

**RISK MANAGEMENT ASSOCIATED
WITH TARIFF-LINKED AGREEMENTS**

**RISK MANAGEMENT ASSOCIATED WITH
TARIFF-LINKED AGREEMENTS**

by

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submitted in fulfilment of the requirements for
the degree of

MASTER OF COMMERCE

in the subject

BUSINESS ECONOMICS

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: Prof E. BEGEMANN

JANUARY 2004

ABSTRACT

The study focuses on tariff-linked (or commodity-linked) agreements entered into between a power utility and commodity producers. The main purpose of these types of agreements is to link electricity tariff payable by commodity producers to the price of the commodity produced thereby transferring a certain level of commodity price risk to the power utility.

The study looks at risk management practices of a power utility company with a particular reference to tariff-linked agreements. Also, the study critically analyses risk hedging mechanisms put in place by the power utility. The report makes practical recommendations, where applicable, in dealing with these risks.

Risk management continuously evolve to meet the challenges of complex financial world. Despite the latest sophisticated risk management tools available commodity producers still encounter difficulties to hedge the price risk. The challenge for the power utility is the application of new risk management tools to effectively manage price risk.

Key terms :

Risk Management; Tariff-Linked Agreements; Price risk; Financial risk; Commodity price risk; Market risk; Electricity tariff; Commodity price; Commodity-Linked Agreement; Commodity hedging.

DECLARATION

I declare that Risk Management associated with Tariff-Linked Agreements is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. It is submitted in fulfilment of the requirements of the degree of Master of Commerce at the University of South Africa, Pretoria. It has not been submitted before for any degree or examination in any other university.

Tsatsi Jonas Mahlatsi

January, 2004

ACKNOWLEDGEMENTS

I would like to sincerely thank all those who assisted me in the completion of this research report. I would especially like to thank the following people:

- Prof. E. Begemann, my supervisor for his guidance, support and encouragement;
- Dr Enoch Zulu Xaba, my mentor, for his invaluable contribution;
- CJ du Plessis, Unisa librarian, for her patience and understanding.

I would like to thank my wife for her unwavering support, understanding and patience throughout the study.

This report is dedicated to my late mother for her support as I progressed over the years with my studies. If it weren't for her encouragement I wouldn't have managed to be where I am today.

Finally, I would like to thank the lord for guiding me through the study.

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CHAPTER 1: INTRODUCTION

1.1 Background

Commodity prices are, generally, very volatile and this normally leads to instability and uncertainty for both producers and consumers alike. Any firm that either produces or consumes significant amounts of commodities, such as, crude oil, gold, aluminium and others is exposed to commodity price risk. According to Galitz (1995:452), *Commodity price risk* arises where a firm is affected by fluctuations in the price of the commodity. Galitz (1995:453), noted that to many of these firms such an exposure is a necessary and unavoidable feature of their business. These firms either transfer the price risk to wholesalers and retail consumers or apply risk-hedging tools in mitigating the risk.

Priovolos & Duncan (1991:1), believe that commodity producers' exposure to price risk and their limited ability to deal with this risk effectively requires them to be innovative in reducing or eliminating a potential financial loss. Generally, consumers are price takers and in majority of cases where they consume a significant amount of a particular commodity they are left with no choice but to hedge themselves against price fluctuations. On the other hand, because commodity producers' revenue is subject to price fluctuations, it is necessary for them to reduce some of the input costs where possible. For producers, electricity constitutes a major component of the production costs. This is the reason why some of the producers in South Africa have entered into a number of commodity-linked agreements with the power utility. With this mechanism the producers can both reduce their cost of electricity in times of low prices and partly transfer the market risk to the power utility.

For the power utility, commodity price risk originates from tariff-linked agreements as well as from the power utility's use of commodities as an input in its business. The fundamental principle underlying the agreements entered into between the power utility and producers is to link the electricity tariff payable to the price of the relevant commodity. The power utility being the synthetic holder of the commodity, in these types of agreements, is therefore exposed to the respective price fluctuations. As a result,

the power utility is required to hedge itself against the price fluctuations. The study looks at the risk mitigation tools and techniques applied by the power utility and their effectiveness in hedging risk exposures resulting from the tariff-linked agreements.

1.2 The need for the study and the importance of the findings

The study would be valuable to the power utility because it will identify all risks associated with tariff-linked agreements as well as the nature and extent of risks it assumes. The study aims to make the power utility aware of existing shortcomings with respect to risk management strategies it applies on current contracts and how best can these shortcomings be overcome in the future. The findings of the study will lead to the power utility either renegotiating some of the current contracts or reviewing existing hedging mechanisms in place.

The study is important to highlight some of the limitations encountered in practice with regard to the risk management techniques currently applied by the power utility. The study is intended to serve as a future source of reference for the power utility. It will help in identifying different risk management approaches the power utility could consider applying, in the future, when hedging risks emanating from similar types of agreements.

1.3 Problem formulation

The power utility has tariff-linked agreements with a number of its key customers. Some of the commodities produced by these customers are tradable on the London Metal Exchange (LME) and others are sold over-the-counter. Commodities sold over-the-counter makes it difficult for firms to apply effective risk hedging strategies because there is no forward market to hedge them against the price fluctuations.

During 2002 a power utility company performed an internal investigation with respect to a tariff-linked agreement it has with a major commodity producer. The commodity thereof is sold over-the-counter and not on an exchange market. A key finding reached

was that a risk inherent could not be sufficiently hedged by a synthetic index constructed from other base metals (e.g. Aluminium, Copper etc.). Suppose the power utility has opted to hedge the commodity through a synthetic hedge the power utility would have been exposed to an unexpectedly high level of basis risk.

1.4 The objectives of the study

The primary objective of the study is to investigate the effectiveness of the risk management strategies applied by the power utility with reference to tariff-linked agreements.

In addition, the other *key objectives* of this study are:

- To investigate tariff-linked agreements in place with the aim of understanding fully the inherent risks associated with these types of agreements;
- To establish the risk quantification techniques and methods applied by the power utility in measuring the market risk;
- To investigate the magnitude of the firm's risk exposure as a result of tariff-linked agreements.

1.5 Research Methodology

This section provides a comprehensive discussion on the research methodology employed in the sampling, collection and analysis of data required for this research. The research approach of this study is based on determining the effectiveness of existing risk management strategies applied by the power utility with respect to financial risks associated with tariff-linked agreements.

The primary source of data is based on empirical study conducted on tariff-linked agreements and unstructured interviews with junior and senior officers within the power utility. The secondary data is gathered through literature review.

The following details are relevant to the research methodology:

- The universe of this research is defined as all tariff-linked agreements entered between the power utility and commodity producers.
- The information was collected via in-depth interviews, scrutiny of various agreements, and review of existing studies, books, publications and market data.
- The unstructured interviews conducted established the background behind the agreements and an understanding of hedging strategies implemented by the power utility.
- The interview technique allowed flexibility for the probing of interesting areas and to clarify certain information.
- The participants interviewed are junior and senior officers within the power utility and are selected on the basis of their expertise and perceived knowledge of the background behind various agreements.

1.6 Limitations of the research

The study is subject to the following limitations:

- The research is based on the investigation of tariff-linked agreements, which by their nature are confidential. Access to some of the agreements requires full cooperation from the power utility.
- The current research and development of some of the present risk quantification tools being applied in practice is a limiting factor if unknown improvement has been made on some of the shortcomings.
- The relevance or irrelevance of the literature that is consulted may limit the completeness of findings of the study.
- The study is based on the power utility's experience therefore the findings of the study might not necessarily hold true for other firms in a similar position.
- Due to the long-term nature of the contracts, relevant and reliable forward pricing data is unavailable to determine the mark-to-market exposure of the hedging instruments. As a result, the pricing thereof is not covered in the study.

- Selective financial information with regard to agreements will be provided in the report because of the confidentiality of the information.
- The study will not attempt to develop or design new risk management tools but to recommend proper usage of some of the available tools.

1.7 Outline of the research report

The research report is divided into four chapters. Chapter 1 covers the background, problem formulation, the need for the study, the importance of the findings, the research methodology and the limitations of the study. The review of risk management literature and other related area to facilitate an understanding of risk management concepts is undertaken in Chapter 2 whilst Chapter 3 will review various tariff-linked agreements. Finally, Chapter 4 lays out summary of the findings and recommendations of the study.

CHAPTER 2: REVIEW OF RELATED RISK MANAGEMENT LITERATURE AND ENVIRONMENT

2.1 Introduction

Chapter 1 have identified the purpose of the study and described the research methodology used to obtain the research findings. This chapter will discuss risk management and related areas. There are plenty of books and journal articles written on risk management and related topics. The focus in this chapter will be to review all the relevant literature with the object of facilitating the understanding of the basic concepts of risk management, derivative jargon and the latest developments in commodity risk management. The chapter will also discuss the market risk and review some of the methods the power utility may apply in mitigating the risk.

2.2 Risk Management

In Chapter 1 it was pointed out that a key finding, from an internal investigation instituted, by the power utility company was that it is exposed to an unexpectedly high basis risk, from one of the tariff-linked agreements, which could not be sufficiently hedged by a synthetic index constructed from other metals. Lately some companies have experienced financial losses because of synthetic hedges. The noteworthy story, is a Business Report article (11 February 2003:p1) about agricultural group, Afgri, that had expelled three of its trading executives for operating what the general manager, Jeff Wright, called a "synthetic hedge", and which had cost the group R110 million. Wright said the traders had hedged yellow maize contracts on the white maize market. This is a lesson to the utility company and other companies that the correct hedging instruments should be applied, if not, there is a risk of incurring financial losses. The best approach is that all known risks assumed by a firm should be continually assessed and managed.

According to Du Toit and Van Rooyen (1998:v) historically, risk management focused on the adverse consequences of risk. They also point out that risk management is evolving to a position where the management of all risks and consequences of risk is

being done in a more integrated and coordinated fashion. In the past risk management was also a confined process in which midlevel professionals were charged with minimizing losses. According to Dowd (1998:4), both the theory and practice of risk management have developed enormously in the last two and a half decades. He noted that theory has developed to the point where risk management is now regarded as a sub-field of the theory of finance. The impetus behind the growth of risk management is as a result of financial losses suffered in the 1990s and technological sophistication. The term risk management does not have a universally agreed definition. In this study by 'Risk Management' we refer to the complete set of policies and procedures, which organisations have in place to manage, monitor and control their exposure to risk.

Even though risk management is increasingly assuming vital role within financial institutions, the effective application of risk management tools and the actual understanding of financial risk continue to be problematic. In parallel with the establishment of an effective structure for risk management, the firm also has to ensure that it has in place a comprehensive risk management process. According to Du Toit and Van Rooyen (1998:31) financial risk management process has the following steps:

- 1) **Identification.** This step involves the identification of the risk.
- 2) **Risk evaluation.** This step involves determining the size and frequency of possible losses.
- 3) **Determine strategy.**
- 4) **Implement.** This involves implementing the chosen alternative to control and finance the risk.
- 5) **Monitor.** During this step the handling methods are monitored and revised to ensure that the desired result is obtained.

The most important question that comes to mind is why should firms manage financial risk. The need to manage financial risk is important because of the potential financial loss firms may incur should this form of risk not be effectively managed. The objective of the power utility's market risk management is to ensure that the power utility and its electricity customers are not exposed to undue financial risk. The management of market risk takes place within the power utility's centralised treasury function and adheres

substantially to the ¹Group of Thirty (G30) recommendations, in particular, to the requirements that the functions of risk assessment and risk management be completely segregated.

The power utility's risk assessment function takes the responsibility for the identification, measurement, reporting and monitoring of market risk. By ensuring that the necessary processes and tools are in place, the risk assessment function seeks to identify potential risks at an early stage so that the information can be supplied timeously to the risk committee. According to Rouyer (2002:3) the objective of risk management is to determine to what extent a firm has developed a comprehensive risk management framework and is operating in a manner that is consistent with its risk appetite.

Based on the information supplied by the power utility's risk assessment function, the power utility's treasury Asset and Liability Committee (ALCO) meets regularly to review and, if appropriate, approve the implementation of optimal strategies for the effective management of the power utility's commodity, liquidity, credit, currency and interest rate risks. The power utility use advanced risk evaluation procedures and, amongst others, VAR methodologies, Scenario analysis and Stress testing are also used extensively. According to an article by Sooran (1999:1) the following modern techniques are applied to measure financial price risk:

- Value at Risk
- Scenario analysis
- Stress Analysis
- Monte Carlo Simulation
- Sensitivity Analysis
- Duration
- Present Value of a Basis Point
- Risk Hole Identification
- Risk Adjusted Returns on Capital (RAROC)

¹ The Group of Thirty (G30) is a private, non-profit association, consisting of senior representatives of the private and public sector and of academia.

From the above, the power utility applies the following techniques for quantifying financial price risk:

- Value at Risk
- Scenario analysis
- Stress Analysis
- Monte Carlo Simulation
- Sensitivity Analysis

As stated earlier, the techniques are complementary therefore it is advisable that they should be applied in combination to be able to analyse all scenarios.

An in-depth discussion of Value at Risk, Scenario Analysis and Stress Analysis is covered later in the chapter. Sooran (1999:1) also noted that it very important, for the risk manager, to understand that the above techniques are complementary and none of them can be used on their own exclusively. The risk manager has to apply the techniques simultaneously to be able to analyse every scenario. Huisman *et al.* (1998:47) believes that the quest for reliable risk management techniques has grown in response to higher volatility and instability on global financial markets compounded by the enormous growth in trading activity and international exposure. This has lead to more sophisticated financial instruments, such as derivates. Derivatives are traded in private, *Over-The-Counter* (OTC) markets, or on organised exchanges.

2.3 Developments in Risk Management

2.3.1 Derivatives

Derivatives are transforming the way in which financial markets hedge, price and evaluate financial risks. Derivatives could be useful to the power utility in hedging financial risks. Over the past three decades, the growth of derivatives has been phenomenal. Until 1972 the only derivatives traded were certain commodity futures and various forwards and options that were traded over the counter. Then, in May 1972, the Chicago Mercantile Exchange started trading foreign currency futures contracts.

Hull (2000:1) defines a *derivative* (or derivative security) as a financial instrument whose value depends on the values of other, more basic underlying variables. Instruments, such as, forwards, futures, swaps, and options are regarded as fundamental building blocks of capital markets and can be broadly classified into categories: linear and non-linear instruments. The first category of instruments belongs to forward contracts, futures, and swaps. The second category belongs to options. These instruments are discussed at length in the next chapter.

According to Hull (2000:623), when valuing a derivative it is customary to assume that there is no risk of default. For an exchange-traded option, this assumption is usually a reasonable one because most exchanges have been very successful in organising trading to ensure that their contracts are always honoured. Unfortunately, the no-default assumption is far less defensible in the over-the-counter market. One problem is to determine how the prices of contracts should be adjusted to reflect the risk that the counterparty might default. We know that a bond issued by a company with a good credit rating sells for a higher price than a similar bond issued by a company that has a poor credit rating. It is common practice to categorize credit risks as either acceptable or unacceptable and then to price all acceptable credit risks in much the same way.

Derivatives are instruments designed to manage financial risks effectively. Derivatives are important financial instruments, however, misuse, misunderstanding, mispricing of these instruments have in the past lead to devastating losses. Notable examples are, Asia's 1997 market turmoil, Russia's 1998 default, and near collapse of Long-Term Capital Management to name but the few. These disasters constantly remind us that companies are not immune from risk. Jorion (2001:31) noted that, overtime, the industry did respond in various ways to these episodes of financial disasters by periodically improving risk-management techniques and, sometimes belatedly, realizing their limitations. Some limitations are, or should be, obvious.

According to Jorion (2001:31), financial disasters that occurred over the years are enlightening for they have one element in common, poor management of financial risks. The industry has over the past decade developed new financial instruments and risk management tools to improve the management of downside risk. Jorion (2001:33) also noted that since derivatives are particularly effective tools to hedge and speculate, they

can lead to large losses if used inappropriately. The collapse of Enron shows that despite the developments of risk management tools financial disaster continued to happen. The latest significant method to measure financial market risk that was developed in response to the financial disaster of the early 1990 is *value at risk* (VAR). Jorion (2001:33) noted that the VAR methodology has spread well beyond derivatives and is totally changing the way institutions approach their financial risk.

Jorion (2001:33), believe that the problem is not the financial tools, but the people who use them. While many financial tools are new, the problem of people acting fraudulently, or just irresponsibly, has always existed. Jorion (2001:33) also noted that in the past, risks were unleveraged, so trading losses were limited. Losses that incurred then might have cost a few individuals their careers, but they would rarely make the newspaper headlines.

2.3.2 Integrated Risk Management

According to Rahl and Lee (2000:20), the current focus areas of risk management include expanded stress testing, integration of market and credit risks. Rahl and Esseghaier (2000:45) believe that measuring and monitoring risk at a firm-wide level has increased the focus on quantification and the need for a consistent firm-wide approach. Traditionally risk was managed on an individual basis, that is, market risk on its own and credit risk also on its own. According to Das (1999:986) deficiencies identified in traditional approaches to risk management led to institutions examining more integrated approaches to risk management of derivative portfolios. Das (1999:986) noted that central to this concept is management of risk on an aggregate basis. This aggregation effectively amalgamates similar instruments as follows:

- All non-option interest products in a given currency;
- All option products in a given currency;
- Currency exposures.

Under this approach, all cash flows within each portfolio are partitioned by their dates into time periods (often referred to as buckets or vectors) as a result of complex financial

products, an increasing number of instruments now mix different types of risks. Credit derivatives, for instance, involve both market and credit risk. So are tradable loans. Jorion (2001:474) believes that these risk interactions created a need for integrated risk-management systems.

According to Jorion (2001:472) Enterprise-wide risk management (ERM), or integrated risk management, aims at measuring, controlling, and managing the overall risk of the institution across all risk categories and business lines. Enterprise risk management is about optimizing the process with which risks are taken. For example, instead of hedging an exposure of both expected revenue and expenditure a net exposure could be hedged. Although this is a very simplistic example ERM is broader than that.

According to Holton (1998:24-28) firms are embracing enterprise risk management because it makes good business sense. Today, they actively make the decision to change the way they take risks. They implement innovative procedures. They install new technology. Lastly, they actively reshape their corporate culture to facilitate better risk taking. Implementing an effective strategy of enterprise risk management is not easy, and for each organization, it is different. There are, however, three fundamental elements, which should comprise any risk management strategy:

- Corporate culture
- Procedures
- Technology

The importance of each of these will vary depending upon the needs of a firm. Most importantly firms should inculcate a culture of risk management in their employees. Firms should also implement the necessary procedures to be followed.

2.3.3 Risk Standards

In the fall of 1996, the Risk Standards for Institutional Investment Managers and Institutional Investors were formally released to the investment community. Since their release, the risk standards have gained wide exposure and acceptance as a defining set of best practices for institutional industry.

According to Rahl and Lee (2000:20), Quantitative methods used to measure and manage risk, including Value-at-Risk (VAR) and Stress Testing have evolved significantly in recent years. While important, quantitative methods represent only one-third of the risk standards recommended by the Risk Standard Working Group (Capital Market Risk Advisors, inc, in New York). The remaining two-thirds of the risk standards are intended to promote awareness and active decision-making. Risk due to new forms of fraud, paradigm changes in markets, new market moves, surprise regulatory infrastructure changes, and “act of God” equivalents are examples of events beyond risk management and should be as small as possible. Below are the risks standards recommend by the Risk Standard Working Group (Capital Market Risk Advisors, inc, in New York).

Table 1: Risk Management Framework

Value-at-Risk Independent Risk Oversight Credit Risk Guidelines - Random Audits - Limits - Risk Attribution Analysis - Dynamic Updating - Checks and Balances Education and Knowledge Complex Structure Pricing - Multi-dimensional Risk Monitoring Guidelines for Hedging Activity	Guidelines for Liabilities/Borrowing Activity Guidelines for Assets/Investments - Procedures and Policies - Controls - Marginal Impact of Business Areas - Systems - Stress testing Timely info. Reporting - Risk-adjusted Return Measures - Receivables/Payables Hedging Guidelines
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Source: Beder. (January 1996:2). *Corporate Cashflow. Cracking the whip: Derivatives Under Control*. Capital Market Risk Advisors, inc, in New York.

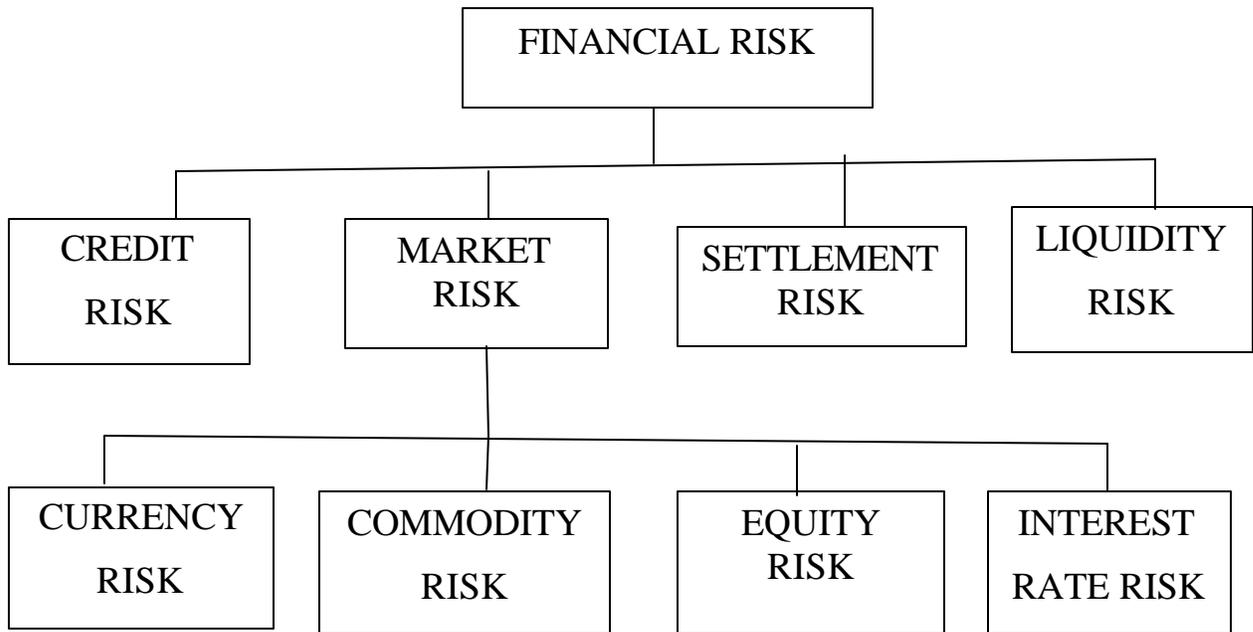
2.4 Understanding Risk

It is necessary to understand exactly what is meant by risk before risk can be managed. For risk managers to be able to manage financial risk effectively, it is important to know what it is and which steps are applicable to manage the financial risk. What is risk? When one talk about risk, people in general, have different understanding of the concept. According to Galitz (1995:5), Risk is defined as any variation in an outcome. However, Jorion (2001:81), defines Risk as the dispersion of unexpected outcomes due to movements in financial variables (e.g. Currency rates, Interest rates and Commodity price). Jorion (2001:81), believe that both positive and negative deviations should be

viewed as sources of risk. His definition is very specific to what causes (i.e. movements in financial variables) risk. The differences in definitions above highlight divergence in the interpretation and understanding of risk. This also underlines the importance in the clarity of the definition.

In practice there are two broad categories of risk, which are pure risk and financial risk. However, when we refer to risk, in this study, we refer to financial risk. Financial risk, on the other hand, is the impact on the financial performance of any entity exposed to risk. A framework of financial risks is stated below whilst definitions are provided in appendix A. SBC Warburg Dillon Read (1998:31), believe that there is no single agreed listing of all the relevant risk factors, the seven categories that were defined by the Basle committee and International Organisation of Securities Commission (IOSCO) in their 1994 papers on risk management in the over-the-counter derivative markets provide a useful reference. These are:

Figure 1: The Financial Risk Structure



Of the above four categories of financial risk the main focus of the study is market risk.

2.4.1 What is Market Risk

Dowd (1998:3), defines *Market risk* as the risk of losses arising from adverse movements in the market prices (e.g. equity prices) or market rates (e.g. interest or exchange rates).

Market risk occurs when there is an adverse movement in the financial market variables contrary to the expectations of the investor in the product. It can be ascribed to different financial variables, such as interest rates, currency and equity. Market risk measurement attempts to quantify the risk losses due to a combination of two factors: the volatility in the underlying financial variables and the exposure to this source of risk. Whereas firms have no control over the volatility of financial variables, they can adjust their exposure to these risks, for instance, through derivatives.

According to Jorion (2001:15), Market risk can take two forms: *Absolute risk*, measured in rand terms (or in the relevant currency) and *relative risk*, measured relative to a benchmark index. While the former focuses on the volatility of total returns, the latter measures risk in terms of tracking error, or deviation from the index. The relevance of absolute or relative risk depends on how the trading or investment operation is judged. For bank trading portfolios or hedge funds, market risk is measured in absolute terms. For pension fund managers that are given the task of beating a benchmark or peer group, market risk should be measured in relative terms.

According to the Financial Risk Manager (FRM) Handbook (2001-2002:286), Market risk can be classified into directional and non-directional risks.

- **Directional risks** involve exposures to the direction of movements in major financial market variables. These directional exposures are measured by first-order or linear approximations such as:
 - **Beta** for exposure to general stock market movements,
 - **Duration** for exposure to the level of interest rates,
 - **Delta** for exposure of options to the price of the underlying asset.

- **Non-directional risks** involve other, remaining exposures, such as non-linear exposures to hedged positions or volatilities. These non-directional exposures are measured by second-order or quadratic exposures such as:
 - **Residual risk** when dealing with equity portfolio,
 - **Convexity** when dealing with interest rates,
 - **Gamma** when dealing with second effects of options,
 - **Volatility risk** when dealing with volatility effects,

- **Basis risk** when dealing with differences in prices or in interest rates.

2.4.2 Major Sources of Market Risk

As mentioned earlier in this chapter, losses could occur through a combination of two factors: the volatility in the underlying financial variable and the exposure to currency, interest, equity and commodity risk factors.

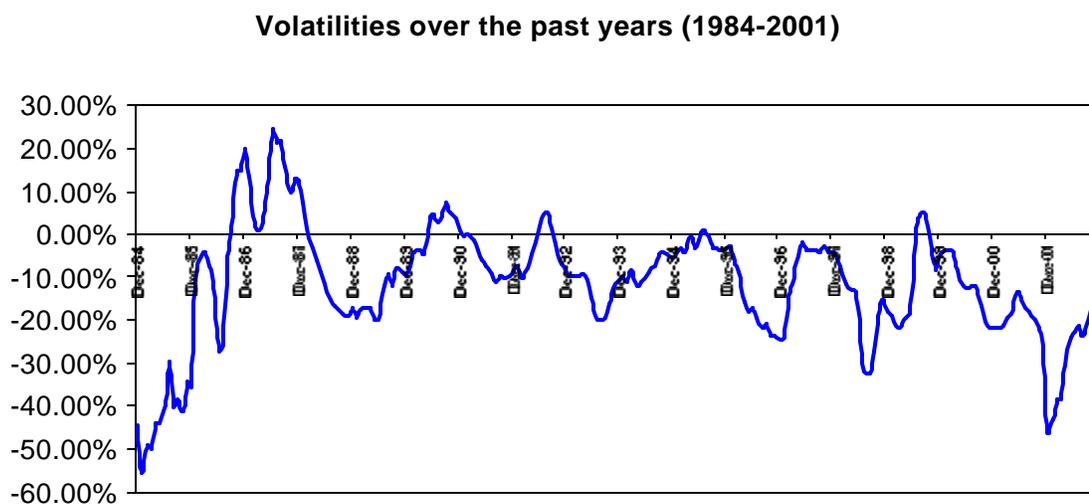
2.4.2.1 Currency risk

Currency risk arises from potential movements in the value of foreign currencies. This includes currency-specific volatility, correlations across currencies, and devaluation risk.

Currency risk arises in the following environments:

- *A pure currency float*, where the external value of a currency is free to move, to depreciate or appreciate, as pushed by market forces;
- *A currency devaluation*, where a currency's external value is fixed (or pegged to another currency) but with possible readjustments in the parity value, called devaluations or revaluations;
- *A change in regime*, where a currency regime that was previously fixed becomes flexible.

Figure 2: Volatilities in the SA Rand against the US Dollar.



Source: I-Net bridge (2002)

Figure 2 above shows the SA Rand/US Dollar historical volatility. Historically the rand has depreciated sharply against the US dollar. The annual depreciation has averaged 11.38 % in the past 18 years. SA is categorised as an emerging market and typically this group of countries have higher currency volatility, due to the fact that their economic fundamentals have greater fluctuations and they are less diversified.

The increased international trade due to globalisation has led to increased currency risk exposure for companies that are involved with international trade. Currency risk is also related to other financial risks, in particular interest rate risk. Often, interest rates are raised in an effort to stem the depreciation of a currency, resulting in a positive correlation between the currency and the bond market. This is the case, for instance when interest rates are driven by inflationary expectations.

2.4.2.3 Commodity price risk

Commodity producers and commodity consumers are exposed to commodity price fluctuations. Commodities have a cyclical price fluctuation. Table 2 below illustrates the huge variability of volatility between the three groups of commodities i.e. Base metals, Precious metals and Energy metals. The precious metals are less volatile compared to the other groups. In contrast, the energy metals are very volatile.

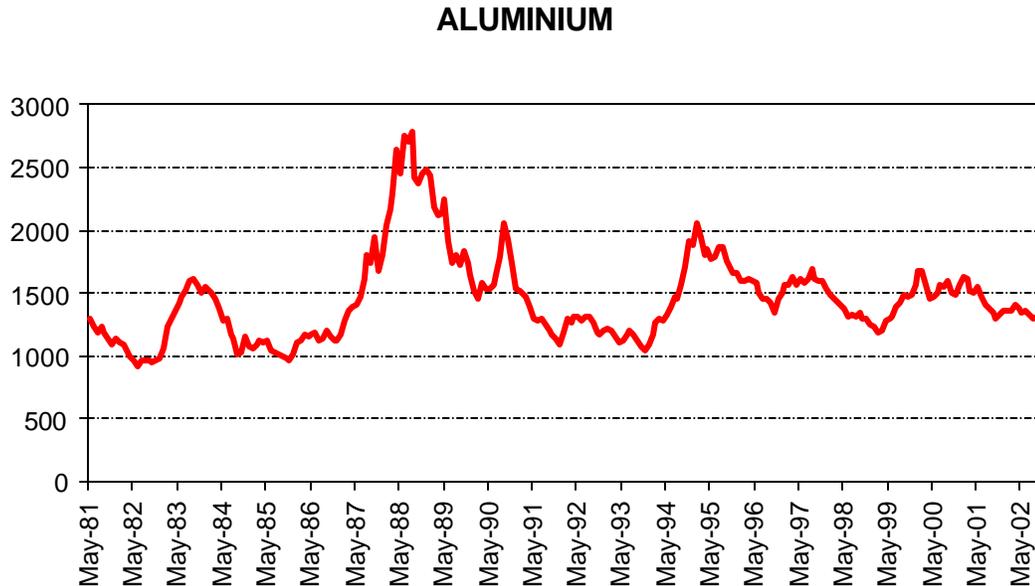
Table 2: Commodity Volatility (Percent)

Commodity	Daily	End 1999 Monthly	Annual	End 1996 Annual
<i>Base metals</i>				
Aluminium, spot	0.778	4.25	14.7	16.8
3-month	0.690	3.94	13.6	15.8
Copper, spot	0.880	5.15	17.9	35.4
3-month	0.829	4.95	17.2	24.9
<i>Precious metals</i>				
Gold, spot	0.985	6.14	21.3	5.5
Platinum, spot	1.408	7.58	26.2	6.5
<i>Energy metals</i>				
Crude oil, 1m	2.077	10.89	37.7	32.8
3-month	1.760	9.15	31.7	29.6
Natural gas, 1m	3.549	18.32	63.5	95.8
3-month	2.369	12.41	43.0	55.2

Source: Financial Risk Manager (FRM) Handbook (2001-2002)

Below is the graphical illustration of the fluctuations in aluminium price.

Figure 3: Fluctuations in the Aluminium price (\$)



Source: I-Net Bridge (2002)

2.4.2 How do we measure risk?

According to Jorion (2001:86) risk is best measured in terms of probability distribution functions. A flatter distribution indicates greater risk, and a tighter distribution, lower risk. In the past, risks were measured using a variety of ad hoc tools, none of which was satisfactory. These included notional amounts, sensitivity measures, and scenarios. While these measures provide some intuition of risk, they do not measure what matters, i.e. the downside risk for the total portfolio. They fail to take into account the probability of adverse moves in the risk factors

Market risk measurement attempts to quantify the risk of losses due to financial market variable. According FRM Handbook (2001-2002:261) market risk is primarily measured with Value at Risk (VAR). The latest evolution of risk management tools, Value at Risk, combines price-yield relationship with the probability of an adverse market movement. VAR captures the combined effect of underlying volatility and exposure to financial risks. The relative strengths of VAR, Scenario analysis and Stress testing are discussed and explained below. Different organisations apply these complementary tools in varying

degrees. At the outset, it is important to understand that individually these tools have limitations.

2.4.2.1 Value at Risk (VAR)

The accelerating trend towards measuring and monitoring risk at a firm-wide level has increased the focus on VAR and the need for a consistent firm-wide approach. According to Jorion (2002:1), VAR was first mentioned in 1993, although the concept goes back to Markowitz (1959). According to Minnich (1998:39) VAR is one of many risk management techniques that should be incorporated into a cohesive risk management approach; it is an extremely important one.

Minnich (1998:39), defines VAR as the maximum loss a portfolio is expected to incur over a specified time period, with a specified probability. VAR is an aggregate measure of downside risk. As stated earlier in the previous section, VAR captures the combined effect of underlying volatility and exposure to financial risks. Until the discovery of VAR sources of risk were measured and managed in isolation. Practitioners, regulators, and academics have embraced VAR, and many view VAR as a vital component of current 'best' practices in risk measurement.

Jorion (2002:2), believe that VAR has become a standard benchmark for measuring financial risk. Jorion (2002:2), also noted that spurred by regulators and competitive pressures more institutions are reporting VAR numbers in annual and quarterly financial reporting. One of the most important aspects of VAR is that unlike *Scenario Analysis or Stress Testing*, which shows what loss, would occur given a certain scenario, VAR actually assigns a probability to a dollar amount of loss occurring.

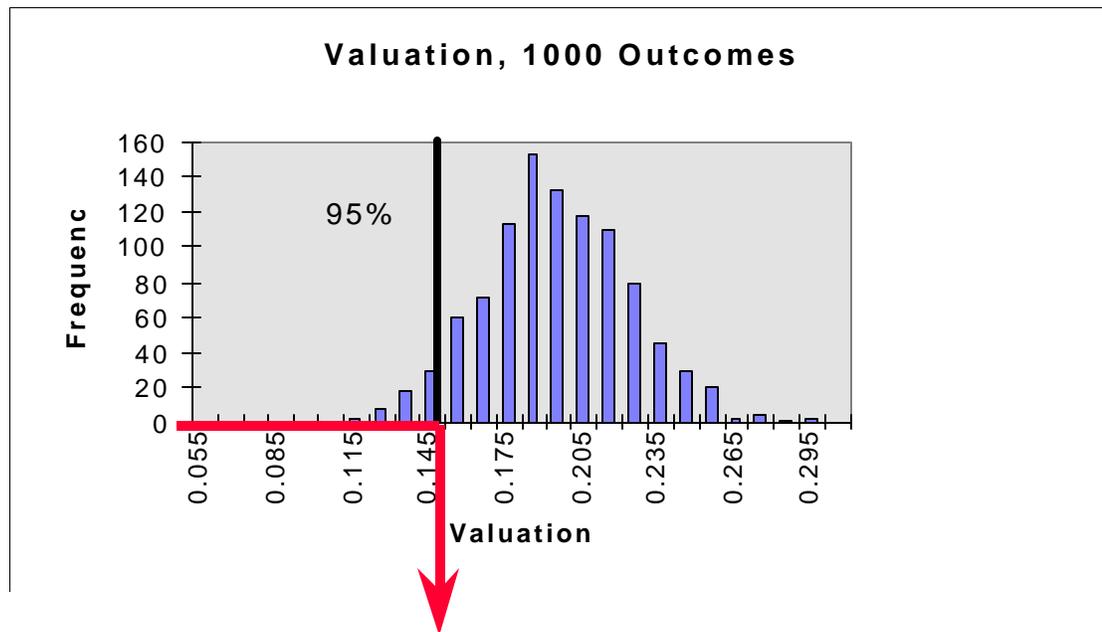
According to Minnich (1998:39), the probability and its corresponding loss amount are not associated with any particular event, but encompass any event that would cause such a loss. It is important to remember that VAR is not the maximum loss that will occur, but only a loss level threshold that will be pierced some percentage of the time. Minnich (1998:39), believes that the actual loss that occurs could be much higher than the VAR.

Jorion (2001:108), regards the following steps important in calculating VAR:

- *Mark-to-Market* of the current portfolio (e.g., \$100million)
- Measure the variability of the risk factors (e.g., 15 percent per annum)
- Set the *time horizon*, or the holding period (e.g., adjust to 10 business days).
- Set the *confidence level* (e.g., 99 percent, which yields a 2.33 factor assuming a normal distribution).
- Report the *worst loss* by processing all the preceding information (e.g., a \$7 million VAR)

For actively traded portfolios, for example, one-day 99% VAR is the amount of money such a portfolio is expected to lose one-day out of 100, based upon the portfolio's current composition and recent market behaviour. For less actively traded portfolios, monthly VAR is often used. For example, a portfolio whose one-month 95% VAR is R0.04million, would be expected to lose R0.04million one-month out of 100, based on its current composition and recent market behaviour. This is illustrated graphically below:

**Figure 4: VAR- Monte Carlo simulation (Profit & Loss valuation)
(Million rands)**



$$\text{VAR} = v_{\text{spot}} - v_{95\%} = 0.185 - 0.145 = 0.04$$

The figure above shows what the probability distribution might look like for monthly portfolio values over the upcoming months. For portfolios that contain options or other derivative instruments, such distributions can be quite complex. In the above figure, the portfolio's one-month 95% VAR was found by simply locating that point on the x -axis such that 95% of the probability falls to the right of the point.

According to Minnich (1998:41), one of the most difficult aspects of calculating VAR is selecting from among the many types of VAR methodologies and their associated assumptions. Depending on the organisation, some of these decisions can be straightforward and clear, but often than not, certain trade-offs will be made. There are three methodologies of VAR whose primary distinction is the type of calculations performed. These methodologies are summarized in Table 3 below. But first, there are certain necessary decisions and assumptions, in the next page, that need to be made regardless of which of the three methodologies is chosen

Table 3: VAR Methodologies

Methodology	Calculations involved
Variance-Covariance	Volatility and correlation matrix Matrix algebra to arrive at VAR
Monte Carlo Simulation	Volatility and correlation matrix Monte Carlo Simulation to generate portfolio return distribution
Historical Simulation	Historical Data set Simulate portfolio using historical returns As actual return distribution

Source: Minnich. (1998:41). *A Primer on Value at Risk*. Capital Market Risk Advisors, Inc.

Table 4 below summarizes the pros and cons of each of the methodologies discussed above. Recognizing that two different departments with a VAR of \$1 million can have very different risk profiles depending on both the nature of their business and the calculation methodology chosen by each is the first step in improving an organisation's use of VAR. VAR is a valuable tool, but must be consistently applied to be a meaningful measuring stick.

Table 4: Summary of Pros and Cons of each VAR Methodology

Method	Pros	Cons
Variance-Covariance	Easy to understand. Least computationally intensive. Industry standard.	May misstate non-linear risks. “Fat tails” problem Computationally intensive
Monte Carlo Simulation	Accommodates any statistical assumptions about risk factors. Can fully capture non-linear risks.	Sampling error.
Historical Simulation	Naturally addresses the “fat tails” problem. Performs well under back-testing. Can fully capture non-linear risks.	Relies on history. Computationally intensive Data intensive.

Source: Minnich. (1998:50). *A Primer on Value at Risk*. Capital Market Risk Advisors, Inc.

According to Minnich (1998:42-45), the following are decisions that must be decided prior to calculating VAR:

- (1) **Time horizon** (The two most important considerations for selecting a time horizon are the liquidity of the instruments and the expected holding period);
- (2) **Confidence interval** (The actual choice of confidence interval is not as important as understanding the implications of the choice and ensuring that limits are set accordingly);
- (3) **Data series** (The choice of historical, implied, or other ways to determine security relationships is important);
- (4) **Mapping/selecting relevant risk factors** (To the extent that historical price series for every position is not available or too monumental a data problems, assumptions as far as mapping securities into security groups or relating security risk factors need to be made); and,
- (5) **Option valuation** (The variance-covariance VAR methodologies are not very good at capturing the non-linear behaviour of options. Monte Carlo Simulation VAR is considered the best methodology for calculating VAR involving non-linear securities such as options).

Care should be taken when considering each, as the choices made can change not only the actual number, but also the uses and meaning of the VAR number itself.

According to Rahl and Essesghaier (2000:50) VAR has the limitations listed below:

1. VAR is not a worst-case scenario.
2. VAR does not measure losses under any particular market conditions.

Rahl and Essesghaier (2000:50), they noted that VAR is not a worst-case scenario and it does not measure losses under any particular market conditions. Understanding limitations of VAR and what VAR is not it's certainly very important. Despite all of the support for VAR, it is not a sufficient parameter for risk measurement. VAR is after all only one number from a rich distribution of return information. Minnich (1998:41), believe that VAR should be used in conjunction with other risk measures such as scenario testing, stress testing, and other assets/business specific risk measures.

2.4.2.2 Stress Testing

Because no risk-measurement model is without limitations or implied assumptions, it is helpful to understand what will happen should some of the underlying assumptions break down. Rahl and Essesghaier (2000:50), believe that stress testing is the catchall term for doing a series of scenario analyses to investigate the effort of violating some of the basic assumptions underlying the risk model.

According to various articles, surveys previously undertaken in the US indicate that stress-testing value at risk assumptions has become widespread, since the late 90s, as a result of various crises. SBC Warburg Dillon Read (1998:70-71), below, give stress testing standards proposed by the Derivatives Policy Group (A framework for Voluntary Oversight, February 1990) as follows:

- Parallel yield curve shifts of 100 basis points up or down.
- Steepening and flattening of the yield curves (2s to 10s) by 25 basis points.
- Each of the 4 permutations of a parallel yield curve shift of 100 basis points concurrent with a tilting of the yield curve (2s to 10s) by 25 basis points.
- Increase and decrease in all 3-month yield volatilities by 20% of prevailing levels
- Increase and decrease in equity index value by 100%.

- Increase and decrease in equity index volatilities by 20% of prevailing levels.
- Increase and decrease in the exchange value (relative to the SA Rand) of foreign currencies by 6% in the case of major currencies and 20% in the case of other currencies.
- Increase and decrease in foreign exchange volatilities by 20% of prevailing levels.
- Increase and decrease in swap spreads by 20 basis points.

It is very important to stress test correlation risk because under two different correlation assumptions, the mark to model can be very different. There are various stress testing approaches. Stress testing can be based on historical events, scenario based history but updated, or institution-specific scenarios. Likewise, stress test results can be interpreted in various ways. It can involve an evaluation of tail events, progressively severe market moves, or extreme standard deviation scenarios.

2.4.2.3 Scenario Analysis

SBC Warburg Dillon Read (1998:93), defines Scenario Analysis as a strategic technique that enables a firm to evaluate the potential impact on its earnings stream of various different eventualities. It uses multi-dimensional projections, and helps the firm to assess its longer-term strategic vulnerabilities. SBC Warburg Dillon Read (1998:93), noted that the purpose of scenario analysis is to help the firm's decision-makers think about and understand the impact of unlikely, but catastrophic, events before they happen.

Whereas, Stress testing is designed to evaluate the short-term impact on a given portfolio of a series of predefined moves, in particular market variables. Scenario analysis on the other hand seeks to assess the broader impact on the firm of more complex and inter-related developments. The process of generating a scenario analysis can be decomposed into five steps as shown in Table 5 below.

Table 5: The Scenario Analysis process

Scenario definition	<ul style="list-style-type: none"> • Description of the starting scenario. • Basis assumptions. • Definition of time horizon.
Scenario-field analysis	<ul style="list-style-type: none"> • Identification of the scenario fields: the risk dimensions and risk factors which are affected and relevant for this scenario analysis.
Scenario projections	<ul style="list-style-type: none"> • Estimate the likely movements of the identified scenario factors and determine the potential loss in that case
Scenario consolidation	<ul style="list-style-type: none"> • Consolidate the results. • Check for consistency errors, double counting. • Independent validation checks
Scenario presentation and follow-up	<ul style="list-style-type: none"> • Summarise results • Analyse and evaluate • Next steps: e.g. put on a hedge.

Goldman Sachs & Swiss Bank Corporation (1998:95). *The Practice of Risk Management*

2.5 Hedging

The traditional approach to market risk management is hedging. According to Galitz (1995:311), Hedging is where an entity already exposed to risk attempts to eliminate the exposure by adopting an opposing position in one or more hedging instruments. There are two main reason why do companies hedge. One reason is because the risks are peripheral to the central business in which they operate. Another reason is that the exposure of the firm to its financial risk is to improve or maintain the competitiveness of the firm. According to Treat (1990:172), when setting hedging objectives companies have to make a trade-off between risk and return.

The core problem, for the power utility, when deciding upon a hedging policy is to strike a balance between uncertainty and the risk of opportunity loss. A simple example is the case of a South African company expecting a foreign currency payment in six months time. Clearly, they are faced with a problem to repatriate those US dollars at some point in the future because they have decided that foreign exchange risk is not something to carry as it is deemed to be peripheral to their core business or exchange control regulations do not allow them to hold foreign currency for more than 182 days.

Immediately the company will have to buy a foreign exchange contract to hedge against the effects of fluctuating Rand/US dollar exchange rate.

The problem has two dimensions: uncertainty and opportunity. If they do not hedge the transaction they do not know with any certainty at what rate of exchange they can exchange the foreign currency when it is delivered. It could be at a better rate or at a worse rate than the rate prevailing currently for exchange of that amount in six months time. The key to hedging is to decide which of the available possible solutions to choose. Hedging is not just about putting on a forward contract. Hedging is about making the best possible decision, integrating the firm's level of sophistication, systems and the preferences of their shareholders. However, the hedging instruments have a potential danger of exposing the power utility to more other risks, such as, default or counterparty risk.

According to FRM handbook (2001-2002:339), hedging can, generally, be distinguished as follows:

- **Static hedging**, which consists of putting on, and leaving a position until the hedging horizon. This is appropriate if the hedge instrument is linearly related to the underlying asset price.
- **Dynamic hedging**, which consists of continuously rebalancing the portfolio to the horizon. This is associated with options since options have a non-linear payoff in the underlying asset, the hedge ratio, which can be viewed, as the slope of the tangent to the payoff function, must be readjusted as the price moves.

A perfect hedge is one where the hedging instrument matches the original exposure perfectly in every detail. If such an instrument is available, risk can be eliminated completely, as illustrated in Figure 5 below. In practice, such perfect correlation between the original exposure and the hedging instrument may not always be obtainable, and the hedge may prove to be less than perfect. What it is very clear from the power utility's residual risk exposure, highlighted in the previous chapter, is that some of the risk hedging instruments being applied work less than perfectly in practise.

Figure 5: Illustration of a perfect and imperfect hedge.

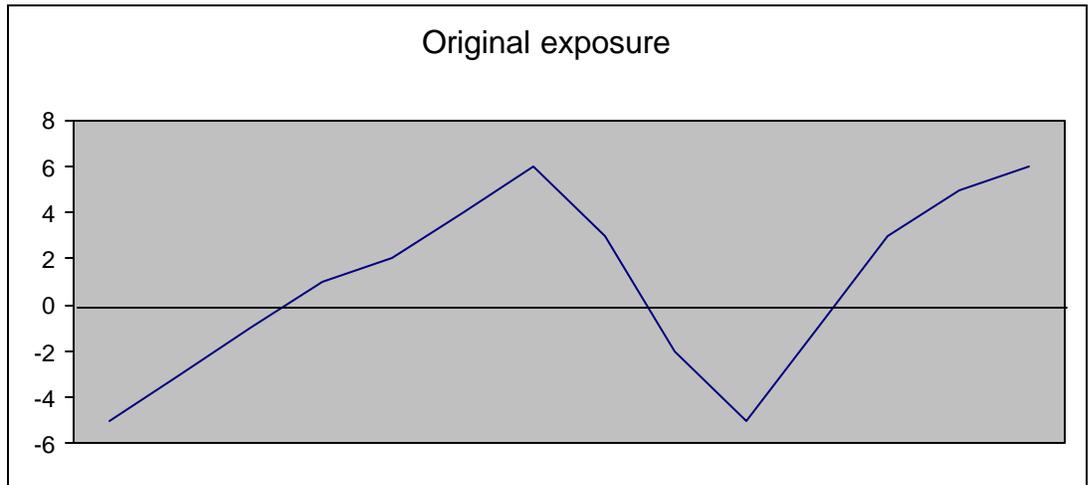


Figure 5 (a)

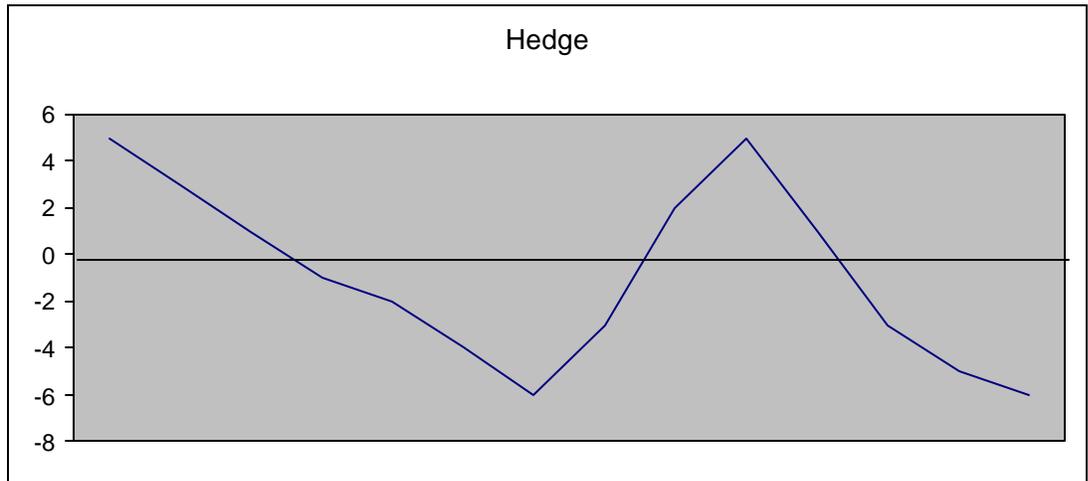


Figure 5 (b)

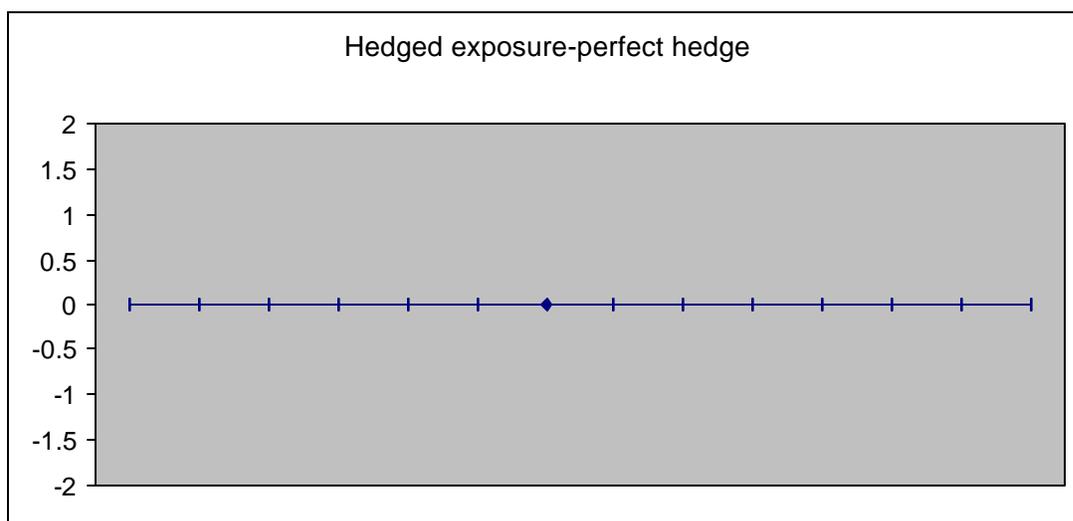


Figure 5(c)

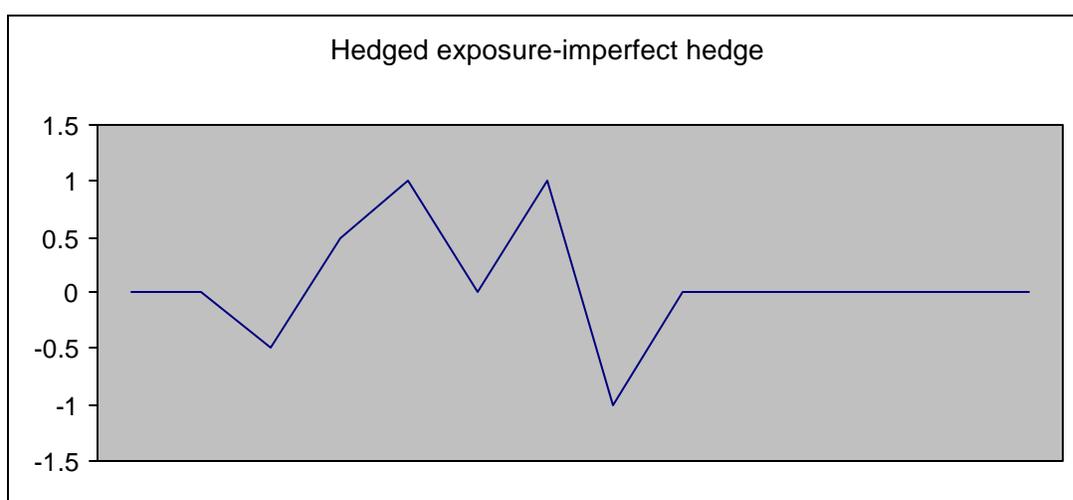


Figure 5(d)

An imperfect hedge illustrated in Figure 5(d) does results in a mismatch hedge. For example, instruments that have different maturity dates but otherwise equivalent terms may be equivalently priced at the outset, but as time goes by they will diverge. The hedge illustrated in Figure 5(d) matched every fluctuation of the original exposure, hedging both adverse and beneficial movements in the underlying price; the end result is an absolute certainty. Hedging can take a number of forms other than the above. It should be kept in mind that one person's 'perfect' hedge may be another's straightjacket.

Galitz (1995:318), suggest that before any hedging scheme can be designed, and certainly before any hedging decisions are implemented, it is vital to clarify what the scheme is meant to achieve. If the risk manager can identify key answers to four key

questions, below, this will help to define what a particular firm's hedging objectives actually are.

- Does the firm simply wish to obtain complete protection against any movement in price?
- If a degree of risk is to be tolerated, how does the desire to obtain upside savings compare with the wish to avoid downside risk?
- How averse is the risk taker to paying for risk protection?
- What is the firm's view of the likely direction, magnitude, and timing, of market movements?

Should the objective of hedging be to lower volatility, hedging will eliminate downside risk but also any upside benefit in the position. More generally, whether hedging is beneficial should be examined in the context of a risk-return trade-off.

2.5.1 Hedging Tools

In this section, the study will look at basic hedging instruments, such as, Options, Futures, Forward and Swaps available for parties exposed to commodities to hedge price risk. It will show how the various tools can be used to manage commodity risk. Each practical use is fully illustrated with a worked example, so as to see how the techniques can be applied.

2.5.1.1 Commodity Option

According to Stoll & Whaley (1993:6), an *option* (basic) contract conveys the right to buy or sell an underlying commodity at a specified price within a specified period of time. In other words, an option is a contract between two parties that is legally binding only on the seller of the option. For the buyer, honouring the contract is literally optional; it is his choice whether to consummate the deal. The buyer has paid the seller of the option for the right to back out of the deal. The seller of the option, whether it is the right to buy or the right to sell the underlying instrument, must honour the contract if the buyer decides to go through with the deal by exercising his option. The option buyer gladly pays for the right to change his mind. The seller grants that right for the premium he

receives. According to Natenberg (1994:1), in option trading all rights lie with the buyer and all obligations with the seller.

Purpose of an option

- obtain protection against unfavourable price movements while retaining the possibility of benefiting from favourable ones
- valorize inventories

Advantages	Disadvantages
<ul style="list-style-type: none">• Available in standardized form on exchanges, and tailor-made over-the-counter• No “funding risk”: the costs of protection are known upfront• Possibility of benefiting from favourable	<ul style="list-style-type: none">• Up-front premiums can be expensive, especially in times of volatile prices• Selling options can be highly risky• Option sellers need to pay margin calls

Source: UNCTAD. *A survey of commodity risk management instruments*, (6 April 1998:32).

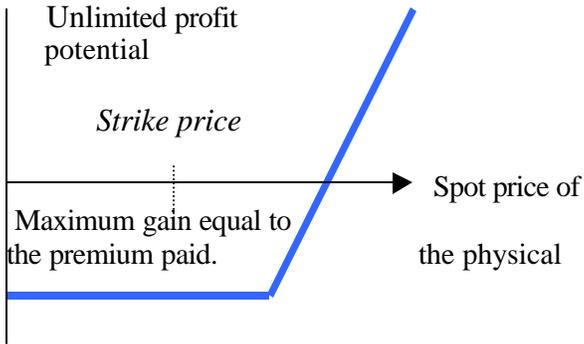
According to Treat (1990:116), there are two types of option-*call options* and *put options*. A *call option* is right to buy or take a long position in a given assets (typically a security, commodity, index, or future contract) at a fixed price on or before a specified date. A *put option* is the right to sell or take a short position in a given asset. According to Benninga and Wiener (1997:1), there are two major classes of options are called European and American. A European option can be exercised only at maturity while an American option can be exercised at any time prior to maturity.

Note the difference between an option and a future contract. A futures contract requires delivery at a fixed price. The buyer and seller of a futures contract both have obligations, which they must meet. The seller must make delivery and the buyer must take delivery of the assets. The buyer of an option, however, has a choice. He can choose to take delivery (a call) or make delivery (a put). If the buyer of an option chooses to either make or take delivery, the seller of the option is obliged to take the other side. Below are pay-off profiles of both call and put options.

Figure 6 : Option Risk-Return profile

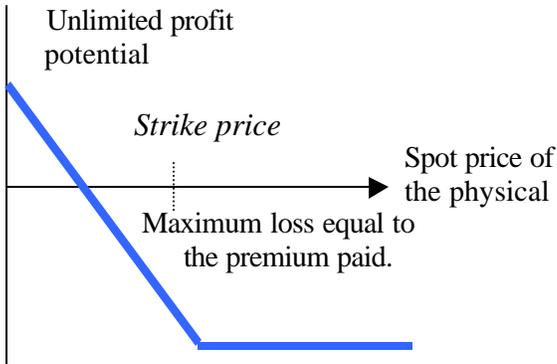
(a) Long call option

Profit/Loss



(b) Long put option

Profit/Loss



Options contracts can be negotiated by the individual parties or by a broker in the *over-the-counter market*, or they can be bought and sold on regulated exchanges. Today, attesting to the popularity and benefits provided by options trading, there are literally thousands of standardized options contracts available on individual stocks, on commodity and financial futures, and on indexes, which can be bought and sold around the world.

Table 6: Definitions of Basic Options Terms

Term	Definition
Call option	The right, but not the obligation, to buy the underlying instrument at a determined price by a specified date.
Exercise price (Strike price)	The price at which the holder of an option may buy (call) or sell (put)
Expiration	The date and time by which an option holder must choose whether to use the option, or the rights conferred by the option will have lapsed.
Grantor (Writer)	The seller of an option.
Intrinsic value	The value in an option if it were exercised immediately and the resulting position were liquidated at the same time-not all options have a positive intrinsic value.
Premium	The price of an option.
Put option	The right, but not the obligation, to sell the underlying instrument at a determined price by a specified date.
Time value (Extrinsic value)	That part of an option's total value that arises from the potential for favourable price changes in the underlying commodity prior to expiration.

Source: Treat. (1990:119). *Energy Futures*.

An example of hedging with options is illustrated as follows:

A commodity consumer who wants to protect himself against an increase in the price of crude oil can buy a call option. This option will give him the right to buy crude oil at a specific price (the strike price) thus enabling him to benefit if market prices move above the strike price. The maximum loss that the commodity consumer can encounter is the premium he has paid.

A commodity producer who wants to protect himself against a decrease in the price of crude oil can buy a put option. This option will give him the right to sell crude oil at the strike price. If the price decreases below the strike price, the producer will exercise his right and will sell oil at the strike price. According to Enron Risk Publication (1995:103), throughout the risk management industry, letters of the Greek alphabet (“the Greeks”) are used to describe the various assumptions underlying an option’s price and its sensitivity to market moves. For users of options it is important to be aware of the Greeks and what they represent. They represent risk aspects such as Vega (volatility), Rho (risk-free), Gamma (convexity) and Theta (time), which form a part of the option and may create new exposures for which no counter aspects are present in the underlying instrument.

2.5.1.2 Commodity Futures and Forward Contracts

2.5.1.2.1 Commodity futures contracts

Alexander (1996:14), defines a *futures contract* (basic) as an agreement to buy from, or sell to, a futures exchange a standard quantity and quality of a specified asset. This asset could be either a commodity (for example, gold), or a financial (for example, the long bond) or notional asset (stock market index). The focus of this study is commodity futures.

According to Pitts & Fabozzi (1990:283), *Hedging* with futures is the employment of a futures position as a temporary substitute for transactions to be made in the cash market at a later date. The goal is to eliminate price risk by effectively fixing the price of the transaction to be made at a later date. If cash and futures prices move together in a predictable way, any loss relative to the target price realised from one position (whether cash or futures) will be offset by a profit on the other position, When the net profit and loss from the positions are exactly as predicted, the hedge is called a “perfect hedge”.

Purpose of futures

- hedge price risk
- lock in the value of inventories or finance part of storage cost
- secure a processing margin

Advantages

- No need to negotiate contract specifications
- Minimal counterparty risk
- Initial position can easily be reversed
- Delivery is not necessarily implied

Disadvantages

- Working capital is frozen in margins
- Possibility of profiting from favourable spot market developments is lost
- Prices of the hedged product and the futures contract may diverge

Source: UNCTAD. *A survey of commodity risk management instruments* (6 April 1998:24).

The following example will illustrate how hedging with commodity futures contract works:

To explain hedging, suppose Mr Y, an oil producer, entered into a contract to supply Mr B with One million gallons of oil in 1 year from now with pricing determined by the spot price of the Brent Crude Oil at settlement date. The challenge for Mr Y is predicting the direction of the oil price in the coming year and the level of the oil price at settlement date. Clearly, Mr Y will require protection against the risk of downward movement of oil price, which is known to be very volatile (refer table page 13). Mr Y faces the risk that in future the oil price could be lower than it is at present due to a variety of factors that will cause a price to drop.

Suppose that Mr Y enter into a commodity futures contract for delivery in 1 year's time. In terms of this hedging strategy, Mr Y has managed to lock into the current price without being exposed to future volatile prices. If the price of oil has dropped on delivery date then the Mr Y would have protected himself against loss of revenue. However, if the price does, in fact, increase Mr Y would suffer an opportunity loss. The profit or loss realized by Mr Y on this contract will depend on the price on the delivery date.

According to Pitts & Fabozzi (1990:5), when the investor first takes a position in a *futures contract*, he or she is required to deposit a minimum amount per contract as specified by the exchange. As the price of future contract fluctuates the value of the investor's equity in the position changes. At the close of each trading day, any market gain results in an increase in the investor's equity, whereas any market loss results in a decrease. This process is referred to as *marking to market*.

2.5.1.2.2 Commodity forward contract

The power utility could also enter into a forward contract. According to Hull (2000:1), a *forward contract* (basic) is a particularly simple derivative. It is an agreement to buy or sell an asset (typically a foreign currency or interest rate) at a certain future time for a certain price. It can be contrasted with a spot contract, which is an agreement to buy or sell an asset today. A forward contract is traded in the over-the-counter market-usually between two financial institutions or between a financial institution and one of its clients.

Purpose of forwards

- lock in forward price
- Secure processing margin

Advantages
<ul style="list-style-type: none"> • Tailor-made for the needs of the contracting parties • Ensures physical market for the commodities produced • Can often make production or pre-export finance possible

Disadvantages
<ul style="list-style-type: none"> • Difficult to revert the initial decision • Major counterparty risk • Possibility of profiting from favourable spot market developments is lost • Pricing is not transparent

Source: UNCTAD. *A survey of commodity risk management instruments*, (6 April 1998:22).

Hull (2000:1), believe that at the time the contract is entered into, the delivery price is chosen so that the value of the forward contract to both sides is zero. This means that it costs nothing to either buy or sell a forward contract

The difference between futures and forwards

Alexander (1996:16), a futures contract is merely a standardised, exchange-traded forward contract. The major difference between the two instruments is that a future is a 'standardised package' and is traded through an exchange, whereas a forward contract may apply to any quantity of any asset, and with any delivery date.

Table 7: A comparison between Futures and Forward Markets

	Futures market	Forward market
Marketplace	Centralised exchange floor or screen dealing	Telephonic worldwide
Integrity system	Guaranteed by clearing house	Person-to-person risk of default
Accessibility	Open to all who need to hedge, or who wish to speculate	Mostly limited to large creditworthy participants
Participants	Large corporations, banks; public participation encouraged.	Large corporations, banks, brokers.
Regulation	Regulated by government body and exchange management.	Self-imposed regulation
Contract sizes	Standardised	To suit individual
Tradeability	Secondary tradeable	Not tradeable
Delivery date	Standardised	To suit individual
Security deposit	Initial plus additional margin	No margining

Source: Alexander. (1996:17). *Futures & Options: A South African guide to derivatives*.

The key risk management principle found in both the forward and futures contracts is that the parties to the contract have fixed the price at which they will buy or sell a commodity and they are obliged to deliver on the agreement.

2.5.1.3 Commodity Swaps

A *swap* (basic) is an agreement between two companies to exchange cash flows in the future. The agreement defines the dates when the cash flows are to be paid and the way that they are to be calculated. According to Hull (2000:121), a forward contract can be viewed as a simple example of a swap. Whereas a forward contract leads to the exchange of cash flows on just one future date, swaps typically lead to cash flow exchanges on several future dates.

Purpose

- to guarantee income streams of operations or new instruments
- obtain easier and cheaper access to capital by securing future cash flows
- lock in long-term prices

Advantages
<ul style="list-style-type: none">• Combining of hedging and securing investments• Long-term• Tailor-made• No or less-strict margin calls• Low administrative burden• Known counterparty

Disadvantages
<ul style="list-style-type: none">• Counterparty risks• Positions are difficult to reverse• High design/set-up costs• Difficult assess the “fair” price for the deal• Possibility of benefiting from favourable price movements

Source: UNCTAD. *A survey of commodity risk management instruments*, (6 April 1998: 36).

The power utility or a commodity producer could enter into a commodity swap. A commodity swap is an agreement between two parties in which each party promises to make a series of payments to the other and of which at least one of the payments is determined by the price of a commodity. Delivering actual units of the commodity price

could make up the payments. A commodity swap contract is a tool of fixing medium-to-long-term prices without any involvement with physical transactions. In addition, commodity swaps are similar to financial swaps. Hence, commodity swaps are becoming increasingly common as hedging techniques. Indeed, it is useful hedging tools when demand and supply are both subject to considerable uncertainties, like with commodities.

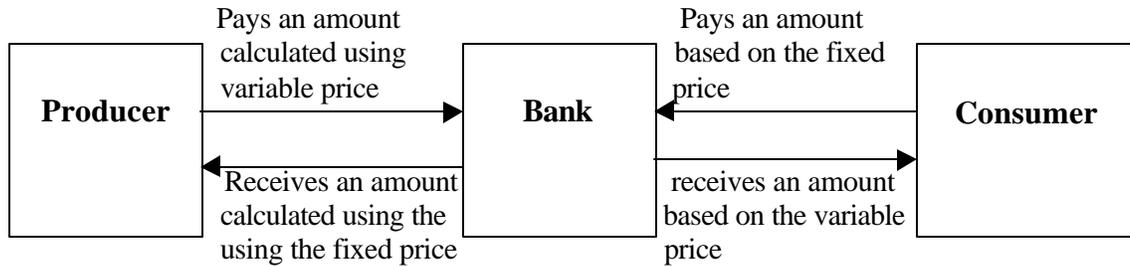
In a swap agreement covering a specified volume of a commodity, two prices are involved. One of these prices is variable and is usually expressed in relation to a published price index such as the price of a futures contract. The other is fixed at the time of the swap agreement. According to Atsou and Ravi (1991:419), the price of a swap, whether the underlying index is a floating interest rate such as LIBOR or the price of oil, depends on the cost of hedging the index at each of the settlement dates. They also noted that the fixed amount in the swap calculation is the average amount (adjusted for the time value of money) at which the swap dealer expects to break even plus a premium for credit exposure and agency value.

Limitations:

- The exact type of the commodity that is used in the swap transaction may not be represented perfectly by the price on which the swap payments are made.
- The quantities and timing of spot market purchases or sales made by the company undertaking a swap transaction may not necessarily correspond to the swap payments. There is a considerable uncertainty in the spot market needs that can make sometimes the hedge far from reality.
- There is a lack of participating institutions.

Below is an example of a swap agreement involving a producer, consumer and bank:

Figure 7: Illustration of a swap agreement



Source: UNCTAD. *A survey of commodity risk management instruments*, (6 April 1998:37).

In practice, only net amounts are paid: by the producer to the bank (or from the bank to the consumer) if the reference price is higher than the fixed price; and by the bank to the producer if the reference price is lower than the fixed price.

2.6 Summary

Literature relating to risk management was reviewed in this chapter. The modern developments in risk management were examined; specifically integrated risk management concept that is lately embraced by business because it makes good sense. Finally, also covered was discussion of market risk and review of the methods generally applied in mitigating the risk. The literature review provided a better understanding of risk and risk management concepts and assisted in formulating appropriate risk mitigation strategies recommended in chapter 4.

CHAPTER 3: TARIFF-LINKED AGREEMENTS

3.1 Introduction

The previous chapter reviewed risk management literature and related areas. This chapter will review Tariff-Linked Agreements entered between the power utility and commodity producers and provide an interpretation of the findings.

3.2 Non-Tariff Special Pricing Policy

The power utility has a number of pricing mechanisms, which may be used simultaneously in structuring a single non-standard pricing agreement. Tariff-linked pricing is one of the non-tariff special pricing mechanisms offered by the power utility. From the power utility's point of view, the **objectives** of the non-tariff pricing policy are:

- To achieve additional sales of electrical energy and hence increased net revenue that would not otherwise materialise by:
 - Selling surplus energy,
 - Taking additional risk with the view to higher return,
 - Competing with other electricity suppliers and other (e.g. coal, gas, etc) energy carriers.
- To achieve a change in demand profiles in order to reduce average supply costs over the longer term.
- To achieve diversification in the electricity market, so as to hedge against market demand cycles.
- To achieve long-term strategic advantage for the utility company.

To achieve the above objectives the power utility has adopted certain **general principles** of which two utmost important are:

- Special pricing agreements may not involve additional costs to other electricity users in the country, compared with the situation where the agreement is not entered into, and
- Any special agreements mechanism should be available to all potential participants so as to ensure that their competitive level playing field is not jeopardised, from an electricity point of view.

Some of the **criteria applied** by the power utility for approval of any submission made are as follows:

- The overall risk that will result from an agreement is acceptable.
- Due to the complexities of special agreements, they should be considered where significant benefit for the power utility is anticipated, compared to expected revenue income at the normal tariff.
- No existing customer competing in the same market should be disadvantaged.

The challenge for the power utility when entering into special pricing agreements is to meet the set objectives. To a greater degree the non-tariff special pricing policy of the power utility is not reflective of the cost of supplying electricity to some of its customers. Because in most cases the power utility give predetermined discounts.

According to the power utility, in other instances, the intention is to provide customers with incentives with the hope that these customers will adopt consumption patterns that lead to a more effective use of electricity and overall translate into reduced supply costs. The policy in the short-term does achieve some of the set objectives for the power utility. However, in the long-term the policy is already creating problems for the power utility especially with regard to capacity shortage, whereby its capacity to supply electricity will be impacted sooner than it would have been without it. Therefore, this requires the power utility to increase capacity at a huge cost. Notwithstanding the above issues, the policy benefits the power utility immensely in the sense that it generates additional revenue, with respect to unutilized energy, which it couldn't have been able to sell under normal circumstances.

3.3 Tariff-Linked (Commodity-Linked) Agreements

The purpose of this section is to provide an in-depth analysis of various tariff-linked agreements between the power utility and commodity producers. Furthermore, the financial risk exposure emanating from these agreements will be identified and analysed. The importance of this type of agreements, for both parties, cannot be over-emphasised. The main reason forwarded for the purpose of this type of agreements is to give relief to the commodity producers during the time when the commodity prices are low thereby billing them at a tariff below the standard rate. The producer will therefore enjoy the benefits of low electricity costs. However, when commodity prices are high the commodity producer is billed at a tariff above standard rate. The power utility will therefore enjoy the benefits of earning higher than normal revenue.

The challenge for the power utility is to ensure that the agreement is structured in such a way that it does not lead to unintended consequences, that is, of exposing itself to further unmanageable risks. When constructing various agreements the power utility company is faced with the other challenge of determining a pricing formula that is equitable for both parties. An equitable formula is a formula that enables sharing of risk and benefits in a fair manner. Should the pricing formula not be equitable it could have unintended consequences for either party.

In the past the power utility encountered problems with some of these agreements and this lead to them being reviewed or revised on an ongoing basis. For example, in some cases the power utility entered with commodity producers into what is referred to as an open-ended agreement. With an open-ended type of agreement, the minimum tariff charge is at marginal cost and without a maximum tariff charge. This means that for the power utility, the advantage is that the upside benefit is unlimited. However, the downside risk is that should the tariff be below the standard tariff until the end of the contract then the power utility would have supplied the electricity at a discount.

In solving some of the problems, the power utility company incorporated collars in most of the agreements. This meant that an agreement has a cap (maximum rate) and a floor (minimum rate). By incorporating collars into agreements lead to limited risks and benefits for both parties. The power utility's risk appetite will determine the level of risk acceptance relative to the expected returns from the agreements. As the risk reaches an unacceptable level the power utility will have to mitigate the unacceptable risk by transferring it to financial institutions or minimise the risk exposure assumed. The power utility's risk appetite with respect to commodity price risk is not clear. There is no set strategic intent in this regard. There is also no cohesive risk management strategy. Each risk emanating from the agreement is dealt with individually.

3.3.1 Rationale for Tariff-Linked Agreements

Notwithstanding various problems, companies enter into this type of agreements for different reasons. According to the power utility there are no compelling reasons for the company to enter into these types of agreements. As indicated earlier in the chapter, the fundamental reason forwarded by the power utility, why it enters into such agreements, is mainly sale of excess capacity. Other than that one the key reasons are purely strategic or socio-political because of the significant role the company plays in the economic development of the country.

In the mid-to-late 80s the power utility erected a lot of power stations on the premise of huge economic growth in the country. Unfortunately, when this didn't materialise the power utility was left with large unutilised capacity. This didn't leave the power utility with much choice but to sell electricity at a discount to some of its key customers. Also, the power utility was prepared to enter into special price agreement with bulk users of electricity. According to the power utility, this is in the best interest of the electricity consumer that the power utility optimises its plant utilisation, specially, considering the fact that electricity cannot be stored.

For commodity producers', on the other hand, if they were to shut down because of low commodity prices the power utility will, therefore, forfeit electricity sales as a result. Also, for producers, electricity is a major cost-component of the production costs;

naturally they will try by all means to reduce the cost with the objective of being competitive. For both parties there are merits and demerits for entering into tariff-linked agreements, which are stated below:

For the Power Utility Company

- **The merits**
 - Sale of excess capacity
 - Shared benefit for in times of high commodity prices
- **Demerits**
 - Indirect exposure to commodity price fluctuations
 - Risk of inadequate hedging mechanism
 - Currency risk exposure

For Commodity producers

- **The merits**
 - Favourable electricity costs
 - Shared risk for in times of low commodity prices
 - Transfer of commodity price fluctuations
- **Demerits**
 - Shared benefit for in times of high commodity prices

3.3.2 Risks assumed by the Power Utility Company

By entering into these types of agreements the power utility assumes financial risks, such as, commodity price risk, currency risk, and credit risks, which are normally associated with these types of agreements. The model risk is also one of the risks assumed by the electricity company. This is the risk that the inequitable pricing formula could be applied.

3.4 Agreements

3.4.1 Aluminium Agreement

3.4.1.1 Background

In the early 1990s, a Power-Utility-Company entered into an Electricity Supply Agreement with an aluminium producer. The agreement entered into was for the supply of electricity by the power utility to the producer. In terms of the agreement, the power utility's obligation is to make available and supply of electricity to the producer. In essence, the agreement is in effect a barter arrangement, in which electricity is exchanged for aluminium at a specific rate of grams per kilowatt hours (kWh).

In terms of the agreement, electricity exchanged for aluminium (at a market price) is determined by a specific formula applied to calculate both electric energy and demand charges. The price of electricity is linked to both three-month London Metal Exchange (LME) sellers' price for 99,7% high-grade aluminium ingot (expressed in US Dollar per ton) and the Rand/US Dollar exchange rate (offer price quoted by the utility company's banker). The producer is advised of the aluminium price and exchange rate as determined by the utility company, as soon as practicable after each meter reading date.

Given the cyclical nature of the aluminium price, and the power utility's surplus capacity, there are benefits to both the commodity producer and the power utility of entering into a variable pricing arrangement. The commodity producer's earnings will fluctuate according to the prevailing aluminium prices and this will protect margins during periods of low prices. It is thus of benefit that one of the producer's major operating cost-component, namely electricity, vary with the aluminium price.

3.4.1.2 Assessment of risk

In terms of this agreement, the power utility's revenue from its customer is no longer a function of its standard tariff structure but is determined by the underlying international price of the respective commodity. Because aluminium prices are US Dollar based and electricity revenue earned is in Rands, therefore, the power utility is exposed to both fluctuations in the aluminium price and the Rand/US Dollar exchange rate. This means that the power utility had to hedge both the commodity price risk and the exchange rate risk.

3.4.1.3 Risk measurement

Once risks have been identified and before the power utility can implement any hedging strategy it is important to quantify the risk exposure. According to the power utility's risk measurement process commodity price risk exposure is measured through *VAR*, *Scenario Analysis* and *Stress testing*. Whilst the credit risk exposure is measured through the *mark-to-market*.

3.4.1.4 Hedging Strategy

The power utility hedged its exposure through a *zero-cost collar* option. The strategy is rolling the collar on a yearly basis. In terms of the collar, the power utility purchased *at-the-money* puts and wrote *out-of-the-money* calls. A collar locks in a certain range of aluminium prices by selling call options (so called '*Caps*') and buying put options (so called '*floors*'). According Galitz (1995:342) a *collar* is usually constructed by buying an option of one type to limit the downside risk, and selling an *option* of the opposite type to limit the upside potential.

The disadvantage with the above strategy is that, by selling a cap, the power utility did limit the upside price potential. Both options are normally out-of-the-money, which leaves a range either side of the current price within which the hedge is inactive. The collar entered into is a rand based zero-cost collar with a financial institution. This is because it is exposed to commodity price fluctuations, as well as fluctuations in the value of rand vis-à-vis the dollar, as the pricing mechanism inherent in these linked tariff agreements is based on international commodity prices, which are all quoted against the dollar. According to the power utility, the following alternatives were considered:

- The power utility could sell dollars forward (expected dollar linked revenue);
- The power utility could buy puts and sell calls (i.e. zero-cost collar);
- The power utility could buy a put option.

The power utility decided on the zero-cost collar above. The following factors were considered in deciding on the hedging mechanisms:

- Accounting practice,
- Liquidity of commodity market,
- Impact on the country's foreign reserves.
- Cost of hedging,
- Exchange control regulations,
- Impact on the forward cover market.

The above factors, immensely, restricted the hedging mechanism the power utility could apply especially exchange control regulations. This in turn led to limited options available in deciding on the suitable hedging strategy. With the zero-cost collar, the power utility incurred no cost in setting up the hedge. In terms of the power utility's strategy, the premium cost of purchasing puts is offset by premium income received by writing calls. The collar offers the power utility a limited upside and a protection against the downside risk.

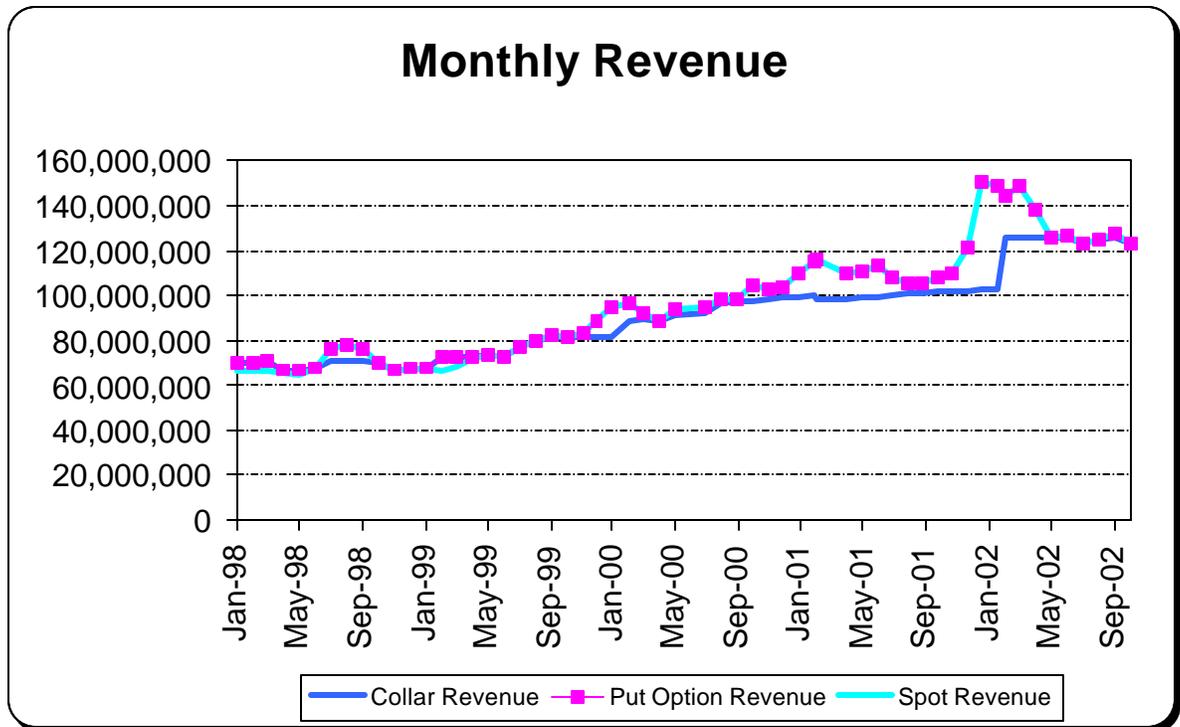
In the final analysis, the motivation for deciding on the above strategy was to achieve the following objectives:

1. 100% standard tariff rate
2. Minimise balance sheet requirements (i.e. zero mark-to-market)
3. Zero premiums

3.4.1.5 Findings

Based on historical data, the strategy achieved about 97% of the standard tariff. Of the three objectives above, only the zero premium objective was achieved because the collar option did not cost a premium to the power utility. Whether the instrument was effective or not, its effectiveness can only be reviewed in terms of set objectives and in comparison with other alternative hedging mechanism. Figure 8 below shows a comparison of the revenue earned from a collar compared with revenue if the power utility didn't hedge and thus earn revenue at spot price or if it bought a put option only.

Figure 8: Monthly Revenue from Electricity Contract



Source: The Power Utility (2003)

Suppose the power utility earned revenue at spot prices it would have earned more revenue compared with the collar. The major disadvantage of this is that there is no protection should there be a major decline in prices. Alternatively, suppose the power utility bought a put option it would have also earned more revenue compared with the collar. This strategy would have provided the power utility with a protection against a downside risk. The only disadvantage of this strategy is that the power utility would have been required to pay a premium and if this were to be taken into account above it would have resulted in lower revenue.

The power utility’s initial intention was to manage the commodity price risk and currency risk separately as no rand based commodity derivatives existed at the time to enter into a single hedge. By a single hedge, means hedging both risks with one financial instrument. Clearly, the zero-cost collar has been effective in reducing the currency risk and the commodity price risk exposure for the power utility.

Assuming no credit default, the benefit of this strategy is that the power utility’s exposure to adverse aluminium price fluctuations is hedged up to the floor. However, the

power utility is still exposed to the *credit risk* with the financial institution in the event of default. A default would occur if the electricity price is below the floor and the power utility can exercise the put option with the financial institution and the institution default on its obligation. This means that the power utility have not managed to recover lost revenue, received from the Aluminium producer, as a result of low aluminium price. The power utility's credit exposure is the mark-to-market of the revenue recoverable from the financial institution.

During the time of the study the power utility revised its strategy by entering into separate hedges. Due to stringent exchange controls regulations, the power utility has been previously been restricted with regard to hedging instruments it can apply. The exchange control authorities have restricted the power utility to apply only this instrument because it does not have an impact on the exchange controls. There are a number of complex financial instruments the power utility could apply, recommended in chapter 4, which will allow more realisation of the upside benefit.

3.4.2 Ferro-Chrome Agreements

3.4.2.1 Background

In the mid-90s the power utility entered into Electricity Supply Agreements (ESA) with various Ferro-Chrome producers. The parties agreed to share the risks and benefits resulting from fluctuations in the Ferro-Chrome price. The prices charged for the electricity supplied is based on a pricing mechanism established by the power utility and agreed to by both parties. In terms of the pricing mechanisms agreed, both a floor and a cap price have been incorporated in the formula applied.

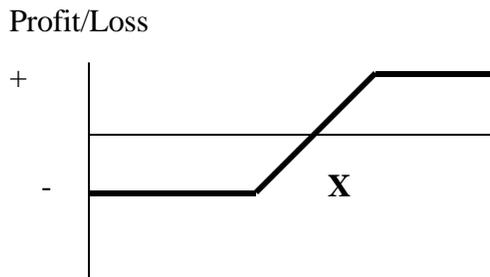
Because Ferro-Chrome is sold over-the-counter and not traded on an open exchange market, such as the London Metal Exchange, the Ferro-Chrome price with respect to various agreements is derived by averaging prices published in several publications. The prices published are quoted in US Dollar whereas revenue earned by the power utility is in Rand. Therefore, the pricing formula applied by the power utility and producers factored in the following parameters:

1. SA Rand/US Dollar exchange rate fluctuations
2. Commodity price fluctuations

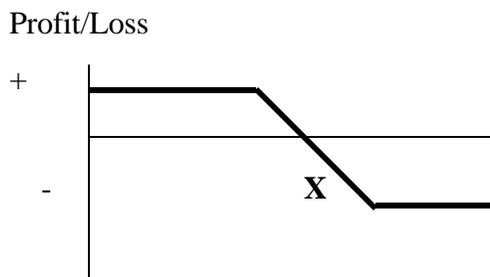
The cashflow or payoff profiles for the power utility and the commodity producer according to the tariff-linked agreement are as follows:

Figure 9: Ferro-Chrome payoff profile

(1) Power Utility



(2) Commodity producer



Where:

X is a standard tariff that corresponds with the Ferro-Chrome price.

The above figures shows a long position on the Ferro-Chrome for the power utility and a short position for the commodity producer together with a floor and a cap that provide for a minimum and a maximum tariff rate applicable. The mechanics of the agreement is that the power utility will benefit should the electricity tariff rate charged to the commodity producer be higher than the standard tariff whilst the commodity producer will lose and pass over the benefit of high Ferro-Chrome price to the power utility. On the other hand should electricity tariff rate charged to the commodity producer be lower

than the standard tariff the commodity producer will benefit and the power utility will therefore forfeit part of expected revenue. In the final analysis both parties benefit.

3.4.2.2 Assessment of risk

Although the agreement has good intentions, the power utility is exposed to commodity price risk, which it cannot hedge. The only remaining alternative hedging mechanism available to the power utility is to hedge through a synthetic index constructed from a basket of other metals. This results in a high level of *basis risk* exposure not acceptable to the power utility. A basis risk results from a hedge with a derivative of an asset that is different from the underlying asset hedged.

3.4.2.3 Hedging Strategy

As stated above, the power utility cannot hedge Ferro-Chrome because there is no liquid forward market for the commodity. To reduce the price risk of Ferro-Chrome, the power utility needs to hedge the Ferro-Chrome exposure with a tradable metal that is closely correlated with Ferro-Chrome. The power utility and the Ferro-Chrome industry are working to find a hedging mechanism that result in a win-win solution for both parties. Otherwise, the power utility assumes all the risk without being able to mitigating or transfer the risk elsewhere. Whatever the hedging strategy the power utility might implement it should always be aware of potential basis risk exposure. This risk will always have to be managed on a continuous basis.

3.4.2.4 Risk measurement

The electricity revenue earned by the power utility from Ferro-Chrome contracts runs into billions of rands. Majority of producers within the industry has entered into tariff-linked agreements with the power utility. The South African Ferro-Chrome industry has a huge influence on the international price, which is US Dollar based.

In 2001, when the International Ferro-Chrome market was depressed this resulted in a lower revenue earned, compared to the previous year, by the power utility. Although, the market risk exposure resulting from the contracts is a fraction of revenue earned because

of a collar built in the pricing formula the impact thereof can result into million of rands loss for the power utility.

3.4.2.5 Findings

The power utility did a historical analysis of the correlation between the Ferro-Chrome price and a base metal index (BMI) formed from a basket of base metals. As indicated in the earlier part of this section, it was discovered that a synthetic proxy to hedge the commodity was less than satisfactory. At the time of the study, the power utility was in the course of constructing an index (BMI) with a number of local banks that could be applied as a hedging tool. Of the several proposal previously received from various banks an index constructed that achieved the highest correlation was at hedge efficiency of 70%. The fact that Ferro-Chrome cannot be fully hedged means that the power utility would have assumed the remaining 30% basis risk. Some of the banks did indicate that they are not prepared to provide a hedge with such a high level of basis risk because the correlation over time it could change either higher or lower.

3.4.3 Gold Agreement

3.4.3.1 Background

In 2000, the power utility and a major gold producer entered into a so-called gold-price-linked tariff agreement, where the producer wishes to have a direct hedge for its gold production with the power utility through linking half of the gold producer's electricity consumption directly to the price of gold. In terms of the agreement, the producer agreed to a guaranteed fixed off-take Gigawatt hours per month for a period of 5 year. This tariff-linked agreement exposes the power utility to movements in the price of gold. Simultaneously, as part of the supply agreement, the power utility and the gold producer executed a hedging arrangement with a financial institution whereby the power utility is paid a fixed monthly enhancement fee for an intermediary role it plays.

3.4.3.2 Risk Measurement

According to sensitivity analysis performed by the power utility should it be necessary that the swap be closed out, with the financial institution, as a result of a default by the commodity producer due to the following events:

- Suppose the gold price plummets to \$250/oz and the commodity producer shuts down its operations completely – If say the hedge has been in place for one year when the commodity producer defaults, closing out the hedge would result in a positive cash inflow to the power utility from the financial institution;
- On the other hand, if the gold producer defaults and the gold price has rallied to \$350/oz, a net cash outflow will be paid to the financial institution.

3.4.3.3 Assessment of risk

In terms of this agreement, the power utility's revenue is exposed to both fluctuations in the Gold price (expressed in dollars) and the Rand/US Dollar exchange rate. This means that the power utility will have to hedge both the commodity price risk and the exchange rate risk.

To eliminate the gold price exposure, the power utility did enter into a commodity swap with a financial institution. In terms of the swap, the power utility is the floating price payer and the financial institution is the fixed price payer. By entering into a swap, the power utility has compounded its counterparty default risk exposure, which initially it had with the commodity producer only in respect of their electricity account. Suppose the commodity producer default on the expected revenue from electricity supplied and at the same time the power utility's obligation in terms of the swap requires settlement on the swap then the power utility will be required to use its own resources for this purpose.

Clearly, according to sensitivities performed by the power utility its risk is on the price of gold rising and the producer defaulting on the gold Price Adjustment. This scenario is highly unlikely because the viability of the commodity producer depends on the strengthening of the gold producer. Although, it might seem remote but one cannot shrug-off a possibility of the financial institution defaulting and not paying the power

utility the money due or the gold producer is closed down. This will result in the power utility either receiving a lower than standard tariff revenue or not receiving revenue at all but with financial obligations to the financial institution.

3.4.3.4 Hedging Strategy

In terms of the hedging arrangement, to eliminate the gold price exposure, the power utility entered into a commodity swap with the financial institution. This means that the financial institution will receive a floating gold price adjustment and pay the power utility a fixed gold price adjustment plus an enhancement fee. The enhancement fee is for the credit risk the power utility assumes, with respect to the swap, as a result of the intermediary role it plays.

In terms of the swap agreement, the power utility swaps the risk of the floating gold price for a fixed price with the financial institution. This means that when the fixed swap price is greater than the average domestic spot price of gold, the financial institution has to pay the difference between the swap price and the average price to the power utility. On the other hand when the fixed swap price is less than the average price the power utility has to make a payment to the financial institution. For the two parties the mechanism of swaps is purely financial meaning that it is cash settled and no delivery of commodities is involved.

3.4.3.5 Findings

The cash flow received from the hedge when the gold price is low offsets the reduced revenue from gold producer. The power utility is effectively acting as an intermediary between the commodity producer and the financial institution. The power utility is compensated a fixed monthly enhancement fee, by the financial institution, for the role it plays. However, a senior official at the power utility admitted that the compensation received is not adequate because the credit risk was not properly priced. This means that the credit risk assumed by the power utility is substantially high relative to the

enhancement fee. The mark-to-market risk exposure is worth millions of rands and the enhancement fee is worth thousand of rands.

One of the power utility's senior officials believes that the commodity producer could have entered into the swap directly with the financial institution without the power utility being an intermediary. If this was the case the power utility would have avoided the credit risk resulting from the swap. As a result of the hedging mechanism the power utility was exposed to a credit risk due to potential default by the financial institution. In terms of the arrangement, the power utility receives a credit enhancement fee on a monthly basis for its intermediary role.

3.5 Conclusion

At the present, the strategy of selling electricity utilising excess capacity is beneficial to the power utility but because, in few years time, such capacity is expected to run out this will result in additional costs for all the current and future electricity consumers. This will happen due to, for example, building of new power stations earlier than expected. Although a review of the power utility's special pricing policy as a whole is beyond the scope of the study the power utility will have to review some aspects of the policy. It is a concern that the power utility has sold a large portion of the excess capacity it had; because maintaining a substantial reserve on generating capacity is very important so that reliable supply is maintained for existing consumers into the future. Also, what is in doubt is how acceptable is the risks and costs associated with negotiated pricing agreements in the long-term.

Some of the criteria applied by the power utility for approval of any tariff-linked agreement requests in the short-term are being met, however, in the long-term it's uncertain whether the criteria will be fully met through some of the proposed agreements. As mentioned earlier in the chapter, from the utility company's point of view, non-tariff pricing agreements are entered into to achieve objectives mentioned at the beginning of the chapter. The objectives are noble for now, however, going forward the objectives will have to be revisited to determine as to whether are they still relevant and also are they in the best interest of the company.

There is no doubt regarding the benefits enjoyed by the power utility from tariff-linked agreements though, somehow, it will still have to find a balance between the need to provide key customers with suitable electricity prices and the potential of unnecessary market risk exposure. The power utility's risk appetite will determine the level of risk acceptance relative to the expected returns from the exposure taken. As the risk reaches an unacceptable level the power utility will have to either avoid or mitigate the risk by hedging or transferring the unacceptable risk to third parties.

The power utility has reached a stage whereby some of the good intentions the negotiated tariff policy represents have been attained and going forward the cost of electricity might overshoot unless caution is exercised. Also, the amounts involved runs into millions and effectively the power utility is increasingly exposing itself to commodity price risk on the income side of the business. Changing the policy is potentially the difficult part the power utility is facing because of the precedent it has set. For new entrants (commodity producers) in the market, because the power utility has entered into such contracts with existing firms within the industry, this may be seen as unfair competitive advantage competitors have over them. International competitors of local commodity producers are already accusing the power utility at the moment of subsidising the local commodity producers through tariff-linked agreements.

The major concern for the power utility should be tariff-linked agreements on commodities not listed on the London Metal Exchange (LME). For the power utility it is very difficult to hedge the risk associated with these commodities because no liquid forward market exists. There is a good financial engineering required on the part of the power utility to mitigate some of the risks related to these commodities. In addition to the electricity consumption the power utility is always faced with the price uncertainty, which may over time increase the power utility's revenue volatility. Financial engineering will help the power utility in either transferring or replacing the risks with certainty.

Another concern is the credit risk assumed through hedging mechanisms put in place. The power utility should quantify the total exposure directly emanating from hedging techniques applied and then formulate an effective risk management strategy to reduce this risk. Various credit risk mitigation techniques have been suggested in some sections of the report, which should be taken into account when such a strategy is implemented. Ideally, where possible the power utility can avoid this risk by not playing an intermediary role and let the producers enter into hedging arrangements directly with financial institutions.

In conclusion, the hedging mechanisms put in place by the power utility have been effective as far as mitigating the commodity price risk with respect to commodities listed on the LME but at the same time they have converted market risk into credit risk.

CHAPTER 4: RESEARCH FINDINGS

4.1 Introduction

The previous chapter reviewed tariff-linked agreements and investigated financial risks the power utility is exposed to as a result of various agreements. This chapter will provide an interpretation of the research findings and make recommendations.

4.2 Summary and Interpretations of findings

The study has highlighted some important findings, which will be beneficial to the power utility. The key among these findings is the fact that, with respect to the gold swap agreement, the power utility has compounded its credit risk without adequate compensation. With respect to the zero-cost collar, the instrument has been effective in hedging the market risk, however, it has limited the ability of the power utility to benefit more on the upside. Also, when the collar is out-of-money, that is, when the tariff is below the floor, the power utility is exposed to the risk of a potential default from the financial institution.

In the case of the Ferro-Chrome agreement, the power utility also assumed a certain level of the price risk, which it cannot hedge because there is no forward market for Ferro-Chrome. Although the power utility has on several occasions attempted, without success, to hedge the risk through a synthetic index, constructed from other base metals, it is still un-hedged at this point in time. This is because of an unacceptable low correlation level between the constituted index and Ferro-Chrome. Financial institutions were not comfortable with the high level of basis risk, therefore, the power utility could not hedge the Ferro-Chrome price exposure. A relief to the power utility is that some of the Ferro-Chrome agreements have an in-built collar that limits revenue volatility.

There is no question regarding the objectives of the special pricing policy of the power utility the primary one being utilisation of the spare capacity and the secondary one being diversification of the revenue stream. The power utility managed to achieve both objectives. However, the only shortcoming with regard to the policy is unintended

consequences that resulted, in some instances, in market risk or counterparty risk, which could not be hedged.

It should be noted that the above findings reinforce the fact that the power utility will have to either review its policy regarding tariff-linked agreements or it will have to re-examine some of the agreements because of the high level of risk it assumes. Risk is part of everyday business and by going into business companies take risk. To have a competitive edge over competitors companies need to take risk. Some risks are necessary and some are not. Also, some risks are manageable others are not. In taking risk companies are expected to be adequately compensated otherwise companies wouldn't have been in business. When companies assume risk without adequate compensation they are likely to encounter financial difficulties.

As indicated earlier, in the case of the gold swap the power utility wasn't fully compensated for the level of risk it assumes. Although the power utility enjoyed benefits through the electricity supply agreement the risk it assumes through the gold swap could have been avoided by not acting as an intermediary. The main concern is that in most cases the power utility acts as an intermediary between the commodity producers and financial institutions when commodity price risk is hedged. The power utility's role as an intermediary by default, as a result of its policy, exposes it to unnecessary market risk. Some of the power utility's senior officers believe that the power utility's benefit overall far surpasses the risk it assumes. While the others believe that the power utility's commitment in assisting commodity producers and the others achieves a strategic objective of selling electricity it wouldn't have otherwise sold if it didn't have entered into such agreements. All things considered, supplying electricity is the power utility's primary business, and a balance should be found between the risk assumed and the benefit enjoyed.

4.3 Recommendations

Recommendations in this report are based on shortcomings of the risk management strategy adopted by the power utility with respect to tariff-linked agreements. The report makes general and specific recommendations to different strategies.

4.3.1 Aluminium

The power utility could have applied the following strategies, to mitigate market risks, without limiting the upside potential or compromising the downside risk:

- Purchase of the put option,
- Using of futures contracts,
- Not hedge but create a reserve fund to cater for temporary losses.

The following are the advantages and disadvantages of the recommended strategies above:

Advantages

- When purchasing a put option, the power utility will be protected against downside risk without having to give up the upside benefit;
- The futures contract provides certainty and minimal counterparty risk;
- A fund provides protection without having to pay third parties for it.

Disadvantages

- When purchasing a put option, sometimes, the cost of initial premium may be very high;
- There is a margin payable for a futures contract,
- A fund has opportunity costs associated with it.

To mitigate the credit risk the power utility could:

1. Purchase credit derivatives to offset undesired credit exposure. Credit derivatives will enable the power utility to manage their credit risks by either buying an insurance against a particular credit risk or exchange one credit risk for another. According to Hull (2000:624) credit derivatives can be very effective in achieving credit risk reductions through diversification;
2. Set limits on total exposure to a given counterparty;
3. Require the posting of collateral;
4. Apply downgrade triggers

According to the power utility, of the above recommendations, point 2 and 3 above are being done with respect to its risk management practices.

4.3.2 Ferro-Chrome

Ferro-Chrome does not have a forward market to hedge the price risk using basic hedging tools available. Therefore, this limits the options available to the power utility in mitigating the risk. One alternative hedging mechanism is a synthetic hedge with an instrument that achieves hedge efficiency acceptable to the power utility.

After considering the synthetic hedge option and evaluating its merits and demerits; it is advisable that the power utility should not hedge the exposure through a synthetic hedge on the basis of the following reason. Suppose the power utility decide to go ahead and hedge the price risk through the proposed synthetic hedge, for example, with an average 85% hedge efficiency. The reason being that Ferro-Chrome cannot be fully hedged and this means that the power utility will have to assume the remaining 15% basis risk

According to the internal investigation, the current pricing formula below has huge revenue volatility. In view of this reason it was recommended that the formula below should be reviewed and an alternative model be considered. The general form of the current pricing formula underlying the agreement is:

1.

$$P_t = S_t + \left[(a \cdot FP_t - b) \cdot \frac{FX_t}{FX_0} - TEP_t \right]$$

Where:

P_t is the tariff payable,

S_t is the ruling standard tariff,

a is constant, and $a > 0$

and b is a constant

FP_t is the average Ferro-Chrome price,

FX_t is the current Dollar/Rand exchange rate,

FX_0 is the base Dollar/Rand exchange rate, and

TEP_t is a parameter that increases by the same annual percentage as the standard tariff.

The power utility considered an alternative pricing formula. The following was proposed as a pricing formula that could be applied:

2.

$$P_t = S \left(1 + \frac{(FP_t - FP_0)}{FP_0} \right)$$

Where:

P_t is the tariff payable,

S is the standard tariff,

FP_t is the current price of Ferro-Chrome price, and

FP_0 is the reference price of Ferro-Chrome for the period,

NB: The prices are in Rand cents per pound.

When applying formula (1) and formula (2) above the power utility yields revenue which is less volatile through formula (1) compared to that earned through formula (2) under the same price scenarios over the same period. Given that the power utility would like to earn approximately the standard tariff over the life of the agreement. It was recommended that the above formula (2) should be implemented with a cap and floor and the levels for the cap and floor should be reviewed annually. This view is correct because this will limit the benefits each party could gain and reduce Ferro-Chrome price risk the power utility is exposed to. At the time of writing the report the mechanism of fixing the cap and floor was not yet finalised.

4.3.3 Gold

When the power utility entered into the special pricing agreement with the gold producer the gold swap was negotiated, with the financial institution, as part of the arrangement. The swap is effective in hedging the market risk resulting from the tariff-linked agreement. As stated earlier in the report, the swap exposed the power utility to a credit risk due to potential default by the financial institution. In turn the power utility receives a credit enhancement fee on a monthly basis for the credit risk it assumes.

The power utility could hedge the credit risk through credit derivatives or alternatively it could, partly or wholly, unwind the swap. At the time of writing the report the power utility was considering various ways of reducing the credit risk exposure because of the financial problems the gold producer was experiencing due to low Rand gold price.

4.3.4 Recommended Instruments

4.3.4.1 Commodity-Linked financing

One instrument that could be very useful for the power utility is the commodity-linked financing. According to Priovolos and Duncan (1991:4) the commodity-linked financing is a hybrid instrument: It is a risk management instrument as well as a financing instrument. As commodity-linked financing extend beyond one year, their risk management properties are of strategic importance to the firms exposed to commodity price risk. Commodity-linked financing comes in many forms, such as commodity bonds, commodity loans, and others.

4.3.4.2 Commodity-linked bonds and loans

According to a report by the UNCTAD secretariat (April 1998:43), Commodity-price - linked bonds and loans in reality consists of a large number of non-standardized instruments, often with complicated specifications. There are many ways to tie the repayment of a loan or bond to commodity prices. Commodity-linked bonds are bonds in which the yield to maturity is linked mainly to the price of the underlying commodity. Instead of a fixed interest rate and a fixed amount paid at maturity, the pay-off of a commodity bond's principal and interest are expressed in terms of the price of the underlying commodity. If, say, the price of oil is high, interest obligations are high. When the oil price falls, interest obligations also fall.

The instrument could be useful to the power utility in a situation whereby it set-up a fund as recommended earlier in the chapter. It could also benefit the power utility because from time to time it issues conventional bonds in the market to raise capital for operations. In this way the power utility will benefit because it offers an effective means

of raising capital and at the same time hedging itself against commodity price risk. The power utility will also benefit by diversifying its debt profile and increase its funding base.

Commodity-linked bonds and loans

Purpose

- obtain easier access to finance on better terms
- hedge price risks and simultaneously raise investment finance
- debt rescheduling

Advantages
<ul style="list-style-type: none">• No initial cash transfer by the issuer• Long-term• Repayment is linked to the risks of the borrower: the price of its commodities• Tailor-made

Disadvantages
<ul style="list-style-type: none">• Borrower's credit risk• High volume required due to set-up costs underlying the issuance• Good track record required• Fairly sophisticated distribution network needed for market issue

Source: UNCTAD: *A survey of commodity risk management instruments* (6 April 1998: 32).

Commodity-linked bonds

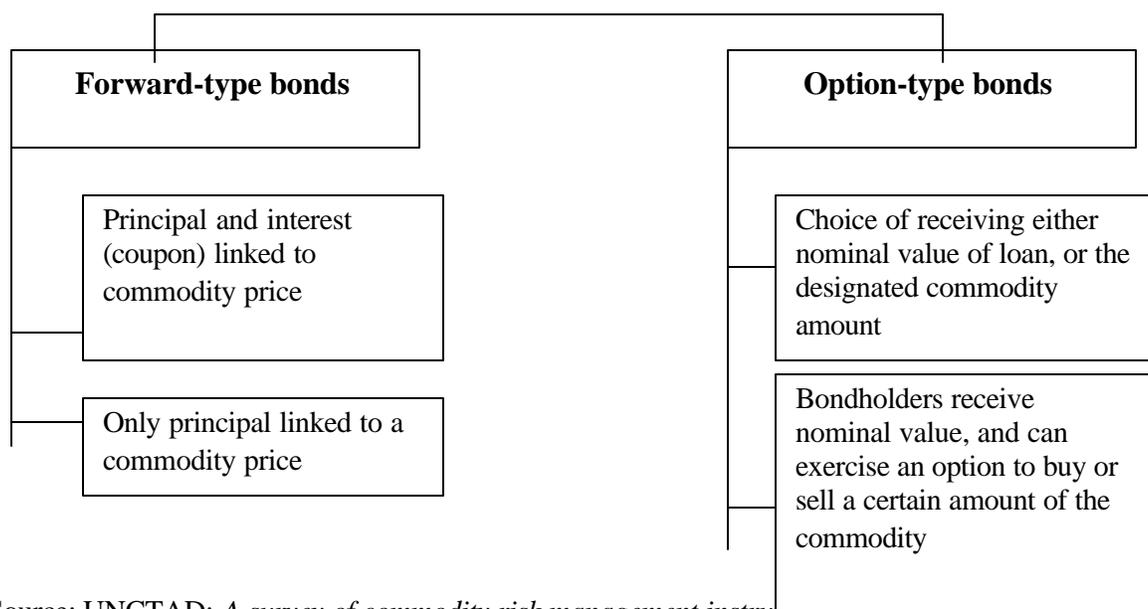
According UNCTAD report (1998:43) there are two types of commodity-linked bonds (*see figure below*), that is, those of a forward type, often called convertible or indexed bonds, and those of the option or warrant type:

- In **forward-type bonds**, the principal and/or interest are linked to a commodity price or to a commodity price index. Its advantages and limits are similar to those of commodity-linked loans. Oil producers for risk hedging often issue these forward-type bonds. If only the principal payment is linked to oil prices, the bond is a security in which a conventional bond and a commodity forward contract are combined. If the coupon payments also are linked, the bond is a combination of a conventional bond and a commodity swap.

- With **option-type bonds**, the holder of the bond has the right to buy or sell a commodity at an exercise price, in addition to his conventional bond. It combines a conventional bond with commodity options. As a result, the holder of the bond has the right to buy/sell oil at an exercise price, in addition to his conventional bond. It is mainly useful for oil producers in order to reduce their cost of financing by attaching long-term options written on oil.

The report also state that the forward-type of commodity bonds are often issued for risk-hedging by the company or producer (or country) involved; the option-type bonds are used to reduce the cost of financing (lower coupons).

Figure 10: Two types of commodity-linked bond



Source: UNCTAD: *A survey of commodity risk management instruments* (October 1998, 15).

Commodity-linked loans

The UNCTAD report (1998:43) defines a commodity-linked loan are loans which tie the payment of interest and/or principal to the price of a commodity or a basket of commodities. It is also a combination of a conventional fixed-rate loan and a commodity swap contract. International banks provide these loans. If used by an oil producer, the credit risk of the loan is lower than that of conventional loan. Indeed, a producer can repay the loan even if oil prices fall significantly. Like commodity bonds, commodity

loans specify the repayment of principal and/or interest as linked to commodity prices, in a direct manner, or as an option.

REFERENCES

1. Atsou, K and Ravi, D. E. (1991). The Handbook of Derivative Instruments: Investment Research, Analysis and Portfolio Applications. Chicago, Illinois: Probus Publishing Company.
2. Beder, T. S. (1996). Derivatives under Control: *Corporate Cashflow*. January (1996) pp. 1-3.
3. Beder, T. S. (1995). VAR: *Financial Analysts Journal*. A Publication of Association for Investment Management and Research. September-October (1995). pp. 12-24.
4. Benninga, S. & Wiener, Z. (1997). *Mathematica in Education and Research*. The Binomial Option Pricing Model. Page 1-9. Available on internet site: www.finance.wharton.upenn.edu/~benniga/
5. Brier, S. (2002). A new language of Risk: a foundation for enterprise-wide risk management. Pretoria: Unisa Press.
6. Carr, P. and Madam, D (1999). Risk. *Correlation derivatives: Introducing the covariance swap*. (February 1999). pp. 47-59.
7. Das, S. (1999). Swap & Derivative Financing: The Global Reference to Products, Pricing, Application and Markets. Australia: McGraw-Hill.
8. Dowd, K. (1998). Beyond Value at Risk. England: John Wiley & Sons.
9. Du Toit, G.S. & Van Rooyen, J.H. (1998). Risk Management: MNK202Q study guide. Pretoria: Unisa.
10. Enron Capital & Trade Resources. (1995). Managing Energy Price Risk. Risk Publications.

11. Falkena, H.B, et al. (1987). The Dynamics of the South African Financial System: Financial Risk Management. Johannesburg: Macmillan South Africa.
12. Galitz, L. (1995). Financial engineering: tools and techniques to manage financial risk. London: Pitman Pub.
13. Ghauri, P.N. (1995). Research Methods in Business Studies: A practical guide. New York: Prentice Hall.
14. Goldman Sachs & Swiss Bank Corporation (1998). The Practice of Risk Management. Published by Euromoney Books.
15. Huisman R. et al. (1998). VAR-x: Fat tails in financial risk management. Journal of Risk. (Fall 1998). Vol. I London, UK: Risk Publications.
16. Hull, J.C (2000). Options, Futures and Derivatives. Fourth Edition. Prentice-Hall International, Inc.
17. Jorion, P. (2002) Fallacies about the effects of Market Risk Management Systems. *Journal of Risk*. (July 2002). pp.1-28. Available on www.gsm.uci.edu/~jorion
18. Jorion, P. (2002). How informative are Value-at Risk Disclosures? *Accounting Review*. (October 2002). pp. 1-35. Available on www.gsm.uci.edu/~jorion
19. Jorion, P. (2001). Value at Risk: The New Benchmark for Managing Financial Risk. 2nd Ed. New York: McGraw Hill.
20. Jorion, P. (2001-2002). Financial Risk Manager Handbook. GARP. John Wiley & Sons, Inc.
21. Larson, D.F, et. al. (1998). Development Research Group: Commodity Risk Management and Development. (April 1998) pp. 1-26.

22. Leedy, P.D. (1974). Practical Research: Planning and Design. Macmillan Publishing Co, Inc.
23. Minnich, M. (1998). A Primer on Value at Risk. **In:** Chapter 3: *Perspectives on Interest Rate Risk Management for money managers and traders*. Edited by Frank J. Fabozzi, pp. 39-50.
24. Natenburg, S. (1994). Option volatility and pricing: advanced trading strategies and techniques. Chigago, III: Probus.
25. Rahl, L. (1994). *Article: 10 Commandments of Risk Management. Treasury & Risk Management*. New York: Capital Market Risk Advisors, Inc. (July-August 1994) pp. 45-47.
26. Rahl, L and Lee, C. (2000). *Article: Reflections and Risk Management*. Capital Market Risk Advisors, Inc., New York. (April 2000). pp. 20-26.
27. Rahl, L and Esseghaier, Z. (2000). *Article: Measuring Financial Risk in the 21st century*. Capital Market Risk Advisors, Inc., New York. (Spring 2000). pp 45-54.
28. Salkind, N.J (2000). Exploring Research 4th Edition. Prentice Hall, New Jersey.
29. Stanislas, R (2002). Enterprise risk management for financial institutions. *ERisk.com*. (January 2002), pp.01-06.
30. Sooran, C. (1999) Article: *The Risk Manager*. (12 February 1999). Available on internet site: www.victoryrisk.com/the_risk_manager.htm
31. Smith, N. (2003). Afgri fires three trading executives. *Business Report*. February 2003.

32. Stoll, H R. & Whaley, Robert E. (1993). Futures and Options: Theory and Applications. Cincinnati, Ohio: South Western Publishing Co.
33. Theophilos, P (1991). Commodity Risk Management and Finance. Oxford University Press.
34. Treat, J.E. (1990). Energy Futures. Oklahoma: Pennwell Publishing Company Tulsa.
35. UNCTAD secretariat. (6 April 1998). *A Survey of Commodity Risk Management Instruments*. Available on internet site: www.unctad.org/commodities/docs.htm

World Wide Web Sources

www.contigencyanalysis.com/

www.cmra.com

www.defaultrisk.com

www.erisk.com/Products/Energy_Solutions/Counterpartycreditriskana.Asp

www.finance.wharton.upenn.edu

www.finpipe.com

www.garp.com

www.google.com

www.isda.com

www.metalbulletin.com

www.riskmetrics.com

www.riskchat.com

www.unctad.org/commodities

www.victoryrisk.com

APPENDIX A

The Risk Management Landscape

Risk Dimension	Definition	Managed by
Market risk	The risk to an institution's financial condition arising from adverse movements in the level or volatility of market prices.	Providing consistent information of market risk across the organisation at all levels; calculation consistent risk measures (volatilities, VAR); establishing appropriate procedures and monitoring risk limits; and understanding where risk comes from across the organisation.
Credit risk	The risk that a counterparty will fail to perform on an obligation owed to the firm.	Monitoring credit exposures relative to limits; resetting limits; resetting limits regularly; and scenario analysis.
Settlement risk	The risk that a firm will not receive funds or instruments from its counterparties at the expected time.	Monitoring counterparty activity and settlement limits; and managing pre-settlement counterparty exposures.
Liquidity risk	An institution faces two types of liquidity risk: one related to specific products or markets, the other related to the general funding of the institution's activities. The former is the risk that an institution may not be able to, or cannot easily unwind or offset a particular position at or near the previous market price because of inadequate market depth or because of disruptions in the market. Funding liquidity risk is the risk that institution will be unable to meet its payment obligations.	Actively matching funding horizon of debt to liquidity of positions; and developing liquidity guidelines to limit exposure in asset classes and instruments.
Operational risk	The risk that deficiencies in information systems or internal controls will result in unexpected loss. This risk is associated with human error, system failures and inadequate procedures and controls.	Establishing proper supervision and segregation of duties; testing all systems in a comprehensive manner, establishing complete reconciliation between internal and external systems; and setting up compete independent backup facilities and systems.
Legal risk	The risk that contracts are not legally enforceable or documents	Carefully contracting and conducting business with

	correctly.	external parties and employees; and establishing clear compliance and regulatory structures.
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Source: SBC Warburg Dillon Read (1998:32)

GLOSSARY OF TERMS

Term	Definition
ALCO	Assets and Liability Committee
At-the-money	An option where the strike is the same as the current spot or forward market rate.
Average option (or Asian option)	An option whose value depends on the average value of the underlying over the option's life.
Back-testing	Testing VAR model against historic data to check its validity.
Barrier option	An option, which is either cancelled or activated if the underlying price reaches a predetermined barrier or trigger level.
Basis risk	The risk that the price or rate of one instrument or position might not move exactly in line with the price or rate of another instrument or position.
Basis swap (or Index swap)	An interest rate swap in which the two legs are based on differently defined floating interest rates.
Bid	The price at which the dealer quoting a price or rate is prepared to buy or borrow. The bid price of a foreign exchange quotation is the rate, which he will buy the base currency and sell the variable currency.
Beta	A measure of the systematic risk of an asset.
BIS	Bank of International Settlements.
Black and Scholes model	A formula for calculating option prices, developed by Fischer and Black and Myron Scholes.
Bootstrapping	The process of building up a theoretical spot yield curve by calculating zero coupon yields for successively longer maturities from those for shorter maturities.
Call option	A deal giving one party the right, without the obligation, to buy an agreed amount of a particular instrument or commodity, at an agreed rate, on or before an agreed future date. The other has the obligation to sell if so requested by the first party.
Cap (Or ceiling)	A package of interest rate option coupled with the sale of

another call option at a different strike, expecting a limited rise or fall in the value of the underlying.

Capital adequacy ratio	The minimum level which supervisors require a bank to maintain for the size of its own funds (available capital and reserves) as a proportion of its risk-weighted assets (the amount of money which it has put at risk in the course of its business).
Collar	The sale of a put (or call) option and purchase of a call (or put) at different strikes – typically both out-of-the-money – or the purchase of a cap combined with the sale of a floor.
Commodity price risk	The risk arises where a firm is affected by fluctuations in the price of the commodity.
Commodity Swap	A swap in which the exchange of payments by the counterparties is based on the value of a particular physical commodity such as oil.
Convexity	A measure of the curvature of an investment's price/ yield relationship, indicating the extent to which its value does not change in direct proportion to yield.
Counterparty	The opposite side in a financial transaction.
Counterparty risk	The risk that a borrower, or a counterparty deal, will default on repayment or not deliver its side of the deal.
Correlation	A measure of the extent to which two things do, or do not, move together.
Covariance	A concept linking correlation and variance, measuring how much two things vary, relative to each other.
Covered option	An option bought or sold against an existing position.
Credit derivative	A derivative whose payoff depends on the creditworthiness of one or more entities.
Currency risk	The risk that a borrower, or a counterparty to a deal, or the issuer of a security, will default on repayment or not deliver its side of the deal.
Currency swap	A swap in which the parties sell currencies to each other subject to an agreement to repurchase the same currency in the same amount, at the same exchange rate, and at a fixed date in the future.
Delta ()	The change in the value of an option as a proportion of the

change in the value of the underlying.

Derivative	Any financial instrument whose value is derived from another, such as a forward foreign exchange rate, a futures contract, an option, an interest rate swap etc. Forward deals to be settled in full are not always called derivatives.
Discount	The amount by which one currency is cheaper, in terms of another currency, for forward delivery than for spot.
Duration (or Macaulay duration)	The weighted average life of a bond or other series of cashflows, using the present value of each cashflow as it's weighting.
Dynamic Hedging	A procedure for hedging an option position by periodically changing the position held in the underlying asset. The objective is usually to maintain a delta-neutral position.
European option	An option that may be exercised only at expiry.
Exercise	To required the seller of an option to fulfil the underlying transaction.
Exotic option	A general term for any complex option.
Exposure	The maximum loss from default by a counterparty.
Fixed rate	A borrowing or investment where the interest or coupon paid is fixed at the beginning of the arrangement.
Floating rate	A borrowing or investment where the interest or coupon paid changes throughout the arrangement in line with some reference rate such as LIBOR.
Floor	A package of interest rate options whereby at each of a series of future fixing dates, if agreed reference rate such as LIBOR is lower.
Forward	A deal for settlement later than the normal settlement date for that particular commodity or instrument.
Future contract	A deal, traded on a recognized exchange, to buy or sell some financial instrument or commodity for settlement on a future date.
G30	The Group of Thirty is a private, non-profit association, consisting of senior representatives of the private and public sector and of academia.
Gamma ($\tilde{\Delta}$)	The change in the value of an option's delta as a proportion of

the change in the value of the underlying.

Hedge	Protect against the risks arising from potential movements in exchange rates, interest rates or other variables.
Hedge ratio	The face value of one instrument which must be used to hedge another instrument or a portfolio, as a proportion of the face value of the latter.
Historical volatility	The actual volatility observed using historical data over a particular period.
Holder	The purchaser of an option.
In-the-money	An option whose strike is more advantageous to the option buyer than the current market rate.
Intrinsic value	The difference between the strike price and the current market price of an in-the-money option (zero for an out-of-the-money option).
Leveraged	A speculative position where the amount of cash which it is necessary to invest less than the principal amount at risk.
LIBOR	London inter-bank offered rate, the rate at which banks are willing to lend to other banks of top creditworthiness. Generally used to mean both the interest rate at any time, and specifically the fixing at a particular time (11:00 a.m.).
Long	A surplus of purchases over sales of a given currency or asset, or a situation which gives rise to an organization benefiting from a strengthening of that currency or asset. To a money market dealer, a surplus of borrowings taken in over money lent out.
Margin	Initial Margin is collateral placed by one party with a counterparty or clearing house at the time of a deal, against the possibility that the market price will move against the first party, thereby leaving the counterparty with a credit risk. In a repo, initial margin is the same as a haircut . Variation is a payment made, or collateral transferred, subsequently from one party to the other because the market price of the transaction or of collateral has changed. Variation margin payment is either in effect a settlement of profit/loss (for example in the case of a future contract) or the reduction of credit exposure (for example in the case of a repo).
Mark to market	Revalue a position at current market rates.
Measure	Sometimes also called a probability measure, it defines the

	market price of risk.
Monte Carlo simulation	Application of a large number of random price changes to a position or portfolio, to assess the risk or probable outcome.
Nominal probability distribution	A particular probability distribution assumed to prevail in a wide variety of circumstances, including the financial markets.
Notional	In a bond futures contract, the standardized non-existent bond traded, as opposed to the actual bonds which are deliverable at maturity.
Offer	The price at which the dealer quoting a price or rate is prepared to sell or lend. The offer price of a foreign exchange quotation is the rate at which he will sell the base currency and buy the variable currency.
Option	The right, without any obligation, to undertake a particular deal.
Out-of-the-money	An option whose strike is less advantageous to the option buyer than the current market rate.
Over-the-counter (or OTC.)	A transaction dealt privately between any two parties, rather than dealt on an exchange.
Par yield curve	A curve showing yield against time to maturity for theoretical bonds which would be priced at par to be consistent with the yields of actual instruments available in the market.
Present value of a Basis Point	The price change in an investment arising from a 1 basis point change in yield.
Probability distribution	The mathematical description of how probable it is that the value of something less than or equal to a particular level.
Put option	A deal giving one party the right, without the obligation, to sell an agreed amount of a particular instrument or commodity, at an agreed rate, on or before an agreed future date. The other party has the obligation to buy if so requested by the first party.
Rho (ρ)	The change in the value of an option as a proportion of the change in the interest rate.
Scenario Analysis	An analysis of the effects of possible alternative future movements in market variables on the value of a portfolio.
Sensitivity Analysis	Analysis of impact on an economic analysis, plan or forecast of a change in one of the input variables.

Settlement date	The date on which a transaction is consummated, i.e. delivery takes place.
Settlement risk	The risk that a counterparty defaults during settlement-a particular category of counterparty risk.
Short	A surplus of sales over purchases of a given currency or asset, or a situation which gives rise to an organisation benefiting from a weakening of that currency or asset. To a money-market dealer, a surplus of money lent out over borrowings taken in.
Spot	A deal to be settled on the customary settlement date for that particular market. In foreign exchange market, this is for value in 2 working day's time.
Standard deviation	The square root of the variance of a series of numbers.
Static Hedge	A hedge that does not have to be changed once it is initiated.
Stress testing	Testing of the impact of extreme market moves on the value of a portfolio.
Synthetic Option	An option created by trading the underlying asset.
Underlying	The instrument or commodity, which is being bought or sold in an option.
Value at risk	The maximum potential loss which a bank expects to suffer on its positions over a given time period, estimated with a given confidence level.
Volatility	The annualised standard deviation of the continuously compounded rate of return on an investment. A measure of how much the price fluctuates.
Writer	The writer of an option.
Yield	A return provided by an institution.
Zero-cost option	A combination of options bought and sold, such that the premiums paid and received net to zero.