicity to the portfolio of investment. Thus, it can be deduced that a project with a low market beta helps reduce the overall risk held by the market portfolio. Daniel et al. (2008) defined beta of a stock or marketable security as a correlation of the expected return of a firm's equity to that of the market. Equations 3.14, 3.15 and 3.16 define this beta parameter.

$$\beta_i = \frac{\mathrm{COV}(r_i, r_m)}{\mathrm{VAR}\,(r_m)} \qquad [3.14]$$

$$Cov(r_i, r_m) = \frac{\sum_{i=1}^{n}(r_i - \overline{r}_i)(r_m - \overline{r}_m)}{N} \qquad [3.15]$$

$$Var(r_m) = \frac{\sum_{i=1}^{n}(r_m - \overline{r}_m)^2}{N} \qquad [3.16]$$

**Where:**

$\beta_i$ is the risk of the security *i* relative to the market index;
$r_i$ is the return from security *i* (%);
$r_m$ is the return from market portfolio (%);
$\overline{r}_i$ is the arithmetic mean of returns from security *i* (%);
$\overline{r}_m$ is the arithmetic mean of returns from market portfolio (%); and
N is the number of sample elements.

Where, Cov ($r_i$ , $r_m$ ) is the covariance between the expected return of the security $r_i$ and the expected return of the market $r_m$. Var ($r_m$) is the variance of return from the market portfolio.

### (ii) Arbitrage pricing model

Although, the CAPM is an elegant and appealing explanation for the way investment risk and expected return are related, it suffers a number of empirical anomalies, motivating the need for economist to seek alternative answers (Iqbal et al., 2012). In his quest for an alternative methodology, Ross (1976) incepted the Arbitrage Pricing Theory (APT).

APT is a general theory of asset pricing that defines expected return as a linear function of multiple systematic risk factors. This theory holds that expected return of a financial asset can be modeled as a linear function of various micro and macroeconomic factors, where sensitivities to changes in each factor is represented by a beta coefficient. The arbitrage pricing theory is built on the concept that there are other factors that contribute to the risk of a given asset. To the contrary, the CAPM is constructed on a platform that assumes the market portfolio as the only systematic source of risk of an asset. Due to this underlying reason, many researchers term the APT as a more reliable measure of risk premium. Despite this recognition, many investors still prefer the use of the CAPM over the APT. This may be due to the fact that APT does not specify the factors that explain the volatility in stock returns (Iqbal et al., 2012). Many researchers have debated the validity of the APT. Different micro and macroeconomic factors affect asset returns differently thus APT needs to be tested for its validity in different economies.

The APT is built on the following assumptions:

- Perfect competitive and frictionless market;
- Number of assets under consideration are much larger than the number of factors. This is to avoid matrix singularity; and
- Random returns are due to the macroeconomic factors in the market.

Risky asset returns are said to follow a factor intensity structure:

$$R_i = R_f + b_{i1}F_1 + b_{i2}F_2 + \cdots + b_{ik}F_K + E_i \quad [3.17]$$

**Where:**

$R_i$ is the random return of asset i (%);
$R_f$ is the constant for asset i (%);
$b_{ik}$ is the sensitivity of the assets return to the k factor / loading factor (%);
$E_i$ is the random error (represents unsystematic or idiosyncratic factor) (%); and
$F_k$ is the systematic factor.

APT states that if assets follow a factor structure in Equation 3.17, then the following relationship exists between the expected return and factor sensitivities.

$$E(r_i) = r_f + b_{i1}RP_1 + b_{i2}RP_1 + \cdots + b_{ik}RP_k \quad [3.18]$$

**Where:**

$r_f$ is the risk free rate (%); and

$RP_k$ is the risk premium of the $k^{th}$ factor (%).

**(iii) Gordon model**

The Gordon model is a financial model that determines the intrinsic value of stock. This model determines the cost of equity using the dividend concept as a basis. It is for this reason that it is also known as the dividend valuation model. The Gordon model recognizes the concept that stocks are in themselves perpetuities. This assertion provides a platform for solving the present value (stock value) of the infinite series of all future dividends.

The present value of all future dividends ($P_0$) can be represented by Equation 3.19.

$$P_0 = \frac{d_1}{(1+K_e)^1} + \frac{d_2}{(1+K_e)^2} + into\ perpetuity\ (\infty) \quad [3.19]$$

**Where:**

$d_1$ is the expected future dividend at the end of year 1 ($);
$d_2$ is the expected future dividend at the end of year 2 ($); and
$K_e$ is the cost of equity (%).

Equation 3.19 can be rewritten as:

$$P_0 = \frac{d_1}{K_e} \quad [3.20]$$

The Gordon model can be further developed to allow for growth in future expected dividend streams. There are three assumptions to this dividend growth pattern, these include constant growth, no growth (zero growth) and growth in phases (growing at a non-constant rate). Abraham et al. (2008) notes that for $K_e$ to be realistic, market expectations must be such that dividends are believed to grow at a rate of g. Thus, Equation 3.20 can be written as:

$$P_0 = \frac{d_1}{(K_e - g)} \quad [3.21]$$

**Where:**

g is the growth factor/rate (%).

Rearranging Equation 3.21, cost of equity ($K_e$) can be calculated as:

$$K_e = \frac{d_1}{P_0} + g \quad [3.22]$$

**(b) Weighted Average Cost of Capital (WACC)**

This is the required rate of return by all claimholders in the business. It is termed as the weighted cost of third party and own sources of financing. The WACC can mathematically be defined as:

$$WACC = W_d K_d(1 - T) + W_e K_e \quad [3.23]$$

**Where:**

$K_d$ is the cost of debt (%);
T is the income tax rate (%);
$W_e$ is the percentage weight of equity (%);
$W_d$ is the percentage weight of debt (%); and
$K_e$ is the cost of equity (%).

### 3.11 Treatment of inflation

Inflation can be defined as excess money supply in an economy with respect to goods and services leading to reduced purchasing power of the monetary unit. This phenomenon is usually evidenced by the rise of prices in an economic environment.

According to So and Wong (2015), inflation can be measured in two ways. These include:

- **Consumer Price Index (CPI):** Measures average changes in prices of consumer goods and services purchased by a common consumer; and
- **Producer Price Index (PPI):** Measures average changes in prices received by domestic producers for their output.

Project evaluation techniques account for inflation in two renowned ways:

- Use of a discount rate that is not corrected for inflation (Nominal discount rate) to discount future cash flows that have not been adjusted for inflation (Nominal cash flows); and

- Use of a discount rate that is corrected for inflation (Real discount rate) to discount future cash flows that have been adjusted for inflation (Real cash flows).

The relationship between real (constant) and nominal (actual or current) cash flows is defined as:

$$R(\$) = \frac{A(\$)}{(1+f)^n} \quad [3.24]$$

**Where:**

R($) is real dollars ($);
A($) is actual dollars ($);
f is the inflation rate (%); and
n is the year of cash flow occurrence.

The fisher equation in economics estimates the relationship between nominal, real and inflation rate. This equation is defined as:

$$(1 + i_n) = (1 + i_r)(1 + f) \quad [3.25]$$

**Where:**

$i_n$ is the nominal interest rate (%);
$i_r$ is the real interest rate (%); and
$f$ is the inflation rate (%).

### 3.12 Accounting for risk

Mining is a risk capital intensive venture, it is for this reason that investors wish to recoup their initial investment as early as possible. This section gives a brief discussion of two widely applied

methods for accounting risk in mining investment. These methods are the Risk Adjusted Discount Rate (RADR) and the Certainty Equivalent (CE) approach.

### 3.12.1 Risk Adjusted Discount Rate (RADR)

The RADR method incorporates risk in the project valuation process by using a discount rate that has been adjusted upward for risk. This technique has found wide application in the field of economics and finance because of its simplicity.

Despite this benefit, the RADR method lumps the time premium and risk premium as one. This automatically presupposes that risk is compounded over time. This asserts that cash flows occurring in the distant future are more risky than cash flows occurring in the short term. However, this may not be true for all projects. Mining projects are one such unique investment where the uncertainty is very high in the first years but quiet low in subsequent years.

### 3.12.2 Certainty Equivalent (CE) Approach

This technique is similar to the RADR method. However, instead of accounting for risk using the discount rate the CE approach incorporates risk into a project valuation process by adjusting expected future cash flows. This approach derives its concept from utility theory. The Certainty Equivalent Value (CEV) of a project can be described as the payment that an investor would have to receive to be indifferent between that payoff and a given gamble. Similarly, it can be defined as the guaranteed return that someone would accept rather than taking a chance on a higher uncertain return. Hogan (2008) describes the CEV of an investment as the amount where the investor would be indifferent to investing in a risky project or accepting a risk free investment with a certain return. Similarly, Daniel et al. (2008, p.19) describes the CEV in terms of cash flows as "the amount that would make the investor indifferent between having that amount for certain or maintaining the rights to the uncertain cash flows from the project".

Hogan (2008) used the CEV as an approach in assessing the profitability of risky and risk free mining projects. The main decision criteria used in the profitability assessment is summarized in Table 3.1.

**Table 3.1: Decision criteria for assessing profitability of mining projects (Hogan, 2008)**

| Risk/Attitude Towards Risk | Profitability Measure | Profitability Assessment | | |
|---|---|---|---|---|
| | | Uneconomic | Marginal | Economic |
| **Risk Free Project** | Net Present Value (NPV) | <0 | =0 | >0 |
| **Risky Project** | | | | |
| *Risk Neutral Investor* | Expected Net present Value (ENPV) | <0 | =0 | >0 |
| *Risk Averse Investor* | Certainty Equivalent Value (CEV) | <0 | =0 | >0 |

According to Hogan (2008), the decision rules of this criteria can be summarized as follows:

(i) **NPV applies to a risk free project** – The NPV is the sum of the present value of all expected cash inflows and cash outflows discounted at a risk free rate (assumed as the long term government bond).

(ii) **ENPV applies to a risky investment and a risk neutral investor** – The ENPV can be defined as the probability weighted sum of the net present value of each possible outcome (uneconomic, marginal and economic).

(iii) **CEV applies to a risky investment and a risk averse investor –** The CEV is defined as the ENPV less Risk Premium (RP) (i.e. CEV = ENPV- RP).

### 3.12.3 Comparison of the RADR and CE techniques

There are number of significant differences between the CE and RADR method. Some of these differences include:

(i) The CE approach accounts for risk by adjusting the future expected cash flows. Conversely the RADR technique incorporates risk by adjusting the free discount rate using either the CAPM, APT or Gordon model

(ii) The RADR approach sums the time and risk premium as one. Conversely the CE technique treats the two premiums as independent variables.

From the second contrast, it can be concluded that the RADR approach assumes that risk is an increasing function of time whilst the CE method assumes risk as being an independent variable of time. This assertion makes the CE approach theoretically superior over the RADR method. This is because the assumption encapsulated in the RADR method does not hold true for all projects.

Despite these differences, the CE and RADR methods are both theoretically acceptable techniques of calculating the NPV. The preferred method being dependent on practical considerations (Grinblatt and Titman, 2002).

### 3.13 Project uncertainty

Single point estimates are usually employed in determining future cash flows. However, this application is negated because uncertainty normally confronts an investment project, altering the estimated cash flow values (Kambani, 2013). This calls for an address of this uncertainty as this leads to erroneous project evaluation results. There are several methods of modeling project uncertainty. These include:

(i) Sensitivity analysis;

(ii) Scenario analysis;

(iii) Monte Carlo simulation;

(iv) Decision trees;

(v) Real options; and

(vi) Breakeven analysis.

#### (a) Sensitivity analysis

A sensitivity analysis can be defined as a method of analyzing the variation of a profitability criteria by fluctuating the values of key variables that affect the valuation result. Kambani (2013, p.12) defines sensitivity analysis as "a method of analyzing the effects of uncertainty by

determining the amount of variation in a profitability criteria (such as NPV, IRR or the PP) produced by a given change in a parameter affecting the valuation results". Some of the key parameters affecting profitability in mining investments include grade, commodity price, operating cost, metallurgical recovery, throughput, project life and salvage value.

The first step in undertaking a sensitivity analysis involves determining the key variables that affect the valuation of a profitability criterion. The values of the key variables are then fluctuated. For each change in value of a key variable one calculation is made. By changing the values of the variables one at a time, the sensitivity analysis presupposes that project variables are independent of each other (Kindlein, 2007). This may not be the case in all situations. Another limitation associated with this method is that it gives little insight into the relative likelihood of different outcomes (Daniel et al., 2008). Lastly, the sensitivity analysis undertakes systematic fluctuations of variables. This is a pitfall especially in the mining industry because most variables do not fluctuate systematically but randomly. Perfect examples of this are the mineral price and grade variables.

**(b) Scenario analysis**

Brealey et al. (2006) considers the scenario analysis as an extension of the sensitivity analysis. Scenario analysis can be defined as a process of analyzing possible future outcomes by considering several situations. The scenario analysis specifies suitable values of strategic variables under different situations and combines them to come up with possible outcomes (Kindlein, 2007). Scenario analysis considers three possible situations, these are optimistic, pessimistic and a most likely scenario. Taking into consideration more scenarios makes the analysis blurry. Whereas the sensitivity analysis changes one variable at a time, the scenario analysis predefines typical scenarios of a project (Kindlein, 2007).

**(c) Monte Carlo simulation**

A number of reasons have necessitated the use of Monte Carlo simulation. These include:

(i) Presence of a large number of strategic variables;

(ii) Complex profitability functions; and

(iii) Demand to use continuous distribution functions.

It is very difficult to handle these problems with a discrete or analytical solution hence the prompted use of Monte Carlo simulation. This method involves generating a probability distribution of a profitability criterion (such as NPV, IRR) by considering a large quantity of possible combinations of strategic variables. This is done by simulating the investment process a large number of times through repeated sampling from the distribution of each variable (Kambani, 2013). The simulated values of each variable are then combined to form a profitability distribution which provides management with a measure of the riskiness of an investment opportunity. The probability distribution of the NPV can be determined in this fashion. A number of statistics can then be calculated, including the standard deviation of the NPV, ENPV, Variance of NPV and the probability of the NPV falling below a certain threshold (Daniel et al., 2008).

Whereas the scenario analysis pre-defines the set of scenarios to be analysed and the sensitivity analysis is limited to changing one variable at a time, the Monte Carlo simulation allows for the analysis of all different combinations of strategic variables in all possible situations (Kindlein, 2007).

**(d) Decision trees**

Decision trees are best suited in crafting sound decisions in conditions of project uncertainty. These instruments take into account risk in strategic variables by attaching probabilities to discrete outcomes. Their central advantage is anchored on the fact that they incorporate managerial flexibility in the decision making process. This refines or improves upon the DCF technique (Daniel et al., 2008). Shapiro (2005) notes that decision trees assist in choosing the optimal sequence of decisions. They illustrate the effects of dissimilar decisions under uncertain conditions (Kindlein, 2007). Decision trees are graphically depicted by branches and nodes representing events and points of uncertainty, respectively.

### (e) Real options

Traditional techniques applied in the evaluation of projects do not take into account managerial flexibility. Techniques such as the NPV and IRR assume that managers are inflexible about the decisions made over time. However, this may not be the case in reality. As a project progresses more information is made available to the investor. When confronted with this circumstance, the investor may alter the decisions that were initially adopted at the commencement phase of the project cycle.

Gilbert (2004, p.50) states that "the combination of two things need to be in place for a real option to exist: there must be uncertainty in terms of future project's cash flows and management must have the flexibility to this certainty as it evolves". Four different types of real options exist. These include the option to abandon, the option to expand, the timing option and the production option (Brealey et al., 2006).

### (f) Breakeven analysis

The breakeven analysis provides a mathematical relationship between sales revenue and costs. It calculates the level at which sales makes the NPV equal to zero (Kindlein, 2007). Management is sometimes interested at which level of sales a project starts losing money. Brealey et al. (2006) notes that managers are interested in knowing how bad sales can get before an investment project starts making a loss.

The breakeven analysis tool is useful in assessing the impact of operating leverage (fixed costs) (Kindlein, 2007). Shapiro (2005) points out that, the more fixed costs are incurred the greater the variation of profits with fluctuations in price.

## 3.14 Summary

Extensive literature has been reviewed on the subject of mineral taxation. This literature has covered both taxation and project evaluation criterions. As discussed in this Chapter, mineral tax policies change over time and different tax systems are applied in different circumstances.

However, it is cardinal to note that no universal optimal mineral taxation model exists. Before any tax regime is implemented it must be evaluated for its merits and demerits using sound proven evaluation criteria. This evaluation must be performed both on the side of the government and investor. A tax regime whose benefits outweigh its cost should be considered as the most suitable tax system for implementation.

# Chapter 4

## 4.0 Conceptual Framework and Research Methodology

### 4.1 Introduction

This Chapter gives a detailed description of the conceptual framework and research methodology that have been employed to realise the objectives of this study. Firstly, it presents the conceptual and procedural framework. Secondly, it highlights the techniques that were employed in the data collection process. This is followed by a presentation of the study types. Explication of the sources of data and sampling techniques is subsequently pursued. This is proceeded by an in-depth discussion of the approach undertaken to evaluate Zambia's mineral taxation regimes. The last sections present the limitations of the research, ethical issues and software application of Microsoft Excel.

### 4.2 Conceptual framework

This section graphically describes the conceptual framework of this research study. Concepts that have been employed to construct this framework have already been discussed in Chapter 3. Figure 4.1 shows a graphical synthesis of the different concepts related to taxation. From this figure, it can be deduced that taxation theory hinges on four concepts, that is, equity, efficiency, risk and administrative efficiency.

The concept of efficiency is based on the concept of Pareto optimality also known as economic allocative efficiency. This concept is built on the premise of allocating resources in an optimal manner that results in maximum production of goods and services that the society requires and at the lowest possible unit cost. This concept applies consistently with the concept of neutrality. In public finance, a neutral tax is one that does not distort an investors decisions. In the mining

context, this applies to decisions concerning exploration, development and exploitation of a mineral resource.

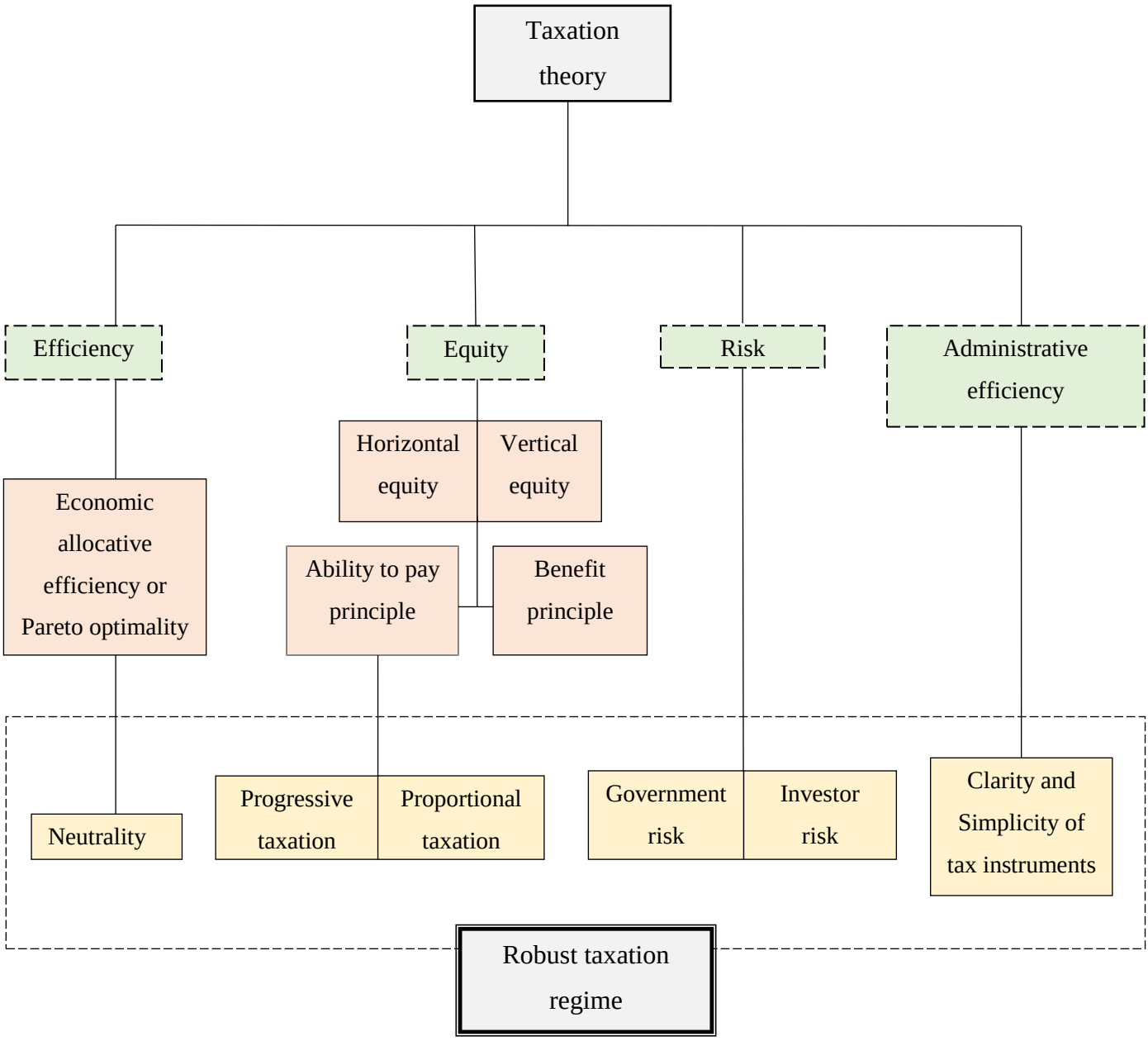


**Figure 4.1: Conceptual framework of research study**

Equity as already discussed in Chapter 3 is materially concerned with the distribution of taxation burden among various taxpayers. There are two dimensions to this concept, that is, horizontal and vertical equity. Firstly, horizontal equity which is also known as equal treatment of equal's

principle requires people in similar situations to pay similar taxes. Vertical equity, on the other hand, involves taxing people in different situations differently. This is also known as the unequal treatment of unequal's principle. Two concepts emanate from the principle of equity, these include, the ability to pay and benefit principle. The ability to pay principle embraces progressive and proportional measures of taxation.

The third theoretical concept of taxation is financial risk, which can be viewed from the perspective of both the government and investor. Both parties will always strive to reduce the risk load so as to increase certainty and subsequently revenue generation. This calls for risk sharing mechanisms between the government and mining investors. However, these risk sharing mechanisms are very difficult to practically induce. This is because it is difficult to apportion risk between the investor and government in the most equitable manner.

No matter how theoretically sound a taxation system is, it must strictly adhere to the concept of administrative efficiency. This concept is grounded in the canon of economy, which requires tax receipts to be greater than tax collection costs. However, the achievement of this effort, requires the implementation of simple and clearly administrative taxation instruments that reduce the compliance cost between the tax authority and taxpayer.

In this study, three tax evaluation principles have been applied to evaluate Zambia's mineral taxation regimes. These include efficiency, equity and risk. Administrative efficiency has been excluded in the analysis because it has been assumed that ZRA has sufficient capacity to competently handle the taxation systems that have been legislated over time.

### 4.3 Procedural framework

The research was undertaken based on the methodological procedure shown in Figure 4.2. The procedural framework illustrates the evaluation of the mineral taxation regimes based on Lumwana Mine using five evaluation measures (i.e. neutrality, progressivity, government risk, investor perception of risk and revenue raising potential). Based on these evaluation measures, an in-depth discussion of results was undertaken which was proceeded by a conclusion and recommendations.

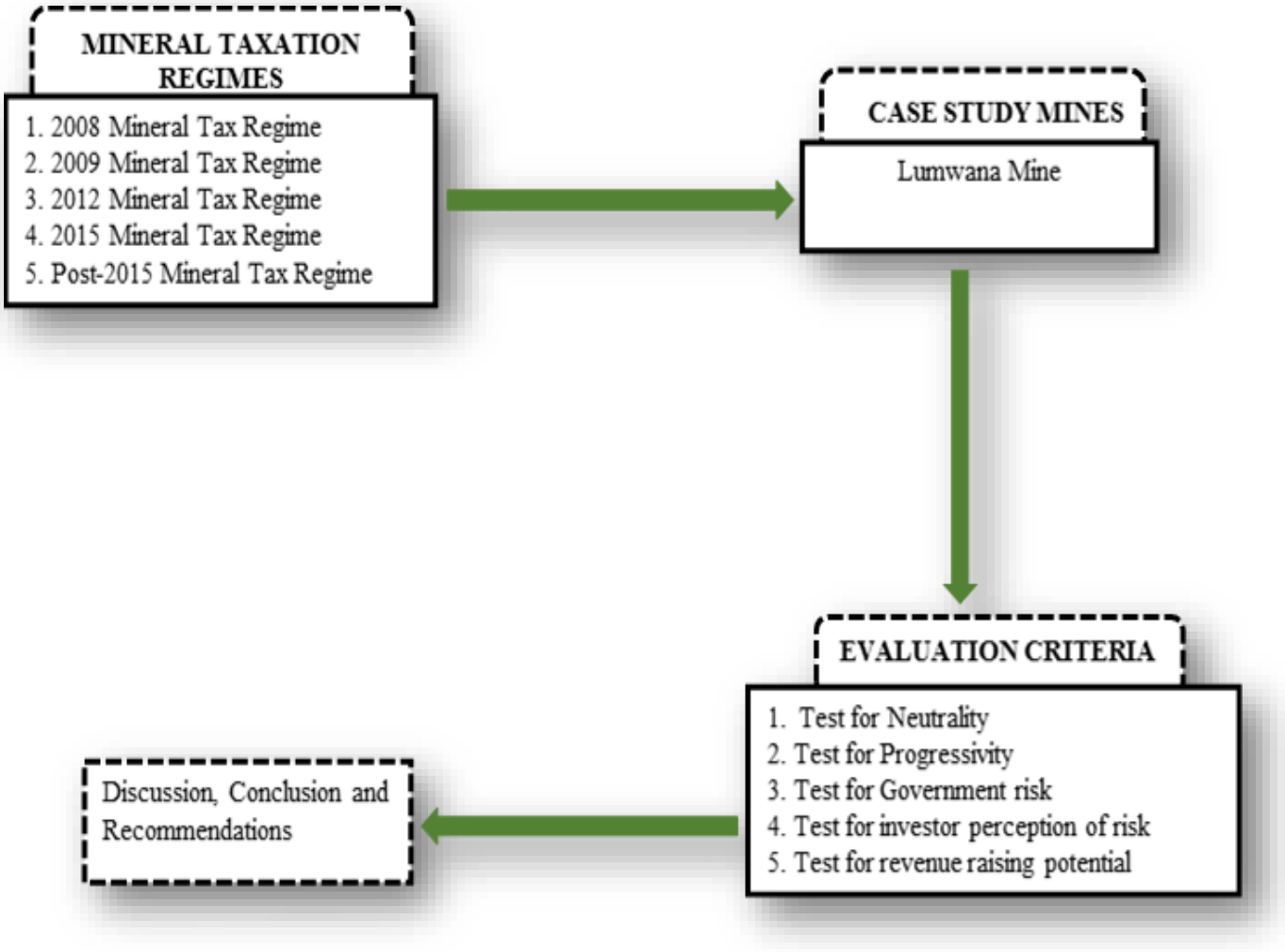


**Figure 4.2: Overview of the methodological framework**

### 4.4 Data collection techniques

The following is a list of data collection techniques that were employed in this study:

- Using available information or documentation review; and
- Group discussions.

### (a) Using available information

This technique involved designing a checklist so as to aid the data collection process. This method was employed because it was a cost effective and easy technique of collecting data. Table C-1 in Appendix C depicts the structure of the checklist tool employed in this study.

### (b) Group discussions

Group discussions with officials from the industry and academia were undertaken so as to gain an insight and understanding of various mineral tax issues. This helped in developing research questions by exploring in greater depth the problem to be investigated. Table 4.1 illustrates the data collection technique and the corresponding tool employed.

**Table 4.1: Data collection techniques**

| Data collection technique | Tool employed |
|---|---|
| Group discussion | Checklist |
| Using available information or Documentation review | Checklist, data compilation forms |

## 4.5 Type of research study

This section briefly describes the study types undertaken in this research. Two types of research approaches are available in theory namely, the inductive and hypothetical deductive approach. The inductive approach involves the coding of data to produce a verbal synthesis. It draws conclusions based on observation. This type of research is commonly applied in the social sciences and is directly linked to qualitative data. On the other hand, the hypothetical deductive approach, gains insight into the phenomenon of interest through the use of statistics. It draws conclusions based on logical and reasonable deduction. This approach is most suitable for research studies that employ quantitative data.

A quantitative research approach has been adopted for application in this study. A quantitative research is one that involves the collection of numerical data in order to explicate, control or predict a phenomenon of interest. Data analysis is usually statistical. This research approach has been applied because this study involves collecting and analysing numerical data to produce descriptive statistical results so as to answer the research questions posed in Section 1.4 of Chapter 1.

The following list gives an outline of four quantitative approaches:

(i) **Descriptive research** – This involves the gathering of data to test a hypothesis or answer questions regarding subjects of study. Data is collected via an interview, a questionnaire or through observation. Descriptive research usually employs visual aids such as graphs and charts to aid the reader in understanding the numerical data.

(ii) **Correlational research** – attempts to investigate whether and to what degree a relationship exists between two or more quantifiable variables.

(iii) **Causal-comparative research** – This type of research involves group comparisons. A causal-comparative research attempts to establish a cause-effect relationship among the groups of subjects that make up the independent variable of the study.

(iv) **Experimental research** – An experimental research involves randomly assigning subjects to the groups that make up the independent variable. Experimental research is closely likened to the causal-comparative research, the only difference being the control of the independent variable. In an experimental research, the independent variable is under the control of the experimenter. That is, the experimenter can randomly assign values to the groups making up the independent variable of the study and measures the effect this group membership has on the dependent variable.

Out of the four types of quantitative approaches described, this research study employs the descriptive and experimental quantitative research methods. A descriptive study has been adopted because this research aims at collecting and analysing numerical data using descriptive statistics through visual aids such as graphs to answer questions about the robustness of Zambia's mineral taxation regimes.

On the other hand, an experimental approach has been employed because the research involves controlling the independent variables (evaluation criterions) through a scenario analysis to determine the effects on the dependent variables (taxation regimes).

An applied research was employed rather than a fundamental one because the research aims at finding a solution that society faces. An applied research can be defined as one that seeks to find a solution to a problem faced by a society or industrial organization. A fundamental research on the other hand is concerned with the generalization and formulation of theory. This study involves the application of already known concepts rather than formulation of theory, an applied research is therefore the most rational, suitable and applicable method of study.

### 4.6 Sources of data

For the purpose of this study, both primary and secondary data have been used. Primary data has been collected from government national speeches, electronic mail and government documents. Secondary data, on the other hand, has been collected from textbooks borrowed from public libraries and from journal and research articles collected from World Wide Web sites.

#### (a) Primary data

Primary data is original, non-interpreted and new information collected by a researcher in a research assignment. This data encompasses documents that are applied at the same time of the research subject. This data is directly linked to people or events being researched. Primary research data is collected through various techniques including interviews, questionnaires and surveys.

The major advantage of primary data is that it possesses high level of accuracy. This is attributed to the fact that it is directly obtained from source and thus does not suffer from loss in meaning when data changes hands. This fact helps improve the reliability of the data analysed.

The major disadvantage of primary data is that data collection process consumes a lot of time and effort. This has the potential of rendering the research void or insignificant. This is because the data under study can change thus rendering the data collected obsolete. Another disadvantage

associated with primary data is that it leads to biasness. This is because the tools employed to collect this data have an inherent weakness of being bias e.g. questionnaire.

**(b) Secondary data**

Secondary data includes documents that interpret, describe and draw conclusions based on the works written by others. This data is not directly connected to the people or events under study. Secondary data encompasses three quarters of the data at the disposal of many researchers. This data is available in typed, written or in electronic form.

The major advantage of secondary data is that it can be easily obtained without consuming time and other resources. This easy and cheap data collection process provides adequate time for the researcher to comprehensively analyse the data collected thus improving the quality of the results produced.

The disadvantage of this type of data is that it losses its original meaning by the time it arrives in the hands of the researcher. This reduces its reliability and accuracy. Secondly, with the passage of time the data becomes obsolete and inapplicable.

**4.7 Sampling**

Sampling is a process which involves the selection of study elements from a population. In research, it is quiet impossible to analyse the entire population in a single sitting because of financial and time limiting constraints. A sample is usually selected from a population through the process of sampling. However, special care must be exercised in this process because the sample that is selected must very closely act as a representative of the entire population. Sampling methods are classified into two namely, probability and non-probability methods. Probability method is one where each element in the population has a chance of being selected. Non-probability method on the other hand is where some elements in the population have a zero chance of being selected.

**(a) Probability methods of sampling**

The following list briefly highlights the probability sampling methods

(i) **Simple random sampling** –This is also referred to as an Equal Probability Sampling (EPS) design because every element in the population has an equal chance of being selected. This sampling technique is usually applied to populations that are small and homogeneous.

(ii) **Systematic sampling** – This sampling method involves arranging population elements in a certain order pattern with an aim of selecting elements at intervals.

(iii) **Stratified sampling** –This involves dividing the population into sub-populations known as stratums. Population elements within these stratums are then selected through the process of random sampling.

(iv) **Multiphase sampling** –This sampling method involves generating successive samples through the use of additional information.

(v) **Multistage sampling** –This is sampling that is done in stages with smaller and smaller units being employed at each stage.

(vi) **Clustered Sampling** –This is also known as a two stage sampling method. The first stage involves the selection of clusters. This is proceeded by the selection of elements within the selected clusters using a cluster technique.

(vii) **Panel sampling** –This involves selecting a sample using the random sampling method and then asking repeated questions to the subjects of the sample, several times and within a certain period of time.

**(b) Non-probability methods**

The following list briefly highlights the non-probability methods that exist in theory

(i) **Quotas sampling** – This is closely likened to stratified sampling. The only difference being in the second step. Instead of using random sampling in the second step, the quotas sampling technique selects the elements based on some already defined measure.

(ii) **Purposive sampling** –This is also known as judgmental sampling. It involves selecting a sample based on the personal judgement of the researcher.

(iii) **Convenient sampling** – This selects a sample based on what is available and convenient.

Out of the 10 sampling methods described above, this research has employed the convenient approach of sampling Lumwana Mine. This is because information relating to other mines could not be sourced due to confidentiality reasons. In this case, Lumwana Mine acted as the most available and convenient sample.

### 4.8 Approach undertaken in evaluating mineral taxation regimes

This section presents an in-depth review of the quantitative methodological set up used to evaluate Zambia's mineral taxation regimes.

#### 4.8.1 Test for neutrality

Neutrality has been examined using three fundamental indicators, namely; AETR, METR and a comparability analysis of pre- to post-tax IRR. These indicators have been evaluated using a scenario analysis based on the status quo and worst case scenario.

#### (a) Average Effective Tax Rate (AETR)

The AETR can be defined as a ratio of the NPV of tax payments at government's discount rate to the NPV of a mining firm's pre-tax cash flows at the hurdle rate. A tax regime that yields a small value of AETR is termed to have a high degree of neutrality and vice versa. Equation 4.1 shows the mathematical definition of AETR.

$$\text{AETR} = \frac{NPV_G}{NPV_M} X\ 100\% \qquad [4.1]$$

**Where:**

$NPV_G$ is the NPV of tax payments at government discount rate (i.e. 8%) ($); and
$NPV_M$ is the NPV of a mining firm's pre-tax cash flows at the hurdle rate (i.e. 15%) ($).

This indicator of neutrality was examined using a scenario analysis based on copper price fluctuation. Under this criterion, two scenarios were adopted for analysis which include the status quo and worst case scenario. The worst case scenario asserts a situation of adverse price conditions whilst the status quo scenario reflects an unbiased (i.e. current status) forecast of copper prices. Table 4.2 depicts the price fluctuation percentages for the two scenarios.

**Table 4.2: Price fluctuation percentages for neutrality test**

| Scenario | Status quo scenario (%) | Worst case scenario (%) |
|---|---|---|
| Price Fluctuation percentages | 0 | -15 |

**(b) Marginal Effective Tax Rate (METR)**

Daniel et al. (2008) describes METR as a ratio of the difference between pre-tax IRR and post-tax IRR to the pre-tax IRR for a marginal project. Another way of expressing this measure is unity less the ratio of post-tax IRR to pre-tax IRR. A tax regime that yields a small value of METR is termed to have a high degree of neutrality and vice versa. Equation 4.2 describes the METR mathematically.

$$METR = \left[1 - \frac{Post\text{-}tax\ IRR}{Pre\text{-}tax\ IRR}\right] X\ 100\% \qquad [4.2]$$

**(c) Comparability analysis of pre- to post-tax IRR**

A comparability analysis of pre- to post-tax IRR was undertaken. A tax system yielding a small difference in magnitude between these parameters is termed to have a high degree of neutrality.

As discussed in Section 3.6.1 of Chapter 3, a tax which leaves the pre-tax ranking of a project equal to its post-tax ranking is termed to be neutral. In theory of project evaluation techniques, two investment alternatives are ranked one higher than the other when ones project IRR is much higher than its hurdle rate when compared to the other investment alternative. This means that a taxation regime which reduces a projects post-tax IRR far below its pre-tax IRR has a high probability of distorting its ranking (i.e. attractiveness) and hence possesses a lower degree of neutrality.

Both the METR and the comparability analysis indicators were evaluated on the basis of the status quo and worst case scenario shown in Table 4.2.

### 4.8.2 Test for progressivity

Progressivity of Zambia's mineral taxation regimes was analysed by comparing the governments take in the pre-tax cash flows of the mining company (AETR) over a range of pre-tax NPVs. The various AETRs and pre-tax NPVs were generated by exclusively fluctuating the yearly copper prices over the forecasted years.

This evaluation criterion was examined using scenario analysis. Two scenarios were adopted for examination, these include the status quo and worst case scenario. Table 4.3 depicts the discount rates associated with these two scenarios.

**Table 4.3: Discount rates for progressivity test**

| | **Discount rates** | |
|---|---|---|
| | **Status quo scenario (%)** | **Worst case scenario (%)** |
| Government of Zambia | 8 | 11 |
| Mining Firm (Lumwana Mine) | 15 | 18 |

The status quo scenario under this indicator asserts a situation of the current status of risk. Conversely, the worst case scenario asserts a situation of high risk. The high risk load in the latter

scenario has been encapsulated by employing a high discount rate. Thus, 3 percentage points have been added to the status quo discount rate[25] to represent the worst case discount rate.

### 4.8.3 Test for revenue raising potential

The revenue raising potential of each mineral fiscal regime was measured using single case time profile graphs of revenue based on the status quo and worst case scenario. Table 4.4 shows price fluctuation percentages associated with these two scenarios.

**Table 4.4: Price fluctuation percentages for revenue raising test**

| Scenario | Status quo scenario (%) | Worst case scenario (%) |
|---|---|---|
| Price Fluctuation percentages | 0 | -20 |

### 4.8.4 Test for Government risk

The uncertainty of revenue inflow is a source of worry to mineral dependent economies. This has called for the development of mineral fiscal tools to combat this risk. The Coefficient of Variation (CV)[26] parameter has been used as a measure of risk in this research study.

Equation 4.3 mathematically describes the CV parameter.

$$CV = \frac{\sigma}{\mu} \qquad [4.3]$$

[25] According to Daniel et al. (2008) the worst case discount rate for most mining projects is 20% in real terms. Thus, 18% is a reasonable estimate.

[26] Coefficient of Variation (CV) is the ratio of the standard deviation to the mean, and is a measure of the dispersion of returns.

**Where:**

μ is the mean; and

σ is the standard deviation.

Standard deviation (σ) can be defined as:

$$\sigma = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \mu)^2} \qquad [4.4]$$

**Where:**

$x_i$ is the observation; and

N is the number of sample elements.

A taxation regime yielding the lowest value of CV reduces government's exposure to risk because it limits the dispersion of revenue inflow. Different NPV values were obtained by solely fluctuating the yearly forecasted real copper prices. Table 4.3 shows the government discount rates that have been employed in evaluating this criterion based on the status quo and worst case scenario.

### 4.8.5 Test for Investor Perception of risk

The investor's perception of risk of Zambia's mineral taxation regimes was evaluated by analysing the cumulative probability distribution of post-tax NPV of Lumwana Mine discounted at 15% and 18%. These discount rates represent the status quo and worst case scenario, respectively. Under this criterion, the status quo scenario signifies the current state of risk as reflected by the use of a low discount rate whilst the worst case scenario asserts a state of adverse risk as reflected by the use of a high discount rate. Different values of post-tax NPV were generated by undertaking a series of price fluctuations. Therefore, this criterion assumes price to be the only source of uncertainty or risk.

From statistics, cumulative probability distribution curves are generated using the cumulative distribution function F(x). The function F(x) has different statistical definitions depending on whether the random variable X is discrete or continuous.

**(a) Cumulative distribution function when X is discrete**

If a random variable X takes on integer or countable values, then X is a discrete random variable. The cumulative distribution function of a discrete random variable X is defined as:

$$F(x) = P(X \leq x) \qquad [4.5]$$

A function F(x) is a cumulative distribution function for a discrete random variable X if it satisfies the following four properties:

- $\lim_{x \to -\infty} F(x) = 0$;
- $\lim_{x \to \infty} F(x) = 1$;
- $\lim_{h \to 0^+} F(x + h) = F(x)$, that is F(x) is right continuous; and
- If a < b then F(a) ≤ F(b), that is F(x) is a non-decreasing function.

It must be noted that when X is a discrete random variable, then F(x) is a step function.

**(b) Cumulative distribution function when X is continuous**

If a random variable X takes values on an interval or intervals (i.e. uncountable sets of values). Then X is said to be a continuous random variable.

**NOTE:**

- P(X=x) = 0, for any continuous random variable X; and
- A continuous random variable X is specified by its probability density function.

A function f(x) is a probability density function for some random variable X if:

- $f(x) \geq 0$ for all x; and
- $\int f(x)\, dx = 1$ for all x.

If f(x) is a probability density function for a continuous random variable X defined over the interval $-\infty < x < \infty$, then the cumulative distribution function of X is given by:

$$F(x) = \int_{-\infty}^{x} f(t)dt \qquad [4.6]$$

If X is a continuous random variable with probability density function f(x) and cumulative distribution function F(x), then:

$$f(x) = \frac{d}{dx}F(x) \qquad [4.7]$$

In this research study, the discrete definition of F(x) has been adopted to generate cumulative probability distribution values of post-tax NPV. This is because the post-tax NPV variable is assumed to take on countable values. Even though this method produces a step function, points are joined on the graph to produce smooth probability distribution curves.

The post-tax NPVs that were generated were assumed to follow a normal distribution[27]. Thus, the normal distribution function *NORM.DIST(x,μ,σ,True)* of Microsoft Excel was employed to expedite the generation of cumulative probability distribution values of post-tax NPV.

Table 4.5 shows a summary of the evaluation criteria along with key indicators.

[27] See Table B-3 in Appendix B

**Table 4.5: Summary of evaluation criteria**

| EVALUATION CRITERION | KEY INDICATORS | TYPE OF OUTPUT |
|---|---|---|
| ***Neutrality*** | Average Effective Tax Rate (AETR) | Range of cases |
| | Marginal Effective Tax Rate (METR) | Range of cases |
| | Comparability of pre- to post-tax IRR | Comparison analysis |
| ***Progressivity*** | Tax share of pre-tax cash flows (AETR Vs Pre-tax NPV) | Range of cases, graphs |
| ***Revenue raising potential*** | Time profile of revenue | Range of cases, graph |
| ***Government risk*** | Dispersion of NPV (Coefficient of Variation) | Probability distribution of cases |
| ***Investor perception of risk*** | Cumulative probability distribution of outcomes (Post-tax NPV) | Probability distribution of cases, graph |

### 4.8.6 Rationalization for the adoption of the evaluation criteria

The evaluation process of this research has employed five criterions which include neutrality, progressivity, revenue raising potential, government risk and investor perception of risk[28]. These measures have been selected as a criteria of evaluation because they best explain and encapsulate the revenue generating objective of a tax regime. However, it must be mentioned that other important evaluation measures exist including international competitiveness, administrative efficiency and susceptibility of taxation regimes to tax planning schemes. These measures require an in-depth analysis and are thus beyond the scope of this research.

[28] This evaluation criteria has been used by the Technical Assistant Department (TAD) of the IMF to evaluate petroleum and mineral taxation regimes in various jurisdictions.

## 4.9 Limitations of the study

The following flaws and limitations were anticipated and faced during the research study:

(i) The research findings were based on one case study mine instead of all the mines currently operating in Zambia. These findings do not depict an entirely true reflection of the impact of different taxation regimes on the Zambian mineral industry;

(ii) The analysis employed in this study only covered a forecasted span of 10 years. This means the research findings reflect short term results rather than results associated with the full life span of the project;

(iii) Analysis of mineral taxation regimes only considered direct taxes and excluded indirect taxes such as export duty and VAT;

(iv) Difficulties were encountered in forecasting monthly copper prices for the purpose of calculating windfall tax; and

(v) Some of the project financial data such as the yearly operating expenditures for the case study mine were not made readily available by the mine and revenue authorities due to confidentiality reasons.

However, to overcome these flaws and limitations candid determination and struggle was exhibited.

## 4.10 Software application

Microsoft Excel was used to simulate different evaluation results. These simulated results are discussed in Chapter 5. This software was chosen as the most suitable software for application because it provides a cheap and easy platform for undertaking spreadsheet modeling on which this project was based.

## 4.11 Ethical issues

The nature of the research and sources of data did not necessitate any significant ethical considerations. All material used in this research has been duly acknowledged. To the best of the author's knowledge there has been no ethical transgression in the process of the research.

## 4.12 Summary

This Chapter has reviewed the conceptual framework and the research methodology that have been employed in this study. It has clearly presented the road map the research undertook from start to completion. Several methodological research issues have been discussed including data collection techniques, type of research adopted, sampling methods, limitation of the study and approach employed in the evaluation process. The Chapter closes with a discussion on software application and ethical issues.

# Chapter 5

## 5.0 Presentation and Discussion of Results

### 5.1 Introduction

This Chapter presents an analysis of all the data gathered by the approach of the methodological framework discussed in Chapter 4. It discusses the research findings and answers questions posed in Chapter 1.

### 5.2 Developing the forecasted Lumwana Mine model

A forecasted Lumwana Mine model was developed for the purpose of evaluating Zambia's mineral taxation regimes. Relevant assumptions have been made to some input parameters because they could not be sourced due to confidentiality reasons. Other data was easily accessible through the internet published by well-known institutes' e.g. the World Bank for copper prices. Tables A-2 to A-7 in Appendix A depict the forecasted Lumwana Mine models in relation to Zambia's mineral taxation regimes.

The subsequent subsections give a brief highlight of the different parameters adopted in generating the forecast.

#### 5.2.1 Forecasting of mineral prices

The World Bank price forecast was used to determine the prices of copper at different points in time. Table D-1 of Appendix D shows this forecast in real 2010 United States (US) dollars.

### 5.2.2 Forecasting of production

A linear regression production forecasting model for Lumwana Mine was developed using Microsoft Excel. Past copper prices were plotted against past copper ore production values with an aim of determining a relationship between the two variables. To achieve this, a statistical residual analysis was first undertaken to eliminate extreme outliers and a linear trend line was then fitted to the plot. A fairly strong positive linear relationship existed between the two variables. Figure 5.1 depicts the graphical representation of the linear production forecasting model. This figure has been developed using data (i.e. past copper prices and ore production values) in Table A-1 of Appendix A.

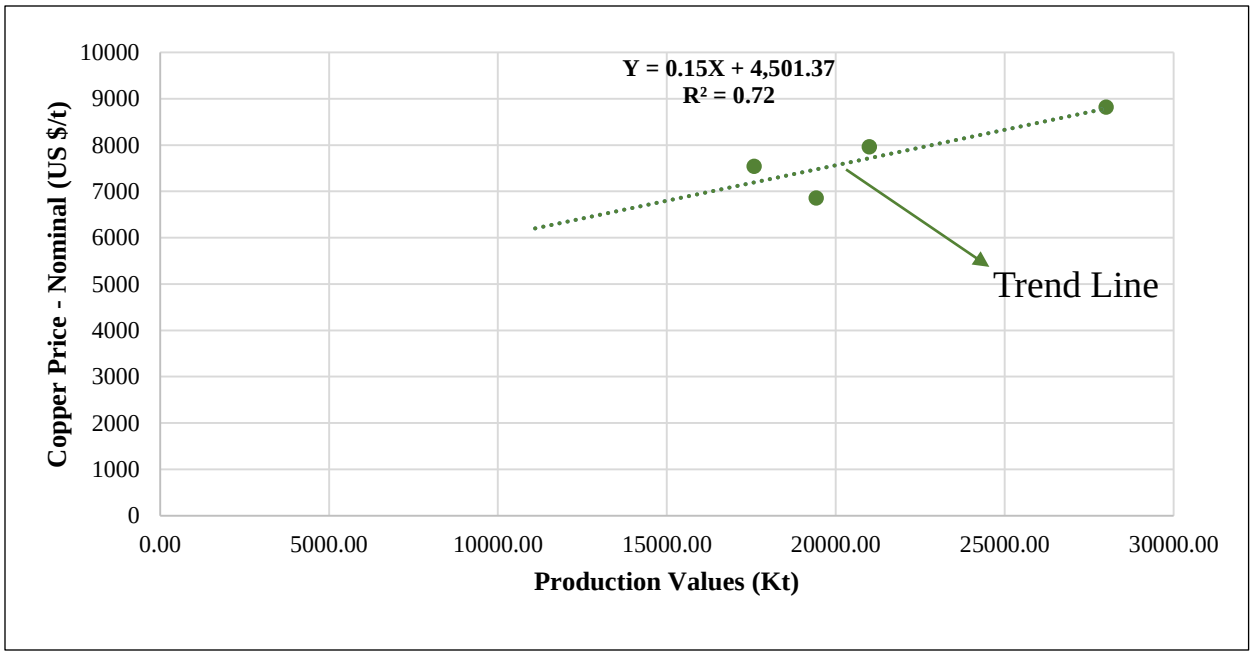


**Figure 5.1: Graphical representation of the linear production forecasting model**

From the above figure, it can be deduced that there is a positive linear relationship between copper price and ore production. This linear relationship can mathematically be expressed as:

$$CP_n = 0.15(P) + 4501.37 \qquad [5.1]$$

**Where:**

$CP_n$ is the nominal copper price ($/t); and
P is the copper ore production (kt).

Rearranging Equation 5.1 gives:

$$P = 6.67(CP_n) - 30{,}009.13 \qquad [5.2]$$

**(a) Testing for outliers**

Before fitting the linear trend line in Figure 5.1, a statistical residual analysis was first undertaken to determine extreme outliers. This was done so as to improve the fit of the regression by identifying and eliminating these outliers.

A residual value can be defined as:

$$e = y_t - \tilde{y}_t \qquad [5.3]$$

**Where:**

e is the residual value;
$y_t$ is the observed y value; and
$\tilde{y}_t$ is the corresponding y coordinate value predicted by the equation used to fit x-$y_t$ data.

A prediction model that gives residual values that are scattered around zero is termed to be a good forecasting model.

Table 5.1 shows the residual values obtained by employing Equation 5.3. The past copper ore production values (i.e. mill throughput values) and past copper prices have been obtained from Table A-1 of Appendix A.

**Table 5.1: Residual analysis**

| Past copper ore production values (Kt) (x values) | Past copper prices ($/t) ($y_t$ values) | $\tilde{y}_t$ | e |
|---|---|---|---|
| 11100.00 | 6967.00 | 6113.92 | 853.08 |
| 13090.00 | 5159.00 | 6384.61 | -1225.61 |
| 17580.00 | 7540.00 | 6995.35 | 544.65 |
| 28000.00 | 8818.00 | 8412.70 | 405.30 |
| 21000.00 | 7957.00 | 7460.55 | 496.45 |
| 25150.00 | 7341.00 | 8025.04 | -684.04 |
| 19421.52 | 6856.00 | 7245.84 | -389.84 |

In Table 5.1, any ($x$,$y_t$) point having a residual value above or below ±600 has been treated as an outlier and excluded in the analysis.

Figure 5.2 shows the graphical representation of the residual analysis. It has been generated by plotting residual values against past copper ore production values obtained from Table 5.1.

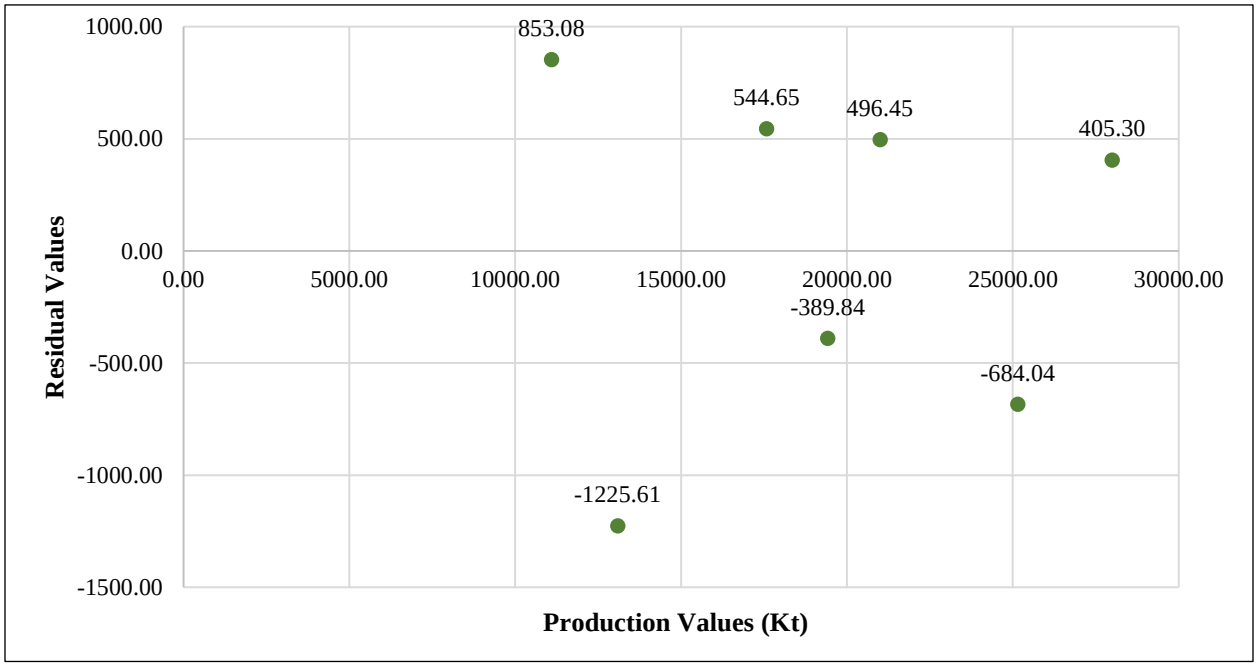


**Figure 5.2: Graphical representation of residual analysis**

### (b) Assumptions of the linear production forecasting model

This section presents the assumptions of the developed linear production forecasting model. These include:

- In all production years quantity supplied (Qs) is less than or equal to quantity demanded (Qd) (i.e. $Qs \leq Qd$);
- Quantity produced (Qp) is equal to quantity supplied (Qs) (i.e. $Qp = Qs$);
- Production is solely dependent on copper price (i.e. Excludes social-political determinants of production); and
- All other macroeconomic variables are assumed to be constant for a period of ten years.

### 5.2.3 Determining mining revenue

Mining revenue (copper sales value) was determined by multiplying the amount of paid copper at the smelter with forecasted real copper prices.

### 5.2.4 Determining operating expenditure

To forecast operating cost the average unit operating expenditure has been adopted for application. The average unit operating expenditure is simply the sum of the averages of yearly unit mining, milling, product shipping and refining costs of the Lumwana Mine model depicted in Table A-1 of Appendix A. To determine the total operating expenditure incurred in a particular year the average unit operating cost has been multiplied with the mill throughput of that year.

### 5.2.5 Determining capital expenditure

The yearly forecasted capital expenditures have been assumed to be 10% of yearly operating expenditures. This applied criterion is consistent with that applied at Zambia's Ministry of Mines. This modus operandi has been adopted because actual values of capital expenditures were not made available by the revenue authority (i.e. ZRA) and mine officials due to confidentiality reasons.

### 5.2.6 Selecting the appropriate cost of capital

An appropriate cost of capital had to be selected for the case study mine and the Government of the Republic of Zambia (GRZ). The discount rate applied by the mining company is usually referred to as the hurdle rate. This rate consists of two components namely, the risk free rate and a market risk premium. The risk free rate compensates the investor for investing funds in an investment project through time and under non-inflationary conditions. Conversely, the market risk premium compensates the investor for absorbing risk.

However, for the case of the Zambian Government a risk free rate was adopted for application. This is because the Zambian Government owns passive equity and thus does not participate in the risk faced by the investor.

A status quo real discount rate of 15% has been applied for Lumwana Mine. This rate was obtained from the Barrick Gold report of first quarter results[29]. At the end of 2014, Barrick Gold Corporation implemented a new capital allocation framework in which each individual project in the portfolio of investment was assessed against a hurdle rate of 15%. Any project not yielding this target was to be differed, cancelled or sold.

Zambia has a market risk premium of 6.6% (Fernandez et al., 2011). The difference between this market risk premium and the Lumwana Mine hurdle rate of 15% gives a risk free rate to be applied for the case of Zambia. Thus, 8% has been adopted as a reasonable status quo discount rate to be applied for government's assessment. However, a scenario analysis can always be undertaken to examine the effects of different discount rates.

### 5.2.7 Accounting for inflation

Money value today is not the same as that in the near future. This is attributed to risk and inflation. It is therefore, imperative to compensate the investor in terms of these two mentioned attributes. This research employs the real methodology of accounting for inflation which involves the use of a real discount rate to discount future real cash flows. The choice between nominal or real method of discounting cash flows is a matter of preference, both approaches produce similar results.

### 5.2.8 Cash flow structure

Different structures have been employed in theory for the analysis of cash flows. However, the availability of data determines the suitable applicable structure. Table 5.2 shows the structure of the annual cash flow that has been applied in this research study. The structure of cash flow analysis on the investor's side excludes parameters such as working capital, hedging losses and

[29] See http://www.barrick.com/investors/news/news-details/2015/Barrick-Reports-First-Quarter-2015-Results/default.aspx

interest on debt due to the inaccessibility of such data. On the other hand, the structure of government annual cash flow encompasses direct taxes only. This is because indirect taxes are difficult to analyse due to their multiple exemptions and rates.

**Table 5.2: Structure of annual cash flow**

| MINE INVESTOR | | GOVERNMENT | |
|---|---|---|---|
| | Revenue | | Royalty Tax Payable |
| ***Less:*** | Operating expenditure | | |
| | **Gross Income** | | |
| ***Less:*** | Mineral royalty | ***Add:*** | Corporate Income Tax payable |
| ***Less:*** | Loss carry forward | | |
| | **Taxable Income** | ***Add:*** | Windfall Tax Payable |
| ***Less:*** | Corporate Income Tax | | |
| ***Less:*** | Other taxes (Windfall and variable profit tax) | | |
| | **After Tax Profit** | | |
| ***Add:*** | Carry forward losses | ***Add:*** | Variable Profit Tax Payable |
| ***Less:*** | Capital expenditure | | |
| **Net Annual Cash flow of the Mining Company** | | **Net Annual Cash flow to the Zambian Government** | |

### 5.2.9 Base case assumptions for the forecasted Lumwana Mine model

Several assumptions have been made about the forecasted Lumwana Mine models. The following provides a list of key assumptions:

- All the ROM that is mined is taken to the metallurgical plant for processing;
- Taxes are paid in the year of occurrence and no tax planning schemes are undertaken by the mining investor; and
- Considers only direct taxes this is because indirect taxes are difficult to analyse due to multiple rates and exemptions.

### 5.3 Computation of mineral taxes for the various taxation regimes

This section presents the computation methods of the mineral taxes considered in this study. Four direct tax types have been adopted for analysis. These include windfall tax, Variable Profit Tax (VPT), Corporate Income Tax (CIT) and mineral royalty.

#### 5.3.1 Windfall tax

Windfall tax on copper was only applicable to the 2008 Zambian mineral tax regime. Table 5.3 shows its related trigger prices.

**Table 5.3: Trigger prices of windfall tax (ZRA, 2008)**

| DESCRIPTION OF TRIGGER PRICE | AMOUNT (US $/t) |
|---|---|
| First trigger price | 5,512 |
| Second trigger price | 6,614 |
| Third trigger price | 7,716 |

#### (a) Application of windfall tax

The following list provides the standard application of windfall tax:

- Where the average monthly price does not exceed the First Trigger Price (FTP) windfall tax shall not be payable.
- Where the average monthly price exceeds the FTP but does not exceed the Second Trigger Price (STP), windfall tax shall be calculated using Equation 5.4 (ZRA, 2008):

$$WT = Q_n * 25\% \ (MAP - FTP) \qquad [5.4]$$

**Where:**

WT is the windfall tax payable for the month ($);
$Q_n$ is the quantity of copper sold per month (t);
MAP is the monthly average price ($/t); and
FTP is the first trigger price ($/t).

- Where the average monthly price exceeds the STP but does not exceed the Third Trigger Price (TTP) windfall tax shall be calculated according to Equation 5.5 (ZRA, 2008):

$$WT = Q_n\{[\,25\%\,(STP - FTP)] + [50\%(MAP - STP)]\} \qquad [5.5]$$

**Where:**

WT is the windfall tax payable for the month ($);
$Q_n$ is the quantity of copper sold per month (t);
MAP is the monthly average price ($/t);
FTP is the first trigger price ($/t); and
STP is the second trigger price ($/t).

- Where the monthly average price exceeds the TTP, windfall tax shall be calculated in accordance with Equation 5.6 (ZRA, 2008):

$$WT = Q_n\,\{[25\%\,(STP - FTP)] + [50\%\,(TTP - STP)] + [\,75\%\,(MAP - TTP)]\} \qquad [5.6]$$

**Where:**

WT is the windfall tax payable for the month ($);
$Q_n$ is the quantity of copper sold per month (t);
MAP is the monthly average price ($/t);
FTP is the first trigger price ($/t);
STP is the second trigger price ($/t); and
TTP is the third trigger price ($/t).

- All quantity of copper produced within a month is sold at the end of the month. Equation 5.7 has been employed to calculate the quantity of copper sold per month ($Q_n$).

$$Q_n = \frac{YAP}{12} \qquad [5.7]$$

**Where:**

$Q_n$ is the quantity of copper sold per month (t); and
YAP is the yearly average production (t).

- Windfall tax is payable at the end of each month.

**(b) Computation of Monthly Average Price (MAP) for copper**

A World Bank price forecast was employed to calculate monthly real copper prices. Figure 5.3 shows the World Bank copper price forecast in real US dollars. A linear trend line was fitted to the data points in Figure 5.3 using Microsoft Excel in order to provide a basis of generating a price forecasting model capable of calculating monthly real copper prices. These copper prices are a feed parameter for calculating the monthly windfall tax payable.

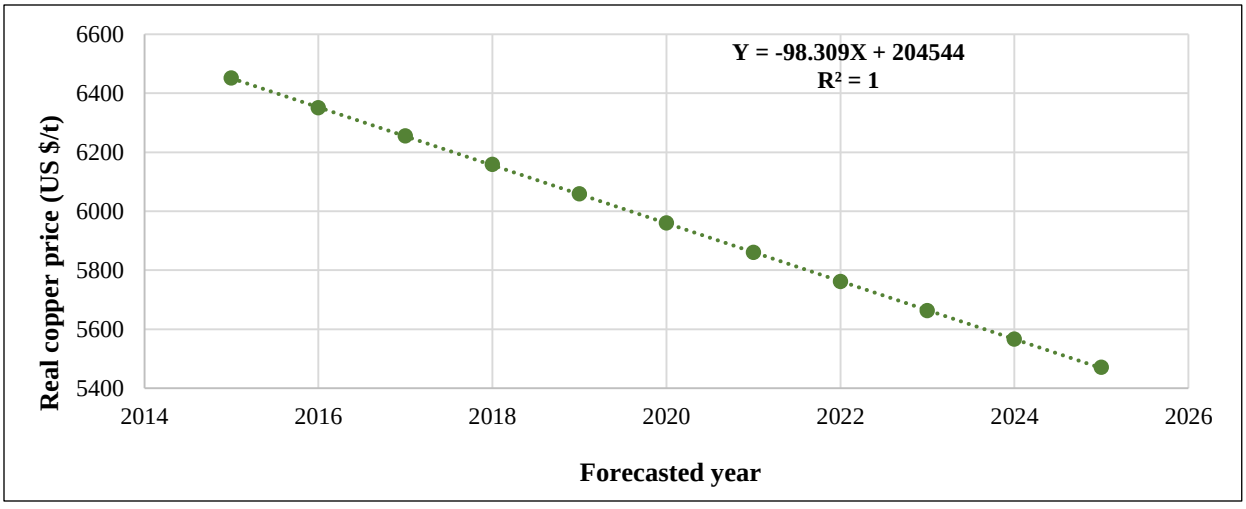


**Figure 5.3 Real copper price forecast (World Bank, 2014)**

From Figure 5.3, the World Bank price forecasting model can be rewritten as:

$$CP_r = -98.31Y_n + 204{,}544 \quad [5.8]$$

**Where:**

$CP_r$ is the real copper price ($/t); and
$Y_n$ is the forecasted year.

From Equation 5.8, the monthly real copper price can be expressed as:

$$MAP_r = -98.31(Y_n + \frac{\varphi}{12}) + 204{,}544 \quad [5.9]$$

**Where:**

$MAP_r$ is the monthly real copper price ($/t);
$Y_n$ is the forecasted year; and
$\varphi$ is the month windfall tax is payable.

### 5.3.2 Variable Profit Tax (VPT)

A 15% VPT has been applied when the ratio of taxable income to gross sales exceeds 8%. For the 2008 tax regime, any income subjected to windfall tax shall not be subjected to a VPT in that charge year. The VPT payable ($VPT_P$) is calculated using Equation 5.10.

$$VPT_P = VPT_R * TI \quad [5.10]$$

**Where:**

$VPT_P$ is the variable profit tax payable ($);
TI is the taxable income ($); and
$VPT_R$ is the variable profit tax rate (%).

Equation 5.11 shows the calculation of the $VPT_R$ as discussed in Section 2.4.2 of Chapter 2 (ZRA, 2008).

$$VPT_R = 30\% + \left[15\% - \left(\frac{1.2\%}{C}\right)\right] \quad [5.11]$$

**Where:**

$VPT_R$ is the variable profit tax rate (%); and
C is the ratio of taxable income to gross sales.

### 5.3.3 Corporate Income Tax (CIT)

CIT payable has been computed by applying a fixed rate to the taxable income base. Taxable income in this research project is equal to the difference between gross margin and the sum of mineral royalty and loss carry forward. Thus, income tax payable can be calculated using Equation 5.12.

$$CIT_P = CIT_R * TI \quad [5.12]$$

**Where:**

$CIT_P$ is the CIT payable ($);
$CIT_R$ is the CIT rate for a particular tax regime (%); and
TI is the taxable income ($).

### 5.3.4 Mineral royalty

Mineral royalty payable ($MR_P$) for the various fiscal regimes has been computed by applying a fixed royalty rate to the copper sales value. This parameter is calculated using Equation 5.13.

$$MR_P = MR_R * CSV \quad [5.13]$$

**Where:**

$MR_P$ is the mineral royalty payable ($);
$MR_R$ is the mineral royalty rate (%); and
CSV is the copper sales value ($).

## 5.4 Evaluation results of mineral fiscal regimes

This section undertakes an evaluation of Zambia's mineral taxation regimes based on neutrality, revenue raising potential, progressivity, government risk and investor perception of risk. This is pursued using the framework discussed in Section 4.8 of Chapter 4. The evaluation process is anchored on two state of affairs which include the status quo and worst case scenario. However, it must mentioned that in the case of revenue raising potential the ranking of the taxation regimes has been based on the worst case scenario. On the other hand, the rest of the evaluation measures have encapsulated both the worst case and status quo scenario in their ranking process.

### 5.4.1 Results of neutrality test

Neutrality of Zambia's mineral taxation regimes has been examined using three fundamental indicators, namely; AETR, METR and a comparability analysis of pre- to post-tax IRR. Table 5.4 shows the neutrality results of these three indicators based on the status quo and worst case scenario.

**Table 5.4: Results of neutrality test**

| STATUS QUO SCENARIO | | | | | |
|---|---|---|---|---|---|
| | MINERAL TAXATION REGIME | | | | |
| INDICATOR | 2008 | 2009 | 2012 | 2015 | POST 2015 |
| Average effective tax rate (%) | 59 | 113 | 115 | 70 | 118 |
| Marginal effective tax rate (%) | 47 | 86 | 88 | 49 | 90 |
| Pre-tax IRR (%) | 261 | 261 | 261 | 261 | 261 |
| Post-tax IRR (%) | 139 | 37 | 31 | 133 | 25 |
| Difference between pre-tax IRR and post-tax IRR (%) | 122 | 224 | 230 | 128 | 236 |
| **WORST CASE SCENARIO** | | | | | |
| | MINERAL TAXATION REGIME | | | | |
| INDICATOR | 2008 | 2009 | 2012 | 2015 | POST 2015 |
| Average effective tax rate (%) | 65 | 117 | 120 | 85 | 123 |
| Marginal effective tax rate (%) | 52 | 92 | 95 | 60 | 100 |
| Pre-tax IRR (%) | 197 | 197 | 197 | 197 | 197 |
| Post-tax IRR (%) | 95 | 16 | 9 | 79 | 0.1 |
| Difference between pre-tax IRR and post-tax IRR (%) | 102 | 181 | 188 | 118 | 196.9 |

As discussed in Chapter 4, a tax system that generates the lowest AETR and METR asserts one which has a high degree of neutrality. Similarly, a tax regime that yields a small difference between pre- and post-tax IRR signifies that which has a high degree of neutrality. To facilitate the calculation of pre- and post-tax IRR, it was assumed that a sustaining capital of $100 million was injected into the Lumwana mining project prior 2015 (i.e. 2014).

Employing the three neutrality indicators under both scenarios (i.e. worst case and status quo), the 2008 tax regime can be ranked as the most neutral followed by a sequential ranking of the 2015, 2009, 2012 and lastly Post-2015 regime. This ranking is reflected by the order of magnitude in value of the three indicators depicted in Table 5.4.

Table 5.5 shows the neutrality ranking of Zambia's mineral taxation regimes in descending order based on the status quo and worst case scenario. The table shows that the 2009 regime ranks higher in neutrality than the 2012 and Post-2015 regime. This can be attributed to its lower mineral royalty rate. Similarly, the 2012 tax system ranks higher than the Post-2015 regime because it has a lower royalty rate than the latter. These results corroborate earlier discussions in Section 3.5.2 of Chapter 3 highlighting that mineral royalty is non-neutral. This means that all things being equal, an increase in the royalty rate results in decreased neutrality of the taxation regime as a whole. The

rationale behind the order of ranking of the 2008 and 2015 regimes has been expounded in Table 5.5.

**Table 5.5: Neutrality ranking**

| RANKING | MINERAL TAXATION REGIME | REASON FOR RANKING |
|---|---|---|
| 1 | 2008 | • Low royalty rate (i.e. 3%)<br>• Unique tax combination comprising of VPT, CIT, mineral royalty and windfall tax. |
| 2 | 2015 | • High royalty rate (i.e. 20%)<br>• Tax system solely based on royalty |
| 3 | 2009 | • Low royalty rate (i.e. 3%)<br>• Combination of the VPT, CIT and mineral royalty within the tax structure |
| 4 | 2012 | • Moderately high royalty rate (i.e. 6%)<br>• Combination of VPT, CIT and mineral royalty within the tax structure |
| 5 | Post-2015 | • Moderately high royalty rate (i.e. 9%)<br>• Combination of VPT, CIT and mineral royalty within the tax structure |

### 5.4.2 Results of revenue raising potential test

The revenue raising potential of Zambia's mineral taxation regimes has been analysed using time profile graphs of revenue based on the status quo and worst case scenario. Figure 5.4 depicts the graphical representation of the forecasted government revenue in a span of 10 years (2015-2025).

This figure has been generated using data in Table B-2 of Appendix B. As can be seen from the figure, revenue generation on the side of the government, both under the status quo and worst case scenario is decreasing over time.

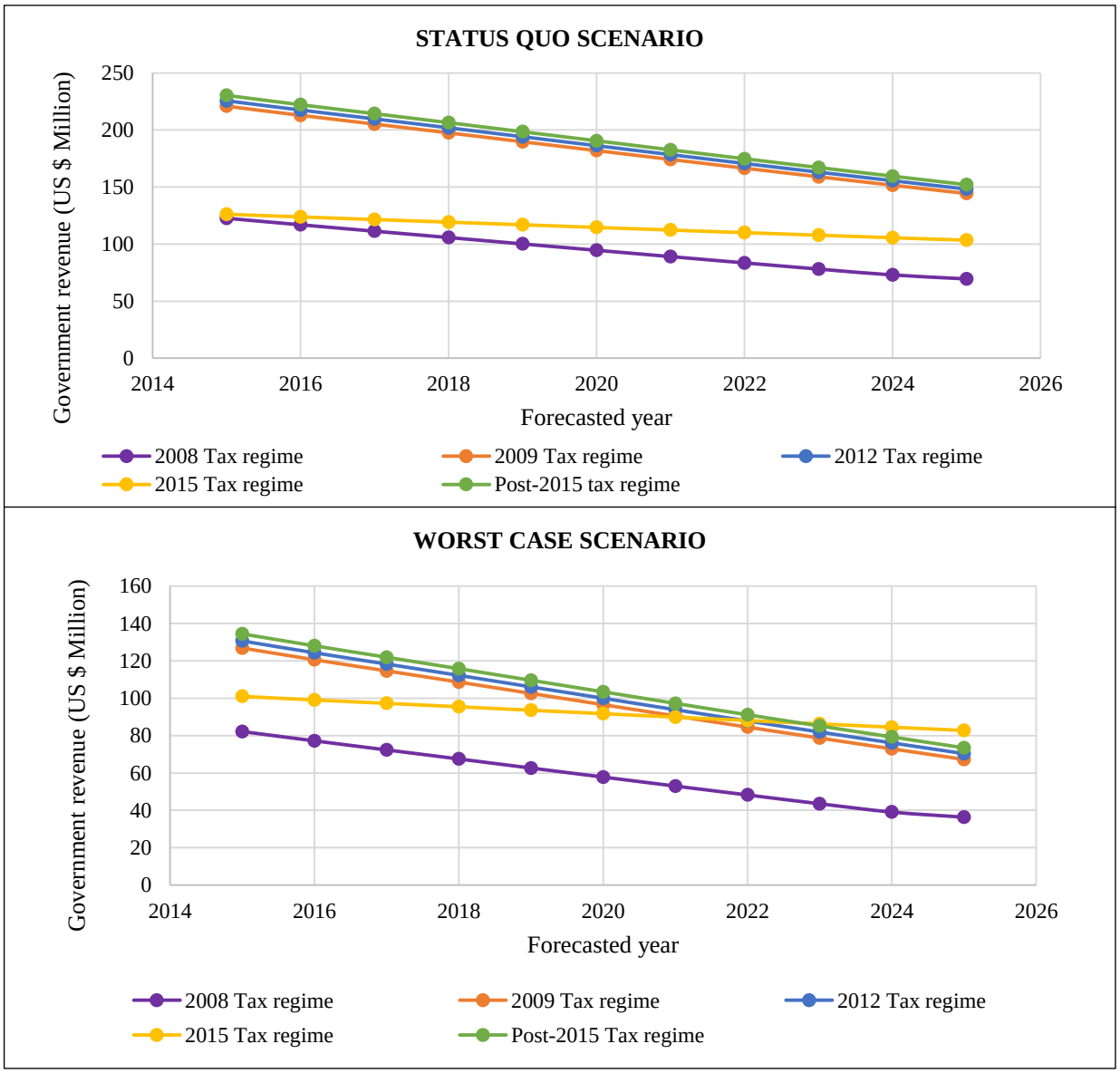


**Figure 5.4: Results of revenue raising potential test**

The revenue raising pattern of Zambia's mineral taxation regimes in the above figure reflects the World Bank copper price forecast employed in this study[30]. In this case, both the copper price

[30] See Table D-1 of Appendix D

forecast and the revenue raising pattern (i.e. on the side of government) exhibit a downward trend. Thus, it is suffice to say that the revenue raising profile has mainly been determined by the copper price forecast. Production has no counter effect on this revenue raising pattern because it solely uses price as a forecasting parameter thus conforming to its plunging tendency.

Under the worst case scenario, it can be deduced that the 2015 taxation regime has the highest revenue raising potential. This is because it begins to generate revenue above that which is generated by each individual taxation regime beyond 2023. This pattern is bound to continue as long as copper prices continue to plummet. These results corroborates earlier discussions in Section 3.5.2 of Chapter 3 highlighting that mineral royalty extracts a fairly substantial amount of revenue for the government in times of low mineral prices (i.e. low business profit).

The 2015 taxation regime is followed by a sequential ranking of the Post-2015, 2012, 2009 and 2008 taxation systems. The reason for this ranking can be explained by the presence of high tax rates and combination of taxes in the regimes.

The following list provides a rationale for this ranking profile.

- The 2015 taxation system ranks higher than all other fiscal regimes because of the high royalty rate. In low price outcomes, this regime secures a relatively high amount of revenue for the government than other taxation systems. This is consistent with the characteristic of mineral royalty as discussed in Section 3.5.2 of Chapter 3;
- The Post-2015 regime ranks higher than the 2012 taxation system because the former has a royalty rate which is 3% above the latter (i.e. 9%);
- The 2012 regime ranks higher than the 2009 tax system because the former has a royalty rate which is 3% above the latter (i.e. 6%); and
- The 2009 tax regime ranks higher than the 2008 tax system because the combination of CIT, VPT and mineral royalty in the 2009 tax regime yields more tax payable to the government than a combination of CIT, VPT, mineral royalty and windfall tax in the 2008 tax system.

### 5.4.3 Results of progressivity test

Progressivity of Zambia's mineral taxation regimes was analysed by comparing the government's take in pre-tax cash flows of Lumwana Mine (AETR) over a range of pre-tax NPVs. The variation in AETR and pre-tax NPV (reflecting project profitability) was generated by solely varying the forecasted copper prices in real terms. Table B-1 in Appendix B shows the fluctuated values of AETR and pre-tax NPV based on the status quo and worst case scenario. Figure 5.5 shows the results of progressivity test.

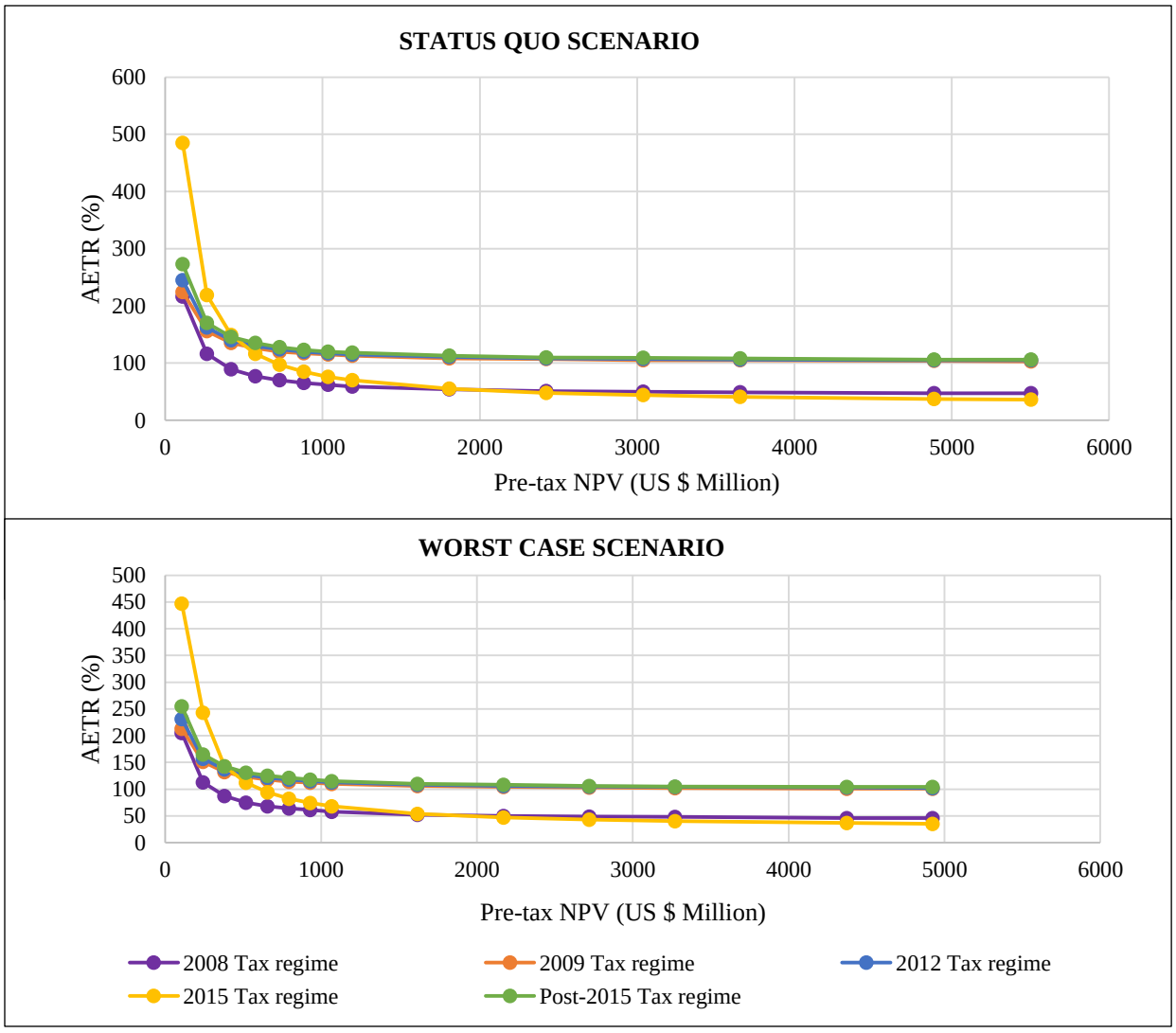


**Figure 5.5: Results of progressivity test**

The AETR in Figure 5.5 represents the share of government revenue in pre-tax cash flows of Lumwana Mine. It should be noted that there is a disadvantage of using the AETR as a measure of profitability. This disadvantage is that the AETR masks the relative progressivity of taxation regimes when presented graphically (Daniel et al., 2008).

"Progressivity" here means that the capacity of a taxation regime ensures that the government receives a rising share of project cash flows as the intrinsic profitability of the project increases. Figure 5.5 under both scenarios shows that all progressivity curves of the taxation regimes move in tandem as the pre-tax NPV just starts to increase. This suggests that all tax regimes trigger similar changes in government take at lower profitability. However, as the pre-tax NPV continues to increase, the progressivity curves of the Post-2015, 2012 and 2009 taxation regimes coincide and are above those generated by the 2008 and 2015 regime. This signifies that the Post-2015, 2012 and 2009 taxation systems grant higher take than the 2008 and 2015 regimes at higher profitability.

The progressivity curves of the Post-2015, 2012 and 2009 taxation regime in Figure 5.5 coincide asserting that the three regimes have the same level of progressivity. This ranking is followed by a sequential ranking of the 2008 and 2015 regime.

The following provides a rationale for this ranking profile:

- The Post-2015, 2012 and 2009 regimes rank higher than the 2008 tax system because the combination of VPT, CIT and mineral royalty in the former taxation systems is more progressive than the combination of VPT, CIT, mineral royalty and windfall tax in the latter regime;
- The Post-2015, 2012 and 2009 regimes rank higher than the 2015 tax system because the combination of VPT, CIT and mineral royalty in the former taxation regimes is more progressive than mineral royalty in the latter regime; and
- The 2008 tax system ranks higher than the 2015 regime because the combination of VPT, windfall tax, CIT and mineral royalty in the former taxation regime is more progressive than mineral royalty in the latter regime.

From these results, it can be concluded that hybridized mineral tax regimes (i.e. 2008, 2009, 2012 and Post-2015 regimes) are more progressive than single tier taxation system based on mineral royalty (i.e. 2015 regime).

### 5.4.4 Results of government risk test

The volatility of revenue inflow from the mining sector is a source of worry to copper dependent economies and Zambia is no exception. This volatility can be attributed to the stochastic behavior of copper prices. Volatility of government tax returns has been employed as a surrogate measure of determining the level of risk of Zambia's mineral taxation regimes to the government. In a quest to estimate the magnitude of this volatility, the Coefficient of Variation (CV) fiscal tool has been applied. This is because the CV parameter best defines risk in terms of dispersion. Table 5.6 shows the standard deviation and CV parameter of Zambia's mineral taxation regimes based on the worst and status quo scenario. This table also shows government mean NPV. Different NPV values were generated using a range of different price sensitivities depicted in Table B-4 of Appendix B.

**Table 5.6: Mean government NPV, standard deviation and CV**

| **STATUS QUO SCENARIO** | | | | | |
|---|---|---|---|---|---|
| **INDICATOR** | **MINERAL TAXATION REGIME** | | | | |
| | **2008** | **2009** | **2012** | **2015** | **POST-2015** |
| Standard Deviation (US $ Million) | 403.88 | 938.12 | 947.42 | 251.64 | 956.85 |
| Mean NPV (US $ Million) | 1574.56 | 3355.87 | 3407.37 | 1371.37 | 3458.8 |
| Coefficient of Variation (%) | 25.65 | 27.95 | 27.80 | 18.35 | 27.66 |
| **WORST CASE SCENARIO** | | | | | |
| **INDICATOR** | **MINERAL TAXATION REGIME** | | | | |
| | **2008** | **2009** | **2012** | **2015** | **POST-2015** |
| Standard Deviation (US $ Million) | 352.92 | 819.64 | 827.89 | 247 | 836.13 |
| Mean NPV (US $ Million) | 1381.60 | 2939.02 | 2983.96 | 1183.83 | 3028.89 |
| Coefficient of Variation (%) | 25.54 | 27.89 | 27.74 | 20.87 | 27.61 |

Under both scenarios (i.e. worst and status quo), the 2015 taxation regime possesses the lowest risk to the government as reflected by low values of CV in Table 5.6. This regime is followed by a sequential ranking of the 2008, Post-2015, 2012 and 2009 taxation systems. This order of ranking is mirrored by the order of magnitude of CV values.

The following list provides a rationale for this ranking profile:

- The 2015 mineral taxation system possesses the least risk to the Zambian Government because it is solely based on mineral royalty at a higher rate (i.e. 20%);
- The 2008 tax regime ranks second lowest in terms of government risk because it is mainly dominated by production based taxes (i.e. windfall tax and mineral royalty);
- The Post-2015 taxation system ranks third because it has a higher royalty rate than the 2012 and 2009 regime (i.e. 9%);
- The 2012 regime ranks higher than the 2009 taxation system because the former has a higher royalty rate than the latter (i.e. 6%); and
- The 2009 regime possesses the highest government risk because it has the lowest royalty rate (i.e. 3%).

These results corroborate earlier discussions in Chapter 3 highlighting that mineral royalty (i.e. ad valorem and unit based) minimizes the risk of government revenue inflow.

### 5.4.5 Results of investor perception of risk test

The investor's perception of risk of Zambia's mineral taxation regimes was evaluated by analysing the cumulative probability distribution of post-tax NPV discounted at 15% and 18%. These discount rates represent the status quo and worst case scenario as explained in Section 4.8.5 of Chapter 4. Figure 5.6 shows the cumulative probability distribution of investor post-tax NPV of Zambia's mineral taxation regimes under the the status quo and worst case scenario.

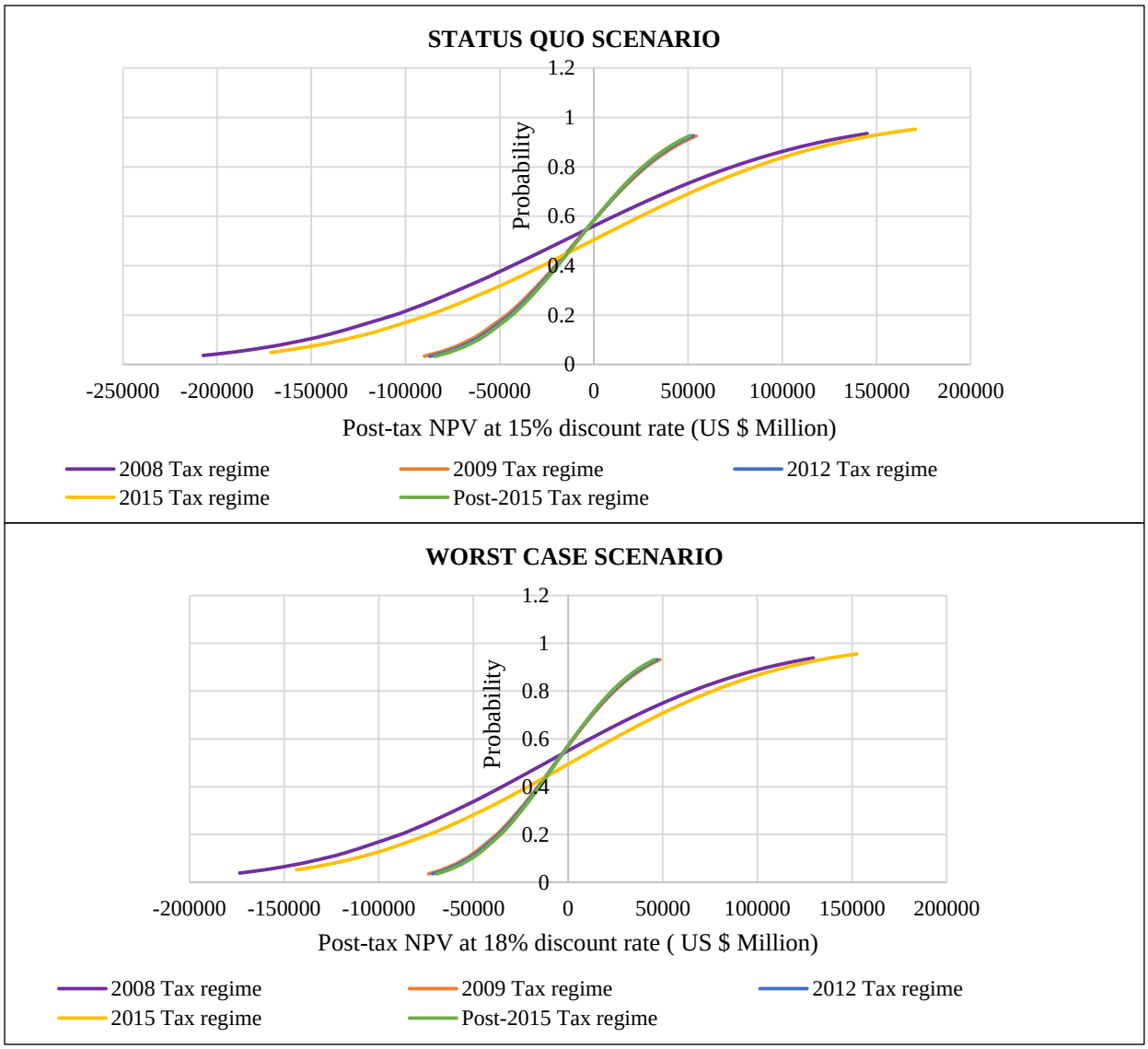


**Figure 5.6: Cumulative probability distribution of investor post-tax returns**

Different values of post-tax NPV were generated by undertaking a series of price fluctuations as shown in Table B-3 of Appendix B. Therefore, this criterion assumes price to be the only source of uncertainty or risk. In Figure 5.6, under both scenarios (i.e. status quo and worst case), the 2008 and 2015 regimes show a relatively low probability of expected positive outcomes and a high probability of expected negative outcomes. To the contrary, the 2009, 2012 and Post-2015 regimes whose graphs coincide show a relatively low probability of expected negative outcomes and a high probability of expected positive outcomes. This directly signifies that the 2008 and 2015 regimes have a higher bearing on investor perception of risk when compared to the 2009, 2012 and Post-2015 taxation systems.

Most investors are risk averse and thus prefer to reduce negative returns as much as possible. Assuming that the Lumwana mining investors are risk averse it is suffice to say that the 2015 taxation regime has a lower bearing on investor perception of risk than the 2008 regime. This is because the 2015 tax system offers a lower probability of expected negative outcomes (i.e. Post-tax NPV) when compared to the 2008 regime.

The cumulative probability curves of the Post-2015, 2009 and 2012 regimes coincide. This signals that the taxation systems have the same bearing on investor perception of risk.

The following provides reasons as to why the different mineral taxation regimes rank higher than others in terms of investor perception of risk:

- The 2009, 2012 and Post-2015 regimes have a lower investor perception of risk than the 2015 regime because the former taxation systems combine VPT, CIT and mineral royalty which yield less risk than mineral royalty solely employed in the latter regime;

- The 2009, 2012 and Post-2015 regimes have a lower investor perception of risk than the 2008 regime because the combination of VPT, CIT and mineral royalty in the former regimes yield less risk than the combination of VPT, CIT, windfall tax and mineral royalty employed in the latter regime; and

- The 2015 regime possesses lower investor risk than the 2008 taxation regime because the combination of mineral royalty, VPT, windfall tax and CIT in the latter taxation regime yields more risk than mineral royalty solely employed in the former taxation regime.

## 5.5 Ranking of mineral taxation regimes

Table 5.7 shows the ranking of Zambia's mineral taxation regimes based on progressivity, revenue raising potential, neutrality, government risk and investor perception of risk.

**Table 5.7: Overall ranking of Zambia's mineral taxation regimes**

| EVALUATION CRITERION | ZAMBIA'S MINERAL TAXATION REGIMES | | | | |
|---|---|---|---|---|---|
| | 2008 | 2009 | 2012 | 2015 | POST-2015 |
| Neutrality | 1 | 3 | 4 | 2 | 5 |
| Revenue raising potential | 5 | 4 | 3 | 1 | 2 |
| Progressivity | 4 | 1 | 1 | 5 | 1 |
| Government risk | 2 | 5 | 4 | 1 | 3 |
| Investor perception of risk | 5 | 1 | 1 | 4 | 1 |
| **Total ranking points** | 17 | 14 | 13 | 13 | 12 |

From Table 5.7, it can be concluded that the Post-2015 taxation regime is the most robust based on the five evaluation criterions as reflected by the lowest ranking point. This is followed by a sequential ranking of the 2015 and 2012; 2009; and lastly the 2008 regime.

This analysis of results has shown that the Post-2015 taxation regime is the most robust in design. This can be attributed to the proper harmonization of its robust taxation instruments. The results also show that the Post-2015, 2015, 2012 and 2009 taxation systems are relatively robust in design except the 2008 regime. This is because the latter has a weakly constructed tax structure that lacks proper harmonization of its taxes.

However, it is important to be cognizant with the fact that there is a tradeoff among the five evaluation criterions. Thus, the most solid measures adopted in determining a robust mineral taxation regime depends on the taxation doctrine of the policy formulator and what is to be achieved.

## 5.6 Summary

Zambia's mineral taxation regimes have been evaluated based on five criterions using Lumwana Mine as case study. These evaluation criterions include neutrality, progressivity, revenue raising

potential, government risk and investor perception of risk. A scenario analysis of these criterions has been undertaken based on the status quo and worst case scenario. The Lumwana Mine model which acted as a benchmark for analysis was developed based on generally acceptable financial and economic principles.

From the evaluation results, the following are a summary of the major findings:

(i) The 2008 tax regime is the most neutral in design because of its unique tax combination comprising of windfall tax, CIT, VPT and mineral royalty;

(ii) The 2015 tax system has the highest revenue raising potential. In low price outcomes, this regime secures a substantial amount of revenue for the government than all other taxation systems;

(iii) The Post-2015 taxation regime is the most progressive because of its well-built hybridized taxation structure encapsulating VPT, windfall tax and mineral royalty;

(iv) The 2009, 2012 and Post-2015 regimes have the least effect on investor perception of risk as reflected by the cumulative probability distribution of post-tax NPV in Figure 5.6;

(v) The 2015 regime offers the least risk to the government. This is because it is solely based on royalty which provides stable revenue inflow into government coffers;

(vi) The Post-2015 regime is the most robust in design in terms of capturing mining revenue based on the five evaluation criterions, this can be attributed to its robust tax structural design;

(vii) The 2008 taxation regime is the least robust in design because of its weak tax structure that lacks proper harmonization of its taxation instruments; and

(viii) The research results indicate that Zambia's mineral taxation systems except the 2008 regime are relatively robust in design in terms of capturing mining revenue based on the five evaluation criterions that were employed.

# Chapter 6

## 6.0 Conclusions and Recommendations

### 6.1 Conclusions

There has been constant pressure that has been mounted on the Zambian Government by the electorate that the mineral taxation regimes have not yielded the desired results in terms of revenue generation. This has mainly been attributed to their weak tax structural design. In the midst of all this, debate has emanated among citizens as to which mineral taxation regime is the most robust amid other taxation systems. In this regard, the study focused on evaluating Zambia's mineral fiscal systems with an aim of achieving two primary objectives namely, to assess their robustness and to determine the most robust tax system in design. This research used Lumwana Mine as case study. The evaluation process encompassed five criterions and these included neutrality, progressivity, revenue raising potential, government risk and investor perception of risk. These criterions were evaluated using a scenario analysis based on the status quo and worst case scenario.

The research results indicate that Zambia's mineral taxation systems have different intensities of robustness based on the evaluation criterion that is employed. Thus, the most solid measures adopted in determining a robust mineral taxation regime depends on the taxation doctrine of the policy formulator and what is to be achieved. The research has shown that Zambia's mineral taxation regimes are relatively robust in capturing mining revenue except the 2008 regime. This is because of its weak tax structure that does not exhibit proper harmonization of its taxation instruments. The research has reviewed that the Post-2015 mining tax structure is the sturdiest in design. This has been attributed to the robust harmonization of taxes encapsulated in its tax structural design. The ranking of this taxation regime in terms of robustness has been followed by a sequential ranking of the 2015 and 2012; 2009; and lastly the 2008 taxation system.

This study has shown that it is not a single tax that affects a mineral taxation regime but the lump sum of all taxes and how they harmonize with each other. This asserts that it is possible to have robust tax instruments within a taxation regime but once there is no proper harmonization among these instruments it is suffice to render the whole tax structure weak in design.

## 6.2 Recommendations

The following were the main recommendations:

- The Zambian Government should review and optimize the Post-2015 mineral taxation regime encapsulating other tax evaluation measures such as international competitiveness;
- The government should replace the Variable Profit Tax (VPT) in the Post-2015 mineral taxation structure with another robust profitability tax instrument like windfall tax (i.e. sliding scale royalty) so as to achieve optimal taxation. This is because the VPT instrument lacks economic rationale;
- The Zambian Government should optimize mining taxation based on all the taxation instruments encapsulated in the mining tax structure rather than achieve this cause by optimizing a single tax. This is because it is not a single tax that affects a mineral taxation regime but the lump sum of all taxes and how they harmonize with each other;
- The Government of the Republic of Zambia (GRZ) should sign renegotiation contracts with various mining houses so as to attract FDI and to provide some freedom of revocation in circumstantial adverse conditions;
- In case of unforeseen, long-term economic downturns, the Zambian Government must resist spending in times of good economic conditions or consider establishing sovereign revenue equalization funds;
- Zambia Revenue Authority (ZRA) must increase its administrative capacity so as to maximize revenue collection. An increase in capacity will help curb some of the tax planning schemes of transfer pricing, misreporting of grade and production values, hedging manipulation and debt repayment abuse;

- The Zambian Government should enforce mandatory disclosure of financial statements on the side of the investor so as to achieve a sound reconciliation status among mining houses, civil society groups and itself; and
- Before implementing any mineral tax policy the government should undertake economic spreadsheet modeling similar to the one employed in this study to determine the merits and demerits of such a policy.

### 6.3 Suggestions for further work

The outcomes of the research has raised the prospect of further research. The following are the likely avenues worth investigating:

- Optimization of Zambia's Post-2015 mineral taxation regime with an aim of maximizing revenue generation on the side of government;
- To further extend the evaluation process of Zambia's mineral taxation regimes to include measures of administrative efficiency and susceptibility of mineral fiscal systems to tax planning schemes;
- Maximization of revenue generation from the Zambian mining sector through use of non-tax instruments;
- Investigation in the efficient use of mining revenue generated from the mineral resource sector by the Zambian Government; and
- Optimization of mineral tax administration in Zambia.

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# Appendix A

## LUMWANA MINE MODELS

### Table A-1: Lumwana Mine model based on past cash flows

| LUMWANA COPPER MINE MODEL BASED ON PAST CASH FLOWS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **CONSTANT DOLLAR ANALYSIS** | | | | | | | | |
| **YEAR** | | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** |
| COPPER PRICE | US $/lb | 3.16 | 2.34 | 3.42 | 4.00 | 3.61 | 3.33 | 3.11 |
| **PRODUCTION** | | | | | | | | |
| MILL THROUGPUT | kt | 11100.00 | 13090.00 | 17580.00 | 28000.00 | 21000.00 | 25150.00 | 19421.52 |
| MILL GRADE | % | 1.29 | 0.95 | 0.86 | 0.62 | 0.48 | 0.60 | 0.60 |
| MILL RECOVERY | % | 58.10 | 84.10 | 91.80 | 84.20 | 81.20 | 81.40 | 83.30 |
| COPPER METAL PRODUCED | kt | 83.19 | 104.58 | 138.79 | 146.17 | 81.85 | 122.83 | 97.07 |
| **COPPER REVENUE** | | | | | | | | |
| PERCENT PAID BY SMELTER | % | 96.50 | 96.50 | 96.50 | 96.50 | 96.50 | 96.50 | 96.50 |
| PAID COPPER BY SMELTER | kt | 80.28 | 100.92 | 133.93 | 141.06 | 78.98 | 118.53 | 93.67 |
| COPPER SALES VALUE | $M | 559.29 | 520.64 | 1009.83 | 1243.89 | 628.62 | 870.20 | 642.25 |
| **LESS: OPERATING COST** | | | | | | | | |
| TOTAL MINING COST | $ | 605785.00 | 387155.00 | 545649.00 | 878487.00 | 740293.00 | 782455.00 | 780549.00 |
| UNIT MINING COST | $/t | 16.05 | 8.70 | 9.13 | 9.22 | 10.36 | 9.15 | 11.82 |
| TOTAL MILLING COST | $ | 189199.00 | 246144.00 | 360185.00 | 574544.00 | 422412.00 | 477633.00 | 469539.00 |
| UNIT MILLING COST | $/t | 5.01 | 5.53 | 6.02 | 6.03 | 5.91 | 5.58 | 7.11 |
| PRODUCT SHIPPING COST | $ | 91631.00 | 102318.00 | 109504.00 | 130291.00 | 89555.00 | 160185.00 | 160443.00 |
| UNIT PRODUCT SHIPPING COST | $/t | 2.427 | 2.298 | 1.831 | 1.368 | 1.254 | 1.873 | 2.429 |
| TREATMENT AND REFINING | $ | 112808.00 | 170457.00 | 165407.00 | 172136.00 | 105080.00 | 173694.00 | 175081.00 |
| UNIT TREATMENT AND REFINING | $/t | 2.99 | 3.83 | 2.77 | 1.81 | 1.47 | 2.03 | 2.65 |
| TOTAL OPERATING EXPENDITURE | $/t | 26.47 | 20.35 | 19.75 | 18.43 | 19.00 | 18.63 | 24.00 |
| **TOTAL OPERATING EXPENDITURE** | $M | 293.83 | 266.39 | 347.14 | 516.10 | 399.06 | 468.63 | 466.17 |
| **GROSS MARGIN** | $M | 559.29 | 520.64 | 1009.83 | 1243.89 | 628.62 | 870.20 | 642.25 |

## Table A-2: Forecasted Lumwana Mine model

| FORECASTED LUMWANA COPPER MINE MODEL | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REAL DOLLAR ANALYSIS | | | | | | | | | | | | | | |
| YEAR | | | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| FORECAST OF US INFLATION RATE | | 2.2% Per annum | | | | | | | | | | | | |
| US DOLLAR INFLATION FACTORS | | | | 1.02 | 1.04 | 1.07 | 1.09 | 1.11 | 1.14 | 1.16 | 1.19 | 1.22 | 1.24 | 1.27 |
| FORECAST OF COPPER PRICES - REAL | $/t | | | 6,451 | 6,351 | 6,255 | 6,158 | 6059.00 | 5,960 | 5,860 | 5,761 | 5,663 | 5,566 | 5,470 |
| FORECAST OF COPPER PRICES- NOMINAL | $/t | | | 6880 | 6872 | 6864 | 6856 | 6848 | 6840 | 6832 | 6824 | 6816 | 6808 | 6800 |
| PRODUCTION | | | | | | | | | | | | | | |
| MILL THROUGHPUT (AVERAGE) | Kt | | | 15880.47 | 15827.11 | 15773.75 | 15720.39 | 15667.03 | 15613.67 | 15560.31 | 15506.95 | 15453.59 | 15400.23 | 15346.87 |
| AVERAGE MILL GRADE | % | 75 | | | | | | | | | | | | |
| AVERAGE MILL RECOVERY | % | 85 | | | | | | | | | | | | |
| METAL PRODUCED | Kt | | | 101.36 | 101.02 | 100.68 | 100.34 | 99.99 | 99.65 | 99.31 | 98.97 | 98.63 | 98.29 | 97.95 |
| COPPER REVENUE | | | | | | | | | | | | | | |
| AVERAGE PERCENT PAID BY THE SMELTER | % | 97 | | | | | | | | | | | | |
| PAID COPPER BY SMELTER | Kt | | | 97.81 | 97.48 | 97.15 | 96.82 | 96.50 | 96.17 | 95.84 | 95.51 | 95.18 | 94.85 | 94.52 |
| COPPER SALES VALUE - REAL | $M | | | 630.97 | 619.10 | 607.69 | 596.24 | 584.66 | 573.15 | 561.61 | 550.23 | 539.01 | 527.94 | 517.04 |
| OPERATING COST | | | | | | | | | | | | | | |
| AVERAGE UNIT MINING COST | $/t | 10.63 | | | | | | | | | | | | |
| AVERAGE UNIT MILLING COST | $/t | 5.89 | | | | | | | | | | | | |
| AVERAGE UNIT PRODUCT SHIPPING COST | $/t | 1.93 | | | | | | | | | | | | |
| AVERAGE UNIT TREATMENT AND REFINING | $/t | 2.51 | | | | | | | | | | | | |
| AVERAGE TOTAL OPERATING EXPENDITURE | $/t | 20.95 | | | | | | | | | | | | |
| AVERAGE TOTAL OPERATING EXPENDITURE -REAL | $M | | | 332.67 | 331.55 | 330.43 | 329.32 | 328.20 | 327.08 | 325.96 | 324.85 | 323.73 | 322.61 | 321.49 |
| CAPITAL EXPENDITURE - REAL | $M | | | 33.27 | 33.16 | 33.04 | 32.93 | 32.82 | 32.71 | 32.60 | 32.48 | 32.37 | 32.26 | 32.15 |

## Table A-3: Forecasted Lumwana Mine model based on the 2008 tax regime

| FORECASTED LUMWANA COPPER MINE MODEL - SIMULATION OF THE 2008 MINERAL TAX REGIME | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REAL DOLLAR ANALYSIS** | | | | | | | | | | | | | | |
| **YEAR** | | | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| **ASSUMPTIONS** | | | | | | | | | | | | | | |
| FORECAST OF US INFLATION RATE | | 2.2% Per annum | | | | | | | | | | | | |
| US DOLLAR INFLATION FACTORS | | | | 1.02 | 1.04 | 1.07 | 1.09 | 1.11 | 1.14 | 1.16 | 1.19 | 1.22 | 1.24 | 1.27 |
| **FORECAST OF COPPER PRICES-REAL** | $/t | | | 6451 | 6351 | 6255 | 6158 | 6059 | 5960 | 5860 | 5761 | 5663 | 5566 | 5470 |
| **FORECAST OF COPPER PRICES- NOMINAL** | $/t | | | 6880 | 6872 | 6864 | 6856 | 6848 | 6840 | 6832 | 6824 | 6816 | 6808 | 6800 |
| **PRODUCTION** | | | | | | | | | | | | | | |
| MILL THROUGHPUT (AVERAGE) | Kt | | | 15880.47 | 15827.11 | 15773.75 | 15720.39 | 15667.03 | 15613.67 | 15560.31 | 15506.95 | 15453.59 | 15400.23 | 15346.87 |
| AVERAGE MILL GRADE | % | 75 | | | | | | | | | | | | |
| AVERAGE MILL RECOVERY | % | 85.1 | | | | | | | | | | | | |
| METAL PRODUCED | Kt | | | 101.36 | 101.02 | 100.68 | 100.34 | 99.99 | 99.65 | 99.31 | 98.97 | 98.63 | 98.29 | 97.95 |
| **COPPER REVENUE** | | | | | | | | | | | | | | |
| AVERAGE PERCENT PAID BY THE SMELTER | % | 96.5 | | | | | | | | | | | | |
| PAID COPPER BY SMELTER | Kt | | | 97.81 | 97.48 | 97.15 | 96.82 | 96.50 | 96.17 | 95.84 | 95.51 | 95.18 | 94.85 | 94.52 |
| COPPER SALES VALUE - REAL | $M | | | 630.97 | 619.10 | 607.69 | 596.24 | 584.66 | 573.15 | 561.61 | 550.23 | 539.01 | 527.94 | 517.04 |
| **LESS: OPERATING COST** | | | | | | | | | | | | | | |
| UNIT MINING COST | $/t | 10.63 | | | | | | | | | | | | |
| UNIT MILLING COST | $/t | 5.89 | | | | | | | | | | | | |
| UNIT PRODUCT SHIPPING COST | $/t | 1.93 | | | | | | | | | | | | |
| UNIT TREATMENT AND REFINING | $/t | 2.51 | | | | | | | | | | | | |
| **TOTAL OPERATING EXPENDITURE** | $/t | 20.95 | | | | | | | | | | | | |
| **TOTAL OPERATING EXPENDITURE-REAL** | $M | | | 332.67 | 331.55 | 330.43 | 329.32 | 328.20 | 327.08 | 325.96 | 324.85 | 323.73 | 322.61 | 321.49 |
| **GROSS MARGIN - REAL** | $M | | | 298.30 | 287.55 | 277.25 | 266.92 | 256.46 | 246.07 | 235.65 | 225.38 | 215.28 | 205.33 | 195.55 |
| **LESS: MINERAL ROYALTY** | | | | | | | | | | | | | | |
| MINERAL ROYALTY @ 3% - REAL | $M | | | 18.93 | 18.57 | 18.23 | 17.89 | 17.54 | 17.19 | 16.85 | 16.51 | 16.17 | 15.84 | 15.51 |
| **TAXABLE INCOME (LESS: CARRY FORWARD LOSS) - REAL** | $M | | | 279.37 | 268.98 | 259.02 | 249.04 | 238.92 | 228.88 | 218.80 | 208.87 | 199.11 | 189.50 | 180.04 |
| **LESS: CORPORATE INCOME TAX** | | | | | | | | | | | | | | |
| CORPORATE INCOME TAX @ 30% | | | | | | | | | | | | | | |
| CORPORATE INCOME TAX PAYABLE - REAL | $M | | | 83.81 | 80.69 | 77.71 | 74.71 | 71.68 | 68.66 | 65.64 | 62.66 | 59.73 | 56.85 | 54.01 |
| **LESS: OTHER TAXES** | | | | | | | | | | | | | | |
| WINDFALL TAX PAYABLE - REAL | $M | | | 19.91 | 17.65 | 15.40 | 13.16 | 10.95 | 8.74 | 6.55 | 4.38 | 2.22 | 0.28 | 0.00 |
| VARIABLE PROFIT TAX PAYABLE - REAL | $M | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **TOTAL DIRECT TAXES PAYABLE - REAL** | $M | | | 122.65 | 116.91 | 111.33 | 105.76 | 100.16 | 94.60 | 89.04 | 83.55 | 78.12 | 72.97 | 69.52 |
| **ADD: CARRY FORWARD LOSSES -REAL** | $M | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **LESS: CAPITAL EXPENDITURE - REAL** | $M | | | 33.27 | 33.16 | 33.04 | 32.93 | 32.82 | 32.71 | 32.60 | 32.48 | 32.37 | 32.26 | 32.15 |
| | | | *Sustaining capital* | *Projected cash flows* | | | | | | | | | | |
| **COMPANY POST-TAX CASH FLOWS - REAL** | $M | | -100 | 142.38 | 137.48 | 132.87 | 128.23 | 123.48 | 118.76 | 114.01 | 109.35 | 104.78 | 100.10 | 93.88 |
| **COMPANY PRE-TAX CASH FLOWS - REAL** | $M | | -100 | 265.03 | 254.39 | 244.21 | 233.99 | 223.64 | 213.36 | 203.05 | 192.90 | 182.91 | 173.07 | 163.40 |
| **CASH STREAM TO THE GOVERNMENT- REAL** | $M | | | 122.65 | 116.91 | 111.33 | 105.76 | 100.16 | 94.60 | 89.04 | 83.55 | 78.12 | 72.97 | 69.52 |

## Table A-4: Forecasted Lumwana Mine model based on the 2009 tax regime

| FORECASTED LUMWANA COPPER MINE MODEL - SIMULATION OF THE 2009 MINERAL TAX REGIME | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REAL DOLLAR ANALYSIS | | | | | | | | | | | | | | |
| YEAR | | | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| ASSUMPTIONS | | | | | | | | | | | | | | |
| FORECAST OF US INFLATION RATE | | 2.2% Per annum | | | | | | | | | | | | |
| US DOLLAR INFLATION FACTORS | | | | 1.02 | 1.04 | 1.07 | 1.09 | 1.11 | 1.14 | 1.16 | 1.19 | 1.22 | 1.24 | 1.27 |
| FORECAST OF COPPER PRICES-REAL | $/t | | | 6,451 | 6,351 | 6,255 | 6,158 | 6059.00 | 5,960 | 5,860 | 5,761 | 5,663 | 5,566 | 5,470 |
| FORECAST OF COPPER PRICES- NOMINAL | $/t | | | 6880 | 6872 | 6864 | 6856 | 6848 | 6840 | 6832 | 6824 | 6816 | 6808 | 6800 |
| PRODUCTION | | | | | | | | | | | | | | |
| MILL THROUGHPUT (AVERAGE) | Kt | | | 15880.47 | 15827.11 | 15773.75 | 15720.39 | 15667.03 | 15613.67 | 15560.31 | 15506.95 | 15453.59 | 15400.2 | 15346.87 |
| AVERAGE MILL GRADE | % | 75 | | | | | | | | | | | | |
| AVERAGE MILL RECOVERY | % | 85 | | | | | | | | | | | | |
| METAL PRODUCED | Kt | | | 101.36 | 101.02 | 100.68 | 100.34 | 99.99 | 99.65 | 99.31 | 98.97 | 98.63 | 98.29 | 97.95 |
| COPPER REVENUE | | | | | | | | | | | | | | |
| AVERAGE PERCENT PAID BY THE SMELTER | % | 97 | | | | | | | | | | | | |
| PAID COPPER AT SMELTER | Kt | | | 97.81 | 97.48 | 97.15 | 96.82 | 96.50 | 96.17 | 95.84 | 95.51 | 95.18 | 94.85 | 94.52 |
| COPPER SALES VALUE - REAL | $M | | | 630.97 | 619.10 | 607.69 | 596.24 | 584.66 | 573.15 | 561.61 | 550.23 | 539.01 | 527.94 | 517.04 |
| LESS: OPERATING COST | | | | | | | | | | | | | | |
| UNIT MINING COST | $/t | 10.63 | | | | | | | | | | | | |
| UNIT MILLING COST | $/t | 5.89 | | | | | | | | | | | | |
| UNIT PRODUCT SHIPPING COST | $/t | 1.93 | | | | | | | | | | | | |
| UNIT TREATMENT AND REFINING | $/t | 2.51 | | | | | | | | | | | | |
| TOTAL OPERATING EXPENDITURE | $/t | 20.95 | | | | | | | | | | | | |
| TOTAL OPERATING EXPENDITURE - REAL | $M | | | 332.67 | 331.55 | 330.43 | 329.32 | 328.20 | 327.08 | 325.96 | 324.85 | 323.73 | 322.61 | 321.49 |
| GROSS MARGIN - REAL | $M | | | 298.30 | 287.55 | 277.25 | 266.92 | 256.46 | 246.07 | 235.65 | 225.38 | 215.28 | 205.33 | 195.55 |
| LESS: MINERAL ROYALTY | | | | | | | | | | | | | | |
| MINERAL ROYALTY @ 3% - REAL | $M | | | 18.93 | 18.57 | 18.23 | 17.89 | 17.54 | 17.19 | 16.85 | 16.51 | 16.17 | 15.84 | 15.51 |
| TAXABLE INCOME (LESS: CARRY FORWARD LOSS) - REAL | $M | | | 279.37 | 268.98 | 259.02 | 249.04 | 238.92 | 228.88 | 218.80 | 208.87 | 199.11 | 189.50 | 180.04 |
| LESS: CORPORATE INCOME TAX | | | | | | | | | | | | | | |
| CORPORATE INCOME TAX @ 30% | | | | | | | | | | | | | | |
| CORPORATE INCOME TAX PAYABLE - REAL | $M | | | 83.81 | 80.69 | 77.71 | 74.71 | 71.68 | 68.66 | 65.64 | 62.66 | 59.73 | 56.85 | 54.01 |
| LESS: OTHER TAXES | | | | | | | | | | | | | | |
| WINDFALL TAX PAYABLE - REAL | $M | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VARIABLE PROFIT TAX PAYABLE - REAL | $M | | | 118.14 | 113.61 | 109.27 | 104.91 | 100.50 | 96.12 | 91.72 | 87.39 | 83.13 | 78.94 | 74.81 |
| TOTAL DIRECT TAXES PAYABLE - REAL | $M | | | 220.89 | 212.88 | 205.20 | 197.51 | 189.72 | 181.97 | 174.21 | 166.56 | 159.03 | 151.63 | 144.33 |
| ADD: CARRY FORWARD LOSSES - REAL | $M | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LESS: CAPITAL EXPENDITURE - REAL | $M | | | 33.27 | 33.16 | 33.04 | 32.93 | 32.82 | 32.71 | 32.60 | 32.48 | 32.37 | 32.26 | 32.15 |
| | | | *Sustaining capital* | *Projected cash flows* | | | | | | | | | | |
| COMPANY POST-TAX CASH FLOWS - REAL | $M | | -100 | 44.15 | 41.52 | 39.00 | 36.48 | 33.93 | 31.39 | 28.84 | 26.34 | 23.87 | 21.45 | 19.06 |
| COMPANY PRE-TAX CASH FLOWS - REAL | $M | | -100 | 265.03 | 254.39 | 244.21 | 233.99 | 223.64 | 213.36 | 203.05 | 192.90 | 182.91 | 173.07 | 163.40 |
| CASH STREAM TO THE GOVERNMENT- REAL | $M | | | 220.89 | 212.88 | 205.20 | 197.51 | 189.72 | 181.97 | 174.21 | 166.56 | 159.03 | 151.63 | 144.33 |

## Table A-5: Forecasted Lumwana Mine model based on the 2012 tax regime

| FORECASTED LUMWANA COPPER MINE MODEL - SIMULATION OF THE 2012 MINERAL TAX REGIME | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REAL DOLLAR ANALYSIS | | | | | | | | | | | | | | |
| YEAR | | | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| ASSUMPTIONS | | | | | | | | | | | | | | |
| FORECAST OF US INFLATION RATE | | 2.2% Per annum | | | | | | | | | | | | |
| US DOLLAR INFLATION FACTORS | | | | 1.02 | 1.04 | 1.07 | 1.09 | 1.11 | 1.14 | 1.16 | 1.19 | 1.22 | 1.24 | 1.27 |
| FORECAST OF COPPER PRICES-REAL | $/t | | | 6,451 | 6,351 | 6,255 | 6,158 | 6059.00 | 5,960 | 5,860 | 5,761 | 5,663 | 5,566 | 5,470 |
| FORECAST OF COPPER PRICES- NOMINAL | $/t | | | 6880 | 6872 | 6864 | 6856 | 6848 | 6840 | 6832 | 6824 | 6816 | 6808 | 6800 |
| PRODUCTION | | | | | | | | | | | | | | |
| MILL THROUGHPUT (AVERAGE) | Kt | | | 15880.47 | 15827.11 | 15773.75 | 15720.39 | 15667.03 | 15613.67 | 15560.31 | 15506.95 | 15453.59 | 15400.23 | 15346.87 |
| AVERAGE MILL GRADE | % | 75 | | | | | | | | | | | | |
| AVERAGE MILL RECOVERY | % | 85 | | | | | | | | | | | | |
| METAL PRODUCED | Kt | | | 101.36 | 101.02 | 100.68 | 100.34 | 99.99 | 99.65 | 99.31 | 98.97 | 98.63 | 98.29 | 97.95 |
| COPPER REVENUE | | | | | | | | | | | | | | |
| AVERAGE PERCENT PAID BY THE SMELTER | % | 97 | | | | | | | | | | | | |
| PAID COPPER BY SMELTER | Kt | | | 97.81 | 97.48 | 97.15 | 96.82 | 96.50 | 96.17 | 95.84 | 95.51 | 95.18 | 94.85 | 94.52 |
| COPPER SALES VALUE - REAL | $M | | | 630.97 | 619.10 | 607.69 | 596.24 | 584.66 | 573.15 | 561.61 | 550.23 | 539.01 | 527.94 | 517.04 |
| LESS: OPERATING COST | | | | | | | | | | | | | | |
| UNIT MINING COST | $/t | 10.63 | | | | | | | | | | | | |
| UNIT MILLING COST | $/t | 5.89 | | | | | | | | | | | | |
| UNIT PRODUCT SHIPPING COST | $/t | 1.93 | | | | | | | | | | | | |
| UNIT TREATMENT AND REFINING | $/t | 2.51 | | | | | | | | | | | | |
| TOTAL OPERATING EXPENDITURE | $/t | 20.95 | | | | | | | | | | | | |
| TOTAL OPERATING EXPENDITURE - REAL | $M | | | 332.67 | 331.55 | 330.43 | 329.32 | 328.20 | 327.08 | 325.96 | 324.85 | 323.73 | 322.61 | 321.49 |
| GROSS MARGIN - REAL | $M | | | 298.30 | 287.55 | 277.25 | 266.92 | 256.46 | 246.07 | 235.65 | 225.38 | 215.28 | 205.33 | 195.55 |
| LESS: MINERAL ROYALTY | | | | | | | | | | | | | | |
| MINERAL ROYALTY @ 6% - REAL | $M | | | 37.86 | 37.15 | 36.46 | 35.77 | 35.08 | 34.39 | 33.70 | 33.01 | 32.34 | 31.68 | 31.02 |
| TAXABLE INCOME (LESS: CARRY FORWARD LOSS) | $M | | | 260.44 | 250.40 | 240.79 | 231.15 | 221.38 | 211.68 | 201.95 | 192.37 | 182.94 | 173.66 | 164.53 |
| LESS: CORPORATE INCOME TAX | | | | | | | | | | | | | | |
| CORPORATE INCOME TAX @ 30% | | | | | | | | | | | | | | |
| CORPORATE INCOME TAX PAYABLE | $M | | | 78.13 | 75.12 | 72.24 | 69.34 | 66.42 | 63.50 | 60.58 | 57.71 | 54.88 | 52.10 | 49.36 |
| LESS: OTHER TAXES | | | | | | | | | | | | | | |
| WINDFALL TAX PAYABLE | $M | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VARIABLE PROFIT TAX PAYABLE | $M | | | 109.63 | 105.25 | 101.06 | 96.86 | 92.61 | 88.38 | 84.14 | 79.96 | 75.85 | 71.81 | 67.83 |
| TOTAL DIRECT TAXES PAYABLE - REAL | $M | | | 225.62 | 217.52 | 209.76 | 201.98 | 194.10 | 186.27 | 178.42 | 170.69 | 163.08 | 155.58 | 148.21 |
| ADD: CARRY FORWARD LOSSES - REAL | $M | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LESS: CAPITAL EXPENDITURE - REAL | $M | | | 33.27 | 33.16 | 33.04 | 32.93 | 32.82 | 32.71 | 32.60 | 32.48 | 32.37 | 32.26 | 32.15 |
| | | | *Sustaining capital* | *Projected cash flows* | | | | | | | | | | |
| COMPANY POST-TAX CASH FLOWS - REAL | $M | | -100 | 39.41 | 36.87 | 34.45 | 32.01 | 29.54 | 27.09 | 24.63 | 22.21 | 19.83 | 17.49 | 15.19 |
| COMPANY PRE-TAX CASH FLOWS - REAL | $M | | -100 | 265.03 | 254.39 | 244.21 | 233.99 | 223.64 | 213.36 | 203.05 | 192.90 | 182.91 | 173.07 | 163.40 |
| CASH STREAM TO THE GOVERNMENT- REAL | $M | | | 225.62 | 217.52 | 209.76 | 201.98 | 194.10 | 186.27 | 178.42 | 170.69 | 163.08 | 155.58 | 148.21 |

## Table A-6: Forecasted Lumwana Mine model based on the 2015 tax regime

| FORECASTED LUMWANA COPPER MINE MODEL - SIMULATION OF THE 2015 MINERAL TAX REGIME | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REAL DOLLAR ANALYSIS | | | | | | | | | | | | | | |
| YEAR | | | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| ASSUMPTIONS | | | | | | | | | | | | | | |
| FORECAST OF US INFLATION RATE | | 2.2% Per annum | | | | | | | | | | | | |
| US DOLLAR INFLATION FACTORS | | | | 1.02 | 1.04 | 1.07 | 1.09 | 1.11 | 1.14 | 1.16 | 1.19 | 1.22 | 1.24 | 1.27 |
| FORECAST OF COPPER PRICES-REAL | $/t | | | 6,451 | 6,351 | 6,255 | 6,158 | 6059.00 | 5,960 | 5,860 | 5,761 | 5,663 | 5,566 | 5,470 |
| FORECAST OF COPPER PRICES- NOMINAL | $/t | | | 6880 | 6872 | 6864 | 6856 | 6848 | 6840 | 6832 | 6824 | 6816 | 6808 | 6800 |
| PRODUCTION | | | | | | | | | | | | | | |
| MILL THROUGHPUT (AVERAGE) | Kt | | | 15880.47 | 15827.11 | 15773.8 | 15720.4 | 15667 | 15613.7 | 15560.3 | 15507 | 15453.6 | 15400.2 | 15346.9 |
| AVERAGE MILL GRADE | % | 75 | | | | | | | | | | | | |
| AVERAGE MILL RECOVERY | % | 85 | | | | | | | | | | | | |
| METAL PRODUCED | Kt | | | 101.36 | 101.02 | 100.68 | 100.34 | 99.99 | 99.65 | 99.31 | 98.97 | 98.63 | 98.29 | 97.95 |
| COPPER REVENUE | | | | | | | | | | | | | | |
| AVERAGE PERCENT PAID BY THE SMELTER | % | 97 | | | | | | | | | | | | |
| PAID COPPER BY SMELTER | Kt | | | 97.81 | 97.48 | 97.15 | 96.82 | 96.50 | 96.17 | 95.84 | 95.51 | 95.18 | 94.85 | 94.52 |
| COPPER SALES VALUE-NOMINAL - REAL | $M | | | 630.97 | 619.10 | 607.69 | 596.24 | 584.66 | 573.15 | 561.61 | 550.23 | 539.01 | 527.94 | 517.04 |
| LESS: OPERATING COST | | | | | | | | | | | | | | |
| UNIT MINING COST | $/t | 10.63 | | | | | | | | | | | | |
| UNIT MILLING COST | $/t | 5.89 | | | | | | | | | | | | |
| UNIT PRODUCT SHIPPING COST | $/t | 1.93 | | | | | | | | | | | | |
| UNIT TREATMENT AND REFINING | $/t | 2.51 | | | | | | | | | | | | |
| TOTAL OPERATING EXPENDITURE | $/t | 20.95 | | | | | | | | | | | | |
| TOTAL OPERATING EXPENDITURE - REAL | $M | | | 332.67 | 331.55 | 330.43 | 329.32 | 328.20 | 327.08 | 325.96 | 324.85 | 323.73 | 322.61 | 321.49 |
| GROSS MARGIN -REAL | $M | | | 298.30 | 287.55 | 277.25 | 266.92 | 256.46 | 246.07 | 235.65 | 225.38 | 215.28 | 205.33 | 195.55 |
| LESS: MINERAL ROYALTY @ 20% | $M | | | 126.19 | 123.82 | 121.54 | 119.25 | 116.93 | 114.63 | 112.32 | 110.05 | 107.80 | 105.59 | 103.41 |
| EARNED INCOME (LESS: CARRY FORWARD LOSS) - REAL | $M | | | 172.11 | 163.73 | 155.72 | 147.67 | 139.53 | 131.44 | 123.32 | 115.34 | 107.48 | 99.75 | 92.14 |
| TOTAL DIRECT TAXES PAYABLE - REAL | $M | | | 126.19 | 123.82 | 121.54 | 119.25 | 116.93 | 114.63 | 112.32 | 110.05 | 107.80 | 105.59 | 103.41 |
| ADD: CARRY FORWARD LOSS - REAL | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LESS: CAPITAL EXPENDITURE - REAL | $M | | | 33.267 | 33.155 | 33.043 | 32.932 | 32.820 | 32.708 | 32.596 | 32.485 | 32.373 | 32.261 | 32.149 |
| | | | *Sustaining capital* | *Projected cash flows* | | | | | | | | | | |
| COMPANY POST-TAX CASH FLOWS - REAL | $M | | -100 | 138.84 | 130.57 | 122.67 | 114.74 | 106.71 | 98.73 | 90.73 | 82.85 | 75.10 | 67.48 | 59.99 |
| COMPANY PRE-TAX CASH FLOWS - REAL | $M | | -100 | 265.03 | 254.39 | 244.21 | 233.99 | 223.64 | 213.36 | 203.05 | 192.90 | 182.91 | 173.07 | 163.40 |
| CASH STREAM TO THE GOVERNMENT- REAL | $M | | | 126.19 | 123.82 | 121.54 | 119.25 | 116.93 | 114.63 | 112.32 | 110.05 | 107.80 | 105.59 | 103.41 |

## Table A-7: Forecasted Lumwana Mine model based on the Post-2015 tax regime

| FORECASTED LUMWANA COPPER MINE MODEL - SIMULATION OF THE POST-2015 MINERAL TAX REGIME | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REAL DOLLAR ANALYSIS** | | | | | | | | | | | | | | |
| **YEAR** | | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| **ASSUMPTIONS** | | | | | | | | | | | | | | |
| FORECAST OF US INFLATION RATE | | **2.2% Per annum** | | | | | | | | | | | | |
| US DOLLAR INFLATION FACTORS | | | | 1.02 | 1.04 | 1.07 | 1.09 | 1.11 | 1.14 | 1.16 | 1.19 | 1.22 | 1.24 | 1.27 |
| **FORECAST OF COPPER PRICES-REAL** | $/t | | | 6,451 | 6,351 | 6,255 | 6,158 | 6059.00 | 5,960 | 5,860 | 5,761 | 5,663 | 5,566 | 5,470 |
| **FORECAST OF COPPER PRICES- NOMINAL** | $/t | | | 6880 | 6872 | 6864 | 6856 | 6848 | 6840 | 6832 | 6824 | 6816 | 6808 | 6800 |
| **PRODUCTION** | | | | | | | | | | | | | | |
| MILL THROUGHPUT (AVERAGE) | Kt | | | 15880.47 | 15827.1 | 15773.8 | 15720.4 | 15667 | 15613.7 | 15560.31 | 15507 | 15453.6 | 15400.23 | 15346.87 |
| AVERAGE MILL GRADE | % | 75 | | | | | | | | | | | | |
| AVERAGE MILL RECOVERY | % | 85 | | | | | | | | | | | | |
| METAL PRODUCED | Kt | | | 101.36 | 101.02 | 100.68 | 100.34 | 99.99 | 99.65 | 99.31 | 98.97 | 98.63 | 98.29 | 97.95 |
| **COPPER REVENUE** | | | | | | | | | | | | | | |
| AVERAGE PERCENT PAID BY THE SMELTER | % | 97 | | | | | | | | | | | | |
| PAID COPPER BY SMELTER | Kt | | | 97.81 | 97.48 | 97.15 | 96.82 | 96.50 | 96.17 | 95.84 | 95.51 | 95.18 | 94.85 | 94.52 |
| COPPER SALES VALUE - REAL | $M | | | 630.97 | 619.10 | 607.69 | 596.24 | 584.66 | 573.15 | 561.61 | 550.23 | 539.01 | 527.94 | 517.04 |
| **LESS: OPERATING COST** | | | | | | | | | | | | | | |
| UNIT MINING COST | $/t | 10.63 | | | | | | | | | | | | |
| UNIT MILLING COST | $/t | 5.89 | | | | | | | | | | | | |
| UNIT PRODUCT SHIPPING COST | $/t | 1.93 | | | | | | | | | | | | |
| UNIT TREATMENT AND REFINING | $/t | 2.51 | | | | | | | | | | | | |
| **TOTAL OPERATING EXPENDITURE** | $/t | 20.95 | | | | | | | | | | | | |
| **TOTAL OPERATING EXPENDITURE - REAL** | $M | | | 332.67 | 331.55 | 330.43 | 329.32 | 328.20 | 327.08 | 325.96 | 324.85 | 323.73 | 322.61 | 321.49 |
| **GROSS MARGIN - REAL** | $M | | | 298.30 | 287.55 | 277.25 | 266.92 | 256.46 | 246.07 | 235.65 | 225.38 | 215.28 | 205.33 | 195.55 |
| **LESS: MINERAL ROYALTY** | | | | | | | | | | | | | | |
| MINERAL ROYALTY @ 9% - REAL | $M | | | 56.79 | 55.72 | 54.69 | 53.66 | 52.62 | 51.58 | 50.54 | 49.52 | 48.51 | 47.52 | 46.53 |
| **TAXABLE INCOME (LESS: LOSS CARRY FORWARD) - REAL** | $M | | | 241.51 | 231.83 | 222.56 | 213.26 | 203.84 | 194.49 | 185.10 | 175.86 | 166.77 | 157.82 | 149.02 |
| **LESS: CORPORATE INCOME TAX** | | | | | | | | | | | | | | |
| CORPORATE INCOME TAX @ 30% | | | | | | | | | | | | | | |
| CORPORATE INCOME TAX PAYABLE - REAL | $M | | | 72.45 | 69.55 | 66.77 | 63.98 | 61.15 | 58.35 | 55.53 | 52.76 | 50.03 | 47.35 | 44.70 |
| **LESS: OTHER TAXES** | | | | | | | | | | | | | | |
| WINDFALL TAX PAYABLE - REAL | $M | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VARIABLE PROFIT TAX PAYABLE - REAL | $M | | | 101.11 | 96.89 | 92.86 | 88.81 | 84.71 | 80.64 | 76.56 | 72.53 | 68.58 | 64.68 | 60.85 |
| **TOTAL DIRECT TAXES PAYABLE - REAL** | $M | | | 230.35 | 222.16 | 214.32 | 206.45 | 198.49 | 190.57 | 182.63 | 174.81 | 167.12 | 159.54 | 152.09 |
| **ADD: CARRY FORWARD LOSSES - REAL** | $M | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **LESS: CAPITAL EXPENDITURE - REAL** | $M | | | 33.27 | 33.16 | 33.04 | 32.93 | 32.82 | 32.71 | 32.60 | 32.48 | 32.37 | 32.26 | 32.15 |
| | | | ***Sustaining capital*** | ***Projected cash Flows*** | | | | | | | | | | |
| **COMPANY POST-TAX CASH FLOWS - REAL** | $M | | -100 | 34.68 | 32.23 | 29.89 | 27.54 | 25.16 | 22.79 | 20.42 | 18.08 | 15.79 | 13.53 | 11.31 |
| **COMPANY PRE-TAX CASH FLOWS - REAL** | $M | | -100 | 265.03 | 254.39 | 244.21 | 233.99 | 223.64 | 213.36 | 203.05 | 192.90 | 182.91 | 173.07 | 163.40 |
| **CASH STREAM TO THE GOVERNMENT- REAL** | $M | | | 230.35 | 222.16 | 214.32 | 206.45 | 198.49 | 190.57 | 182.63 | 174.81 | 167.12 | 159.54 | 152.09 |

# Appendix B

## RAW DATA OF ECONOMIC SPREADSHEET MODELING

### Table B-1: Simulated AETRs and Pre-tax NPVs

| PRICE FLACTUATION FACTORS | 2008 TAX REGIME | | 2009 TAX REGIME | | 2012 TAX REGIME | | 2015 TAX REGIME | | POST-2015 TAX REGIME | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AETR (%) | PRE-TAX NPV ($M) | AETR (%) | PRE-TAX NPV ($M) | AETR (%) | PRE-TAX NPV ($M) | AETR (%) | PRE-TAX NPV ($M) | AETR (%) | PRE-TAX NPV ($M) |
| **STATUS QUO SCENARIO** | | | | | | | | | | |
| **0.67** | 216 | 111.34 | 224 | 111.34 | 245 | 111.34 | 485 | 111.34 | 273 | 111.34 |
| **0.7** | 116 | 265.42 | 156 | 265.42 | 162 | 265.42 | 219 | 265.42 | 170 | 265.42 |
| **0.75** | 89 | 419.5 | 135 | 419.5 | 140 | 419.5 | 149 | 419.5 | 146 | 419.5 |
| **0.8** | 77 | 573.58 | 126 | 573.58 | 130 | 573.58 | 116 | 573.58 | 135 | 573.58 |
| **0.85** | 70 | 727.66 | 120 | 727.66 | 124 | 727.66 | 97 | 727.66 | 128 | 727.66 |
| **0.9** | 65 | 881.74 | 117 | 881.74 | 120 | 881.74 | 85 | 881.74 | 123 | 881.74 |
| **0.95** | 62 | 1035.82 | 115 | 1035.82 | 117 | 1035.82 | 76 | 1035.82 | 120 | 1035.82 |
| **1** | 59 | 1189.9 | 113 | 1189.9 | 115 | 1189.9 | 70 | 1189.9 | 118 | 1189.9 |
| **1.2** | 54 | 1806.22 | 108 | 1806.22 | 111 | 1806.22 | 55 | 1806.22 | 113 | 1806.22 |
| **1.4** | 51 | 2422.53 | 107 | 2422.53 | 108 | 2422.53 | 48 | 2422.53 | 110 | 2422.53 |
| **1.6** | 50 | 3038.85 | 105 | 3038.85 | 107 | 3038.85 | 44 | 3038.85 | 109 | 3038.85 |
| **1.8** | 49 | 3655.17 | 105 | 3655.17 | 106 | 3655.17 | 41 | 3655.17 | 108 | 3655.17 |
| **2** | 47 | 4887.81 | 104 | 4887.81 | 105 | 4887.81 | 37 | 4887.81 | 106 | 4887.81 |
| **2.2** | 47 | 5504.12 | 103 | 5504.12 | 105 | 5504.12 | 36 | 5504.12 | 106 | 5504.12 |
| **WORST CASE SCENARIO** | | | | | | | | | | |
| **0.67** | 205 | 105.55 | 213 | 105.55 | 231 | 105.55 | 447 | 105.55 | 255 | 105.55 |
| **0.7** | 113 | 243.22 | 151 | 243.22 | 157 | 243.22 | 243 | 243.22 | 165 | 243.22 |
| **0.75** | 87 | 380.89 | 132 | 380.89 | 137 | 380.89 | 143 | 380.89 | 143 | 380.89 |
| **0.8** | 75 | 518.56 | 123 | 518.56 | 127 | 518.56 | 112 | 518.56 | 131 | 518.56 |
| **0.85** | 68 | 656.23 | 118 | 656.23 | 121 | 656.23 | 94 | 656.23 | 125 | 656.23 |
| **0.9** | 64 | 793.9 | 114 | 793.9 | 118 | 793.9 | 82 | 793.9 | 121 | 793.9 |
| **0.95** | 61 | 931.57 | 112 | 931.57 | 115 | 931.57 | 74 | 931.57 | 118 | 931.57 |
| **1** | 58 | 1069.24 | 110 | 1069.24 | 113 | 1069.24 | 68 | 1069.24 | 115 | 1069.24 |
| **1.2** | 52 | 1619.93 | 106 | 1619.93 | 108 | 1619.93 | 54 | 1619.93 | 110 | 1619.93 |
| **1.4** | 50 | 2170.61 | 104 | 2170.61 | 106 | 2170.61 | 47 | 2170.61 | 108 | 2170.61 |
| **1.6** | 49 | 2721.29 | 103 | 2721.29 | 105 | 2721.29 | 43 | 2721.29 | 106 | 2721.29 |
| **1.8** | 48 | 3271.97 | 102 | 3271.97 | 104 | 3271.97 | 40 | 3271.97 | 105 | 3271.97 |
| **2** | 46 | 4373.34 | 101 | 4373.34 | 103 | 4373.34 | 37 | 4373.34 | 104 | 4373.34 |
| **2.2** | 46 | 4924.02 | 101 | 4924.02 | 102 | 4924.02 | 35 | 4924.02 | 104 | 4924.02 |

**Table B-2: Tax revenue inflow to the government based on the status quo and worst case scenario**

| MINERAL TAXATION REGIME | 2008 | 2009 | 2012 | 2015 | POST-2015 |
|---|---|---|---|---|---|
| **STATUS QUO SCENARIO** | | | | | |
| **YEAR** | **REVENUE ($ MILLION)** | | | | |
| **2015** | 122.65 | 220.89 | 225.62 | 126.19 | 230.35 |
| **2016** | 116.91 | 212.88 | 217.52 | 123.82 | 222.16 |
| **2017** | 111.33 | 205.20 | 209.76 | 121.54 | 214.32 |
| **2018** | 105.76 | 197.51 | 201.98 | 119.25 | 206.45 |
| **2019** | 100.16 | 189.72 | 194.10 | 116.93 | 198.49 |
| **2020** | 94.60 | 181.97 | 186.27 | 114.63 | 190.57 |
| **2021** | 89.04 | 174.21 | 178.42 | 112.32 | 182.63 |
| **2022** | 83.55 | 166.56 | 170.69 | 110.05 | 174.81 |
| **2023** | 78.12 | 159.03 | 163.08 | 107.80 | 167.12 |
| **2024** | 72.97 | 151.63 | 155.58 | 105.59 | 159.54 |
| **2025** | 69.52 | 144.33 | 148.21 | 103.41 | 152.09 |
| **WORST CASE SCENARIO** | | | | | |
| **YEAR** | **REVENUE ($ MILLION)** | | | | |
| **2015** | 82.14 | 126.81 | 130.59 | 100.96 | 134.38 |
| **2016** | 77.16 | 120.57 | 124.28 | 99.06 | 128.00 |
| **2017** | 72.32 | 114.60 | 118.24 | 97.23 | 121.89 |
| **2018** | 67.48 | 108.61 | 112.19 | 95.40 | 115.76 |
| **2019** | 62.63 | 102.54 | 106.05 | 93.55 | 109.56 |
| **2020** | 57.80 | 96.52 | 99.96 | 91.70 | 103.39 |
| **2021** | 52.98 | 90.47 | 93.84 | 89.86 | 97.21 |
| **2022** | 48.22 | 84.52 | 87.82 | 88.04 | 91.12 |
| **2023** | 43.52 | 78.67 | 81.90 | 86.24 | 85.14 |
| **2024** | 39.08 | 72.91 | 76.08 | 84.47 | 79.24 |
| **2025** | 36.33 | 67.24 | 70.35 | 82.73 | 73.45 |

**Table B-3: Simulated post-tax NPVs for Lumwana Mine**

| MINERAL TAXATION REGIME | 2008 TAX REGIME | 2009 TAX REGIME | 2012 TAX REGIME | 2015 TAX REGIME | POST-2015 TAX REGIME |
|---|---|---|---|---|---|
| PRICE FLACTUATION FACTORS | STATUS QUO SCENARIO | | | | |
| | NPV ($M) | NPV ($M) | NPV ($M) | NPV ($M) | NPV ($M) |
| **-18** | -207426.9 | -89807.72 | -87139.45 | -171432 | -84471.19 |
| **-17** | -196266.7 | -89977.74 | -82457.71 | -162268 | -79937 |
| **-16** | -185106.5 | -80147.77 | -77775.97 | -153104 | -75404.18 |
| **-15** | -173946.3 | -75317.79 | -73094.23 | -143940 | -70870.68 |
| **-14** | -162786.09 | -70487.81 | -68412.49 | -134775 | -66337.18 |
| **-12** | -140465.69 | -60827.86 | -59049.02 | -116447 | -57270.17 |
| **-9** | -106985.08 | -46337.93 | -45003.8 | -88954.3 | -43669.66 |
| **-8** | -95824.88 | -41507.95 | -40322.06 | -79790.1 | -39136.16 |
| **-7** | -84664.68 | -36677.98 | -35640.32 | -70625.8 | -34602.66 |
| **-5** | -62344.28 | -27018.03 | -26276.84 | -52297.4 | -25535.65 |
| **-4** | -51184.67 | -22188.05 | -21595.1 | -43133.2 | -21002.15 |
| **-3** | -40023.87 | -17358.07 | -16913.36 | -33968.9 | -16468.65 |
| **-2** | -28863.67 | -12528.1 | -12231.62 | -24804.7 | -11935.15 |
| **-1** | -17703.47 | -7698.12 | -7549.88 | -15640.5 | -7401.65 |
| **-0.9** | -16587.45 | -4665.12 | -7081.71 | -14724.1 | -6948.3 |
| **1.0** | 654.5 | 182.36 | 159.25 | 573.58 | 136.14 |
| **5** | 9024.1 | 3319.42 | 3203.86 | 10434.67 | 3088.3 |
| **10** | 19486.1 | 7240.74 | 7009.62 | 22761.03 | 6778.51 |
| **15** | 29948.09 | 11162.07 | 10815.39 | 35087.38 | 10468.71 |
| **20** | 40410.09 | 15083.39 | 14621.15 | 47413.74 | 14158.91 |
| **25** | 50872.09 | 19004.71 | 18426.91 | 59740.1 | 17849.12 |
| **30** | 61334.08 | 22926.03 | 22232.68 | 72066.46 | 21539.32 |
| **35** | 71796.08 | 26847.36 | 26038.44 | 84392.82 | 25229.52 |
| **40** | 82258.08 | 30768.68 | 29844.2 | 96719.17 | 28919.73 |
| **45** | 92720.07 | 34690 | 33649.97 | 109045.5 | 32609.93 |
| **50** | 103182.07 | 38611.33 | 37455.73 | 121371.9 | 36300.13 |
| **55** | 113644.07 | 42532.65 | 41261.49 | 133698.3 | 39990.34 |
| **60** | 124106.06 | 46453.97 | 45067.26 | 146024.6 | 43680.54 |
| **65** | 134568.06 | 50375.29 | 48873.02 | 158351 | 47370.74 |
| **70** | 145030.06 | 54296.62 | 52678.78 | 170677.3 | 51060.95 |
| **WORST CASE SCENARIO** | | | | | |
| **-18** | -173495.32 | -73730.24 | -71541.38 | -143355 | -69352.51 |
| **-17** | -164158.3 | -69765.35 | -67698.09 | -135692 | -65630.84 |
| **-16** | -154824.28 | -65800.47 | -63854.81 | -128029 | -61909.16 |
| **-15** | -145490.27 | -61835.58 | -60011.53 | -120366 | -58187.48 |
| **-14** | -136156.25 | -57870.7 | -56168.25 | -112702 | -54465.8 |
| **-12** | -117488.22 | -49940.93 | -48481.69 | -97376.1 | -47022.45 |
| **-9** | -89486.17 | -38046.27 | -36951.84 | -74386.6 | -35857.41 |
| **-8** | -80152.15 | -34081.39 | -33108.56 | -66723.5 | -32135.73 |
| **-7** | -70818.14 | -30116.5 | -29265.28 | -59060.3 | -28414.05 |

| | | | | | |
|---|---|---|---|---|---|
| **-5** | -52150.11 | -22186.73 | -21578.71 | -43734 | -20970.7 |
| **-4** | -42816.09 | -18221.85 | -17735.43 | -36070.9 | -17249.02 |
| **-3** | -33482.07 | -14256.96 | -13892.15 | -28407.7 | -13527.34 |
| **-2** | -24148.06 | -10292.08 | -10048.87 | -20744.6 | -9805.66 |
| **-1** | -14814.04 | -6327.19 | -6205.59 | -13081.4 | -6083.98 |
| **-0.9** | -13880.64 | -5930.7 | -5821.26 | -12315.1 | -5711.82 |
| **1.0** | 587.21 | 164.87 | 144.22 | 518.56 | 123.57 |
| **5** | 8065.48 | 2967.85 | 2864.59 | 9329.48 | 2761.34 |
| **10** | 17413.32 | 6471.56 | 6265.06 | 20343.13 | 6058.55 |
| **15** | 26761.16 | 9975.28 | 9665.52 | 31356.79 | 9355.76 |
| **20** | 36108.99 | 13479 | 13065.99 | 42370.44 | 12652.98 |
| **25** | 45456.83 | 16982.72 | 16466.45 | 53384.09 | 15950.19 |
| **30** | 54804.67 | 20486.44 | 19866.92 | 64397.74 | 19247.4 |
| **35** | 64152.51 | 23990.15 | 23267.38 | 75411.39 | 22544.61 |
| **40** | 73500.34 | 27493.87 | 26667.85 | 86425.05 | 25841.82 |
| **45** | 82848.18 | 30997.59 | 30068.31 | 97438.7 | 29139.04 |
| **50** | 92196.02 | 34501.31 | 33468.78 | 108452.4 | 32436.25 |
| **55** | 101543.85 | 38005.03 | 36869.24 | 119466 | 35733.46 |
| **60** | 110891.69 | 41508.74 | 40269.71 | 130479.7 | 39030.67 |
| **65** | 120239.53 | 45012.46 | 43670.17 | 141493.3 | 42327.88 |
| **70** | 129587.36 | 48516.18 | 47070.64 | 152507 | 45625.1 |

**Table B-4: Simulated government NPVs**

| MINERAL TAXATION REGIME | 2008 TAX REGIME | 2009 TAX REGIME | 2012 TAX REGIME | 2015 TAX REGIME | POST-2015 TAX REGIME |
|---|---|---|---|---|---|
| **PRICE FLACTUATION** | | | | | |
| **STATUS QUO SCENARIO** | | | | | |
| | **NPV ($M)** | **NPV ($M)** | **NPV ($M)** | **NPV ($M)** | **NPV ($M)** |
| **1.2** | 974.28 | 1961.00 | 1999.23 | 997.36 | 2036.63 |
| **1.3** | 1107.67 | 2271.63 | 2312.15 | 1080.47 | 2352.67 |
| **1.4** | 1241.07 | 2581.44 | 2625.07 | 1163.58 | 2668.71 |
| **1.5** | 1374.47 | 2891.24 | 2937.99 | 1246.70 | 2984.74 |
| **1.6** | 1507.86 | 3201.05 | 3250.91 | 1329.81 | 3300.78 |
| **1.7** | 1641.26 | 3510.85 | 3563.83 | 1412.92 | 3616.82 |
| **1.8** | 1774.66 | 3820.65 | 3876.76 | 1496.04 | 3932.86 |
| **1.9** | 1908.05 | 4130.46 | 4189.68 | 1579.15 | 4248.89 |
| **2.0** | 2041.45 | 4440.26 | 4502.60 | 1662.26 | 4564.93 |
| **2.1** | 2174.85 | 4750.07 | 4815.52 | 1745.37 | 4880.97 |
| **WORST CASE SCENARIO** | | | | | |
| **1.2** | 857.05 | 1720.78 | 1753.47 | 726.27 | 1786.15 |
| **1.3** | 973.61 | 1991.50 | 2026.91 | 944.16 | 2062.31 |
| **1.4** | 1090.18 | 2262.22 | 2300.35 | 1016.78 | 2338.48 |
| **1.5** | 1206.75 | 2532.94 | 2573.79 | 1089.41 | 2614.65 |
| **1.6** | 1323.31 | 2803.66 | 2847.23 | 1162.04 | 2890.81 |
| **1.7** | 1439.88 | 3074.38 | 3120.68 | 1234.67 | 3166.98 |
| **1.8** | 1556.45 | 3345.10 | 3394.12 | 1307.29 | 3443.14 |
| **1.9** | 1673.02 | 3615.81 | 3667.56 | 1379.92 | 3719.31 |
| **2.0** | 1789.58 | 3886.53 | 3941.00 | 1452.55 | 3995.47 |
| **2.1** | 1906.15 | 4157.25 | 4214.45 | 1525.18 | 4271.64 |

# Appendix C

## DATA COLLECTION TOOLS

**Table C-1: Checklist**

| CHECKLIST ITEM | COLLECTED | NOT COLLECTED |
|---|---|---|
| Annual Production values of Lumwana Mine (Kt) | | |
| Cut-off grade (%) - Copper | | |
| Metallurgical recovery (%) - Copper | | |
| Concentrator capacity (Tons per annum) | | |
| Average mining cost ($/t) | | |
| Average concentrator cost ($/t) | | |
| Average smelter cost ($/t) | | |
| Average shipping cost ($/t) | | |
| Operating expenditure ($) | | |
| Lumwana Mine hurdle rate (%) | | |
| Government discount rate (%) | | |
| 2008, 2009, 2012 and 2015 and Post-2015 mineral tax structures | | |
| Tax incentives given to Lumwana Mine | | |
| Forecasted copper price ($/t) | | |
| Forecast of US dollar inflation rate (%) | | |
| Capital expenditure ($) | | |

# Appendix D

**FORECAST OF COPPER PRICES AND US INFLATION RATE**

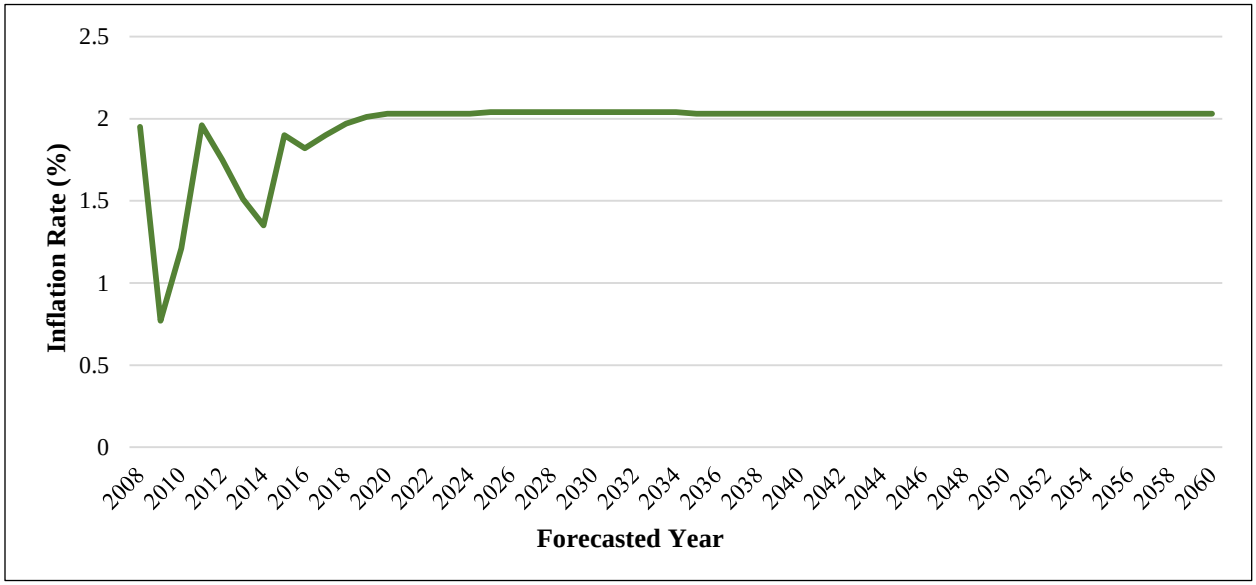


**Figure D-1: OECD Long Term Forecast of US inflation (Knoema, 2015)**

**Table D-1: World Bank copper price forecast in real 2010 U.S. dollars (World Bank, 2014)**

| YEAR | FORECASTED COPPER PRICE |
|---|---|
| 2013 | 6913 |
| 2014 | 6489 |
| 2015 | 6451 |
| 2016 | 6351 |
| 2017 | 6255 |
| 2018 | 6158 |
| 2019 | 6059 |
| 2020 | 5960 |
| 2021 | 5860 |
| 2022 | 5761 |
| 2023 | 5663 |
| 2024 | 5566 |
| 2025 | 5470 |