Foreign Exchange Hedging and Profit Making Strategy using Leveraged Spot Contracts

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Declaration

I, Ching Hsueh LIU, declare that the DBA thesis entitled “Foreign Exchange Hedging and Profit Making Strategy using Leveraged Spot Contracts” is no more than 65,000 words in length, exclusive of tables, figures, appendices, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

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Abstract

Australia currently adopts the floating exchange rate system; therefore the value of the Australian dollar is subject to volatility due to the influence of changing domestic and international economic circumstances. This volatility of the Australian exchange rate system is an issue that affects the majority of Australian businesses. With over fifty percent of Australian trading invoiced in foreign currencies, movements in the value of the Australian dollar can potentially improve or worsen Australian companies' financial performance, and consequently, affect the national economic indicators. The importance of managing these currency risks not only stimulates countless studies attempting to capture a set of factors that are most relevant in contributing to the volatility of the Australian exchange rate system, but also encourages research attempting to develop an optimal hedging model that can assist Australian businesses to manage foreign exchange risk.

From the review of existing literature, there appears to be a noticeable gap between theory and practice. Indeed, there exists a vast literature that looks at traditional financial derivatives such as options, futures, forward, and swaps-for example, the Black-Scholes model is used for options pricings in the share and foreign exchange market. However, there is a paucity of research focusing on the leveraged spot market, both from an empirical and theoretical point of view. This thesis aims to minimize this omission by developing a model of speculation as well as a model of hedging, providing a theoretical framework and empirical simulations.

Our model of speculation, developed in Chapter 3, adapts Krugman's (1991) model of target zones, in order to theoretically determine the optimal number of leveraged spot contracts taken by a speculator. Moreover, using historical data on interest rates and spot rates, we conduct a simulation to provide insights into how changing economic factors affects the speculator's position in the real world. In Chapter 4, we extend this model to show how speculation gains can be hedged with forward contracts. Traditional hedging methods involve the use of money markets and forward contracts; however, in Chapter 4, we describe how leveraged spot contracts can be used for hedging purposes. Moreover, we show that under some circumstances, the leveraged spot contract hedge outperforms these traditional hedging methods.

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Abbreviations

ABS	Australian Bureau of Statistics
ACH	Australian Clearing House Pty Ltd
AFMA	Australian Financial Markets Association
ASX	Australian Stock Exchange
AUD	Australian Dollardollar
BIS	Bank for International Settlements
CME	Chicago Mercantile Exchange
ETOs	Exchange Traded Options
ISDA	International Swaps and Derivatives Association
JPY	Japanese Yen
MNCs	Multinational Corporations
NYMEX	New York Mercantile Exchange
OTC	Over-the-Counter
PHLX	Philadelphia Stock Exchange
RBA	Reserve Bank of Australia
SIMEX	Singapore Mercantile Exchange
USD	US Dollardollar

Chapter One

Introduction

1.1 Context of the Thesis

The foreign exchange market is characterized by volatility, which creates uncertainty in the market and makes predictions regarding future exchange rates difficult, both in the short and long term. However, it is these constant fluctuations in the foreign exchange market that make it possible for companies or individuals to take advantage of the movements in exchange rates through speculative activities. These fluctuations also pose a threat for any importer/exporter trading in the global marketplace as international businesses are naturally exposed to currency risk. This necessitates the adoption of hedging strategies to mitigate risk. The volatility in the foreign exchange market needs to be dealt with in a proper, prudent and timely manner. Otherwise, adverse currency fluctuations can inflict painful lessons on a company or individual. Later in this thesis we will investigate in detail the volatility of the foreign exchange market and the potential risk exposure faced by all market participants.

People enter into the foreign exchange market for various reasons and the abovementioned potential for profit is a very important motivation. Indeed, some traders who come with the intention of making profit by taking advantage of market fluctuations engage in speculative activities in the foreign exchange market and accept the risks involved, while others attempt to protect themselves from volatility by engaging in hedging activities. Traders in this first category are commonly known as speculators, whereas the latter are known as hedgers. Speculators enter the market, in effect, by placing their “bets” on the currency movements. Should their prediction come true, they make profits; if their predictions are not realized, they suffer losses. Hedgers enter the market with the intention of insuring themselves against any adverse currency movements they may encounter in their business operation. Hedging involves the creation of a position that offsets an open position occurring in their business operations; so that the gain in the business (hedge) position will offset the loss of the hedging (business) position. Chapter Two of this thesis will analyze these players in the foreign exchange market using the *Expected Utility Theorem* of Aliprantis and Chakrabarti (2000).

There are various financial instruments used for trading in the foreign exchange market. The most common are spot contracts, forward, futures, options, swaps and various money market instruments. Forward, futures, options and swaps are derivatives instruments. Commonly used instruments in the money market include (but are not limited to): (1) Treasury bills, (2) Eurodollar, (3) Euroyen, (4) certificate of deposit (CD), and (5) Commercial paper. In fact, the money market represents most of the financial instruments that have less than twelve months maturity. A leveraged spot contract is in essence the same as the spot contract, except that in the former, a trader is allowed to trade on a margin specified by the financial institutions. This margin is also known as the leverage ratio and can range from twenty to two hundred, depending on the financial institutions involved. If the given leverage ratio is twenty, the trader using a leveraged spot contract can have access to a credit line twenty times larger than his/her initial margin (collateral). Clearly, the leveraged ratio allows traders (both speculators and hedgers) to trade at a significantly lower capital requirement when compared to the spot market.

The general mechanism of each of these markets (forward, futures, options, swaps and money markets) will be explained in detail in Chapter Two. Nevertheless, it is essential for us to provide a brief explanation of the leveraged spot market as we introduce the context of this thesis in this chapter. This is mainly because leveraged spot contracts are not as commonly used financial instruments as are the forward, futures, swaps, options and spot contracts. Moreover, the fundamental motivation for this thesis is to develop a model for using the leveraged spot market (contract) for both speculative and hedging purposes. The thesis not only illustrates how to use leveraged spot contracts as both a speculative and hedging technique (like the forward, futures, swaps, options and spot contracts), but also shows that under specific circumstances, the leveraged spot contract is superior to these traditional financial tools.

1.2 Limitations of Existing Literature and Aims of the Research

According to our review of the available literature, there appears to be a significant gap between theory and practice. Indeed, most popular models, such as the Black-Scholes, Merton and Whaley Option Pricing Models, have the same assumption that the volatility of the underlying asset is constant. This assumption is obviously not realistic. With the aim to close this gap between theory and practice, a new model is developed in this thesis using the assumptions that the interest rate definitely changes according to economic conditions or policies and that the exchange rate movement follows the pattern of a random walk, which is a stochastic process. Moreover, during the course of our research, we did not encounter any literature that dealt with leveraged spot contracts as both speculative and hedging instruments. It is obvious that the leveraged spot market is relatively less commonly used by financial derivatives traders, compared to traditional instruments such as forward, futures, options, swaps, and the money market. Our objective is therefore to develop a model using leveraged spot contracts as an effective financial instrument that can be used for both speculative and hedging purposes.

1.3 Research Contributions

The completion of this thesis contributes to the studies of global finance and economics in two ways. Firstly, we demonstrate here how the leveraged spot market can be used for speculating and hedging purposes, and that under certain circumstances, the leveraged spot contract can generate risk-free profit. Secondly, we show that under those circumstances, the leveraged spot contract is a better hedging tool than traditional financial instruments used for this purpose, such as the forward and money market hedges.

Chapter Three and Four will illustrate how the leveraged spot market allows speculators and hedgers to gain additional interest as their risk-free profit from a transaction. This is a distinctive feature which is absent when using traditional financial tools. The opportunity of obtaining risk free interest profit helps to lower the risk of trading (both speculating and hedging) in the foreign exchange market. This feature of the leveraged spot market allows traders (both hedgers and speculators) to achieve a specific expected return at a lower risk or a higher expected return for a given level of risk. This makes the leveraged spot market suitable for both risk averse and risk neutral individuals.

While our hedging model using the leveraged spot market can yield superior results when compared to forward and money market hedges, it is vital to understand that the effectiveness of this technique can be reduced under certain circumstances. In fact, the potential of this model is dependant on the leverage ratio and the interest rate differentials. In other words, the higher the leverage ratio and interest rate differentials between nations, the greater the return our methodology can secure using leveraged spot contracts.

1.4 Methodology

The methodology for this research will involve primarily quantitative data analysis and mathematic modeling. The methodology is designed to:

- illustrate how the leveraged spot market can be utilized both as a speculating as well as a hedging tool;
- derive insights into how real world data will affect the optimal number of contracts that a trader should trade (or invest) at any given time;
- present a simulation model for speculation using leveraged spot contracts based on Krugman's (1991) model of exchange rate dynamics within a target zone;
- demonstrate how a trader can hedge an open position in the leveraged spot market with a simultaneous position in the forward market to generate profit; and
- explain how a hedger can hedge an existing business transaction exposure using the leveraged spot.

1.5 Data Collection

The data collected for this research are secondary data. They consist of real world data on interest rates for Australia, the United States (US), and Japan, and historical spot rates of the Australian dollar, the US dollar, and the Japanese yen. The sources of these data include (but are not limited to) the Reserve Bank of Australia, the Federal Reserve Bank of New York, the Bank of Japan, and the Australian Bureau of Statistics. Information regarding derivative contracts specifications and features was mainly gathered from the Australian Stock Exchange (ASX), the Chicago Mercantile Exchange (CME), the Philadelphia Stock Exchange (PHLX), the New York Mercantile Exchange (NYMEX) and the International Swaps and Derivatives Association (ISDA).

1.6 Structure of the Thesis

This thesis is organized into five chapters. The first chapter is an introduction to the thesis. Chapter Two provides a review of previous literature on hedging and the volatility of the foreign exchange market. This second chapter is divided into two parts: the first part covers a background of hedging and explores the common applications and techniques of hedging; and the second part covers the volatility of foreign exchange movements, providing a brief background on the economic fundamentals of exchange rate determination and dynamics, exchange rate systems, international financial markets, and government policies affecting exchange rate systems.

Chapter Three analyses how the leveraged spot market can be used as a speculating tool. We adapt Krugman's (1991) model of exchange rate dynamics within a target zone Based on Krugman, we assume that the exchange rate movement follows the pattern of a random walk and we develop a model showing how the leveraged spot contract can be used as a superior financial tool when compared to forward and spot contracts under certain circumstances. However, before developing this model Chapter Three illustrates the mechanism of trading in the leveraged spot market with a numerical example.

Chapter Four describes how to eliminate the risk which arises from speculative leveraged spot transactions using a forward contract. Moreover, several numerical examples are used to illustrate how companies can utilize leveraged spot contracts as a hedging tool. We show in this chapter that the leveraged spot contract, when used in conjunction with a forward contract, can indeed derive risk free profits for its users. The effectiveness and profit generated from using leveraged spot contracts depends on the leverage ratio and the interest rate differential between the home and foreign countries.

Chapter Five ends this thesis with some concluding remarks on its contributions. Appendix A provides information regarding: (1) the history of hedging; (2) the cost and benefits of hedging; (3) the international financial market and exchange rate system; and (4) data gathered from the 2005 ABS survey on currency exposure and hedging practices of Australian international businesses. Appendix B provides a background on the calculation of currency variance used in the model simulation.

Chapter Two

Literature Review

2.1 Introduction

The financial world has witnessed several major catastrophes in the last dozen years. The first catastrophe was the collapse of Barings Bank in Britain in 1995 (Stonham, 1996a, 1996b). The bank's collapse was a direct result of Nick Leeson's aggressive trading in the futures and options markets. Between 1992 and 1995, the self proclaimed "Rogue Trader"[1] accumulated losses of over £800million. In February 1995, the 233 year-old Barings Bank was unable to meet the Singapore Mercantile Exchange's (SIMEX) margin call. The bank was declared bankrupt and was bought by the Dutch Bank, ING, for only £1.

The second catastrophe was the Asian financial crisis in 1997. Much literature had been written about the crisis as the financial world tries to understand what went wrong that led to the crisis. Some authors claimed that the crisis was triggered by the run of panic investors on those economies as well as depositor on banks which led to the burst of a bubble economy; while others blamed the crisis on the moral hazard in the Asian banking (financing) systems (Radelet and Sachs, 1998; Stiglitz, 1998; Krugman, 1998). We believe that the Asian financial crisis was due mainly (but not limited) to the structural imbalance in the region, caused by large current account deficits, high external debt burden, and the failure of governments to stabilize their national currencies. These problems were worsen by the poor prudential regulation of

[1] Nick Leeson wrote an autobiography called "Rogue Trader" detailing his role in the Barings scandal while imprisoned.

the Asian financial system during the 1990s. The combination of these factors contributed to the long-term accumulation of problems in fundamentals, such as large amount of ‘over-lending’ and bad loans in banking systems which led to the bankruptcies of large firms/banks in the economy, and eventually destroyed the confidence of investors and triggered the panic run of both investors and depositors of the Asian financial system (Kornai, 1980; Dewatripont and Maskin, 1995; Corsetti and Roubini, 1998; Aghevli, 1999; Huang and Xu, 1999; Corsetti, Pesenti and Roubini, 1999; Lane, 1999; RBA, 2002; Homaifar, 2004, pp.68-69). As part of their efforts, governments tried entering the derivative markets to stabilize their currencies. The Thai Government, for instance, utilized the forward market. However, as the world witnessed the collapse of several Asian currencies during the course of the 1997 financial crisis (including the Thai Baht), it was obvious that these stabilizing efforts were not successful.

As the Asian countries continued their recovery efforts, Enron collapsed in 2001 as a result of imprudent use of financial derivatives (Wilson and Campbell, 2003). It had been reported that Enron’s management engaged in questionable transactions in the options market, in an attempt to keep the true economic losses of various investments off Enron’s financial statements and to try to conceal the actual financial situation of the company (Aghevli, 1999; Wilson and Campbell, 2003). The consequences of these catastrophes were devastating. They impacted not only on the governments and companies directly involved in the events, but also their stakeholders, such as shareholders, employees and ordinary citizens. Many studies examining international financial markets have been designed to prevent the future occurrence of a similar catastrophe. Most of these studies are still attempting to learn from past mistakes through analyzing what exactly triggered such catastrophic events. Amongst those many studies, some have been undertaken to assist companies to minimize their exposure to fluctuations in the currency market, and to implement better techniques and supervision of corporate risk and management (RBA, 2002). As a result, topics such as currency exposure, hedging strategies and prudent, ethical company practices have become mainstream issues in international financial markets.

This thesis is concerned with hedging techniques in relation to the risk faced by Australian companies and individuals of currency fluctuations. We will point out the limitations and strengths of common hedging techniques and then derive a new technique for hedging. This new model aims to minimize or eliminate the limitations of existing hedging techniques. The importance of understanding the underlying economic and financial fundamentals, which were possibly responsible for the 1997 Asian financial crisis, is noted. These underlying issues are peripheral to the main theme of this thesis. Nevertheless, they do need to be addressed.

This chapter begins with a background discussion of hedging and explores the common applications and techniques of hedging. It continues by addressing exchange rate volatility through providing a brief background of the economic fundamentals of exchange rate determination and dynamics, and government policies. Information regarding the history of hedging, and the cost and benefits of hedging are provided in Appendix A1 to A4; information on the international financial market and exchange rate system can be found in

Appendix A5. Appendix A6 consists of data from the 2005 Australian Bureau of Statistics Survey; while Appendix A7 includes brief discussions on the mechanisms of the common financial instruments. Discussions regarding the parity relationships and government intervention in the financial markets are included in Appendix A8 and Appendix A9.

2.2 Hedging

Hedging is a preventive strategy used by individual investors or companies to protect their portfolio from adverse currency, interest rate, or price movements and is aimed specifically at reducing any uncertainty in the market. The hedge ratio is explained as the percentage of the position in an asset that is hedged using derivatives. Some see hedgers as risk averse individuals. However, we see hedgers as risk neutral individuals as they choose their hedging strategy based on the expected value (return) of any given strategy. To better justify our view of hedgers being risk neutral individuals, we need to further address risk aversion.

Risk aversion, also known as attitude towards risk, refers to our tolerance for risk and normally affects the way we make our decisions under uncertainty. Aliprantis and Chakrabarti (2000) characterized an individual's risk taking tendency by the nature of their utility function $u:[0,\infty) \rightarrow R$, and the utility generated by wealth w is written as $u(w)$. The utility function over wealth, $u(w)$, is intrinsic to the individual and represents the individual's preferences over different levels of wealth. If the utility function is linear in wealth, that is, $u(w) = aw + b$, then, we say the individual is risk neutral. If the utility function is strictly concave, then the individual is risk averse. If the utility function is strictly convex, then the individual is risk seeking.

Hedging involves taking an opposite position in a derivative in an attempt to offset or balance any gains or losses of the initial portfolio. The ideal result for a hedge would be to cause a “seesaw effect” where one effect will cancel out another. For example, assume a transportation company for which oil is one of the main inputs (costs). With the current volatile oil price, the company believes the oil price may increase substantially in the near future. This may severely affect their operation cost and reduce any potential profit. In order to protect itself from this uncertainty, the company could enter into a six-month futures contract in oil. By doing this, if oil price increases by 10%, the futures contract will lock in a price with profit that will offset the loss which the company experiences in their daily business operations. Note that by hedging, the company is not only protected from any losses (if the oil price increase by 10%), but also restricted from any gains (if the oil price falls by 10%).

In general, there are two main categories of hedging, interest rate hedge and currency movement hedge. Investors or companies can use an interest rate hedge when they are involved in substantial borrowings. An interest rate hedge allows hedgers to minimize the cost of borrowing through transferring risks of any expected, unfavorable interest rate movements. Currency movement hedge, on the other hand, is used by international companies or investors that hold an international portfolio. A currency movement hedge allows hedgers to manage and minimize their exposure to any adverse exchange rate movement. Note that it is only the currency movement hedge that will be the focus of this thesis. We aim to develop a new hedging method that will assist any investor or international company to manage and minimize their exposure to adverse exchange rate movements.

International businesses are naturally exposed to currency risk. With the rapid integration of the global economy, many efforts have been directed to study those risks associated with exchange rate. Transaction risk and translation risk are the two most commonly discussed currency risks for international businesses.Transaction risk can be defined as the impact of unexpected changes in the exchange rate on the cash flow arising from all contractual relationships.

On the other hand, translation risk refers to the risks which arise from the translation of the value of an asset from a foreign currency to the domestic currency (Solnik and McLeavey, 2004, p.578). Authors, such as Mannino and Milani (1992), Hollein (2002), and Homaifar (2004, p.217), also defined translation risk as the change in book value of assets and liabilities, excluding stockholders' equity as residuals, due to changes in the foreign exchange rate. International companies that trade and receive revenue in foreign currencies would incur translation risk. The most common cases of companies experiencing translation risk are when overseas subsidiaries translate the subsidiaries' balance sheet and income statements into the functional currency of the parent companies for consolidation and reporting purposes as required by legislations. During this translation process, movement in the exchange rate can produce accounting gains or losses that are posted to the stockholders' equity.

2.2.1 Hedging and Australian International Businesses

The financial world has experienced a rather long yet continuous evolution in global hedging mechanisms. However, the importance of managing currency risks among Australian international businesses only surfaced in Australia after it adopted the floating currency system in 1983 (Batten et al., 1993; Becker and Fabbro, 2006). Regarding the risk exposure to Australian international businesses, hedging can be a worthwhile practice because the Australian dollar is allowed to appreciate or depreciate freely against other currencies. This volatility affects all importers and exporters by exposing them to exchange rate risk. Indeed, according to the Bureau of Industry Economics in 1986, the Australian manufacturing industry reported an increase in the hedging of foreign currency risk during 1984-86 in response to the depreciating Australian dollar and the increased volatility of the Australian exchange rate movement against other currencies (Batten et al., 1993).

Australian businesses are highly exposed to foreign currency risk as over 70% of Australian trade has been invoiced in foreign currencies (Becker and Fabbro, 2006). Figure 2.1 shows Australia's trade which has been invoiced in foreign currencies from 1998 to 2005, the main foreign currency exposure for Australian enterprises is to the US dollar. In fact, in a 2005 survey on hedging practices, the Australian Bureau of Statistics (ABS) showed that the US dollar constituted at least 50% of the private sector foreign currency exposure, with the Euro accounting for around 15% (ABS, 2001, 2005; RBA, 2005a; Becker and Fabbro, 2006). Other currencies such as the British pound, Japanese yen, and Swiss franc played a noticeable but relatively smaller role when compared to the US dollar and the Euro (See also Appendix A6).

Figure 2.1: Trade Invoice Currencies

Source: ABS (2005).

There has been a significant increase in attention on practicing prudent corporate hedging programs after the recent high-profile derivatives trading disasters and corporate finance scandals, both abroad and amongst Australian companies. This down-side of derivative trading can be seen in Appendix A3.

2.2.2 Fundamental Philosophy behind Hedging

We now proceed to address the fundamental philosophy behind hedging. The commonly accepted views on the facets of hedging fall into two general groups, firstly, as insurance for companies facing foreign exchange risk in any sense, and secondly as a value-enhancing tool for management that can secure a less volatile and well-managed corporate revenue.

Anac and Gozen (2003) claim that hedging is the basic function of any commodity market, such as the London Metal Exchange in England and the

Australian Stock Exchange (ASX) in Australia. They also suggest that the fundamental idea behind hedging 'is to take it as a form of insurance against volatile market movements' (p.132). Dawson and Rodney (1994), for example, support this view claiming that the main purpose for corporate hedging activities is to 'match assets with liabilities' and avoid losses that may be caused by uncovered exchange rate movements. It is based on the fundamental principal that hedging is not to be considered as a gambling or speculative activity for corporations. We found that many multinational corporations involved in hedging tend to include clauses or statements in their annual reports declaring that they do not use financial instruments/derivatives for trading or speculative purposes. However, despite their declarations and signs of supporting (on hedging as insurance for the company), throughout our research we have found examples where companies are involved in questionable hedging activities (See Appendix 3). It is indisputable that imprudent or speculative attitudes towards hedging can be potentially harmful instead of helpful to companies. These examples of bad hedging practices often come to light when the company involved got into irreversible financial damage, as witnessed in the case of Enron (Wilson and Campbell, 2003).

The second group views hedging as a value-enhancing tool for management. Several authors, including Nance, Smith and Smithson (1993) and Geczy, et al. (1997), have expressed their views on hedging as a value-enhancing exercise. According to these authors, the function of hedging is especially obvious when multinational companies are faced with taxes, financial distress, investment costs and agency costs (cited in Nguyen and Faff, 2002).

We have presented that authors embrace hedging as insurance, and hedging as a value-enhancing tool. We believe the common view of hedging can be summarized as follows.

(1) Hedging is one of the three most fundamental reasons for the existence of the financial market, alongside speculative and arbitrage activities (Jüttner, 2000, p.32).

(2) The hedging industry is evolving just like the rest of the business world. In fact, there is no definite set of tools or technique that can define hedging. As the world changes, new hedging mechanisms are derived; and as time passes, these mechanisms are refined and evolve into something new that can be better applied to the contemporary commercial marketplace (Batten et al, 1993; Faff and Chan, 1998; Alster, 2003; ASX, 2005d; and CME, 2005a, 2005b).

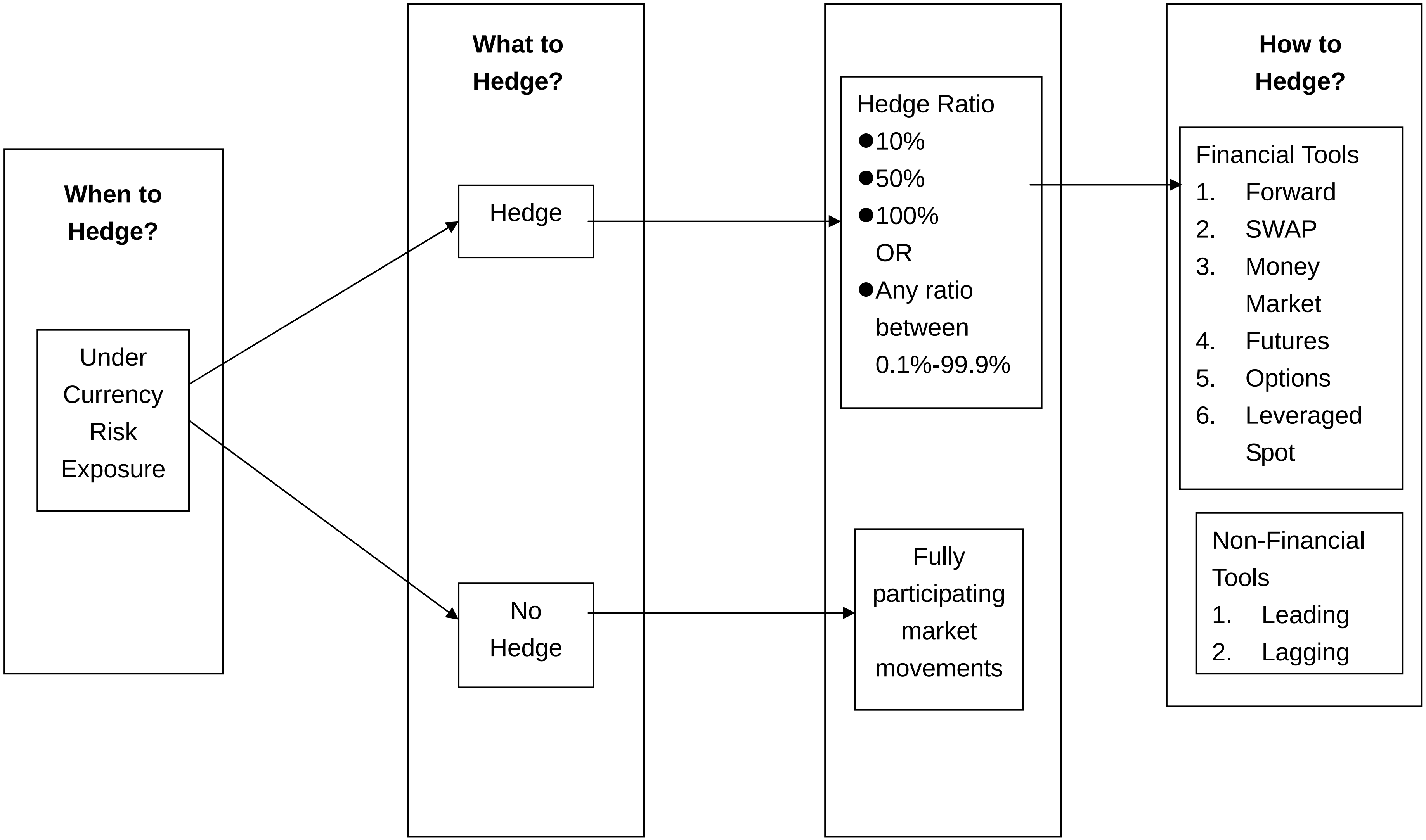
(3) Hedging is not a way of making money, but to assist management in better managing corporate revenue through reducing the corporate exposure to volatility in the foreign currency markets (Nguyen and Faff, 2002, 2003a; Anac and Gozen, 2003; Alster, 2003; De Roon et al., 2003; and Dinwoodie and Morris 2003).

(4) When used prudently, hedging can be effective insurance as well as a value-enhancing exercise for corporations. Effective hedging programs have been proven to allow corporations to minimize or transfer their foreign currency exposure. The diminished exposure to foreign currency fluctuations allows more stable and predictable cash-flows, notably in terms of revenue. As a result, firms are then capable of making more comprehensive financial plans, including more reliable estimations on tax, income after tax and dividends payable to shareholders. It is believed that a dividend payout is often of significant appeal to long-term, current or prospective shareholders (Nguyen

and Faff, 2002, 2003b; Alster, 2003; Anac and Gozen, 2003; De Roon et al., 2003; and Dinwoodie and Morris, 2003).

Having reviewed these commonly held views, we now proceed with our view. Hedging is the preventive strategy used by investors or companies to protect their portfolio from adverse currency, interest rate or price movements. It involves taking an opposite position in a derivative in an attempt to offset or balance any gains or losses of the initial portfolio. The ideal result for a hedge would be to cause a “seesaw effect” where one effect will cancel out another. Because of this “seesaw effect”, hedging not only protects companies from any losses that may occur due to an adverse market, but also restricts companies from any gains if the market goes in favor of the companies. The three main questions surrounding hedging: when, what and how to hedge are shown in Figure 2.2 below as a decision tree.

Figure 2.2: Generic Hedging Decision Tree



The following example illustrates the above Figure 2.2. Assume that Company A is an Australian company that imports photocopy machines from Japan. The chief financial officer of Company A has just concluded a negotiation to purchase 100 photocopy machines from Company J, a Japanese photocopy manufacturer. The contract is for JPY10,000,000 and is signed in March with payment due three months later in June. Since the account is payable in Japanese yen, Company A (the Australian company) is faced with a currency exposure problem. Company A would be very happy if the Australian dollar appreciated versus the Japanese yen. Concerns will rise if the Japanese yen becomes stronger against the Australian dollar.

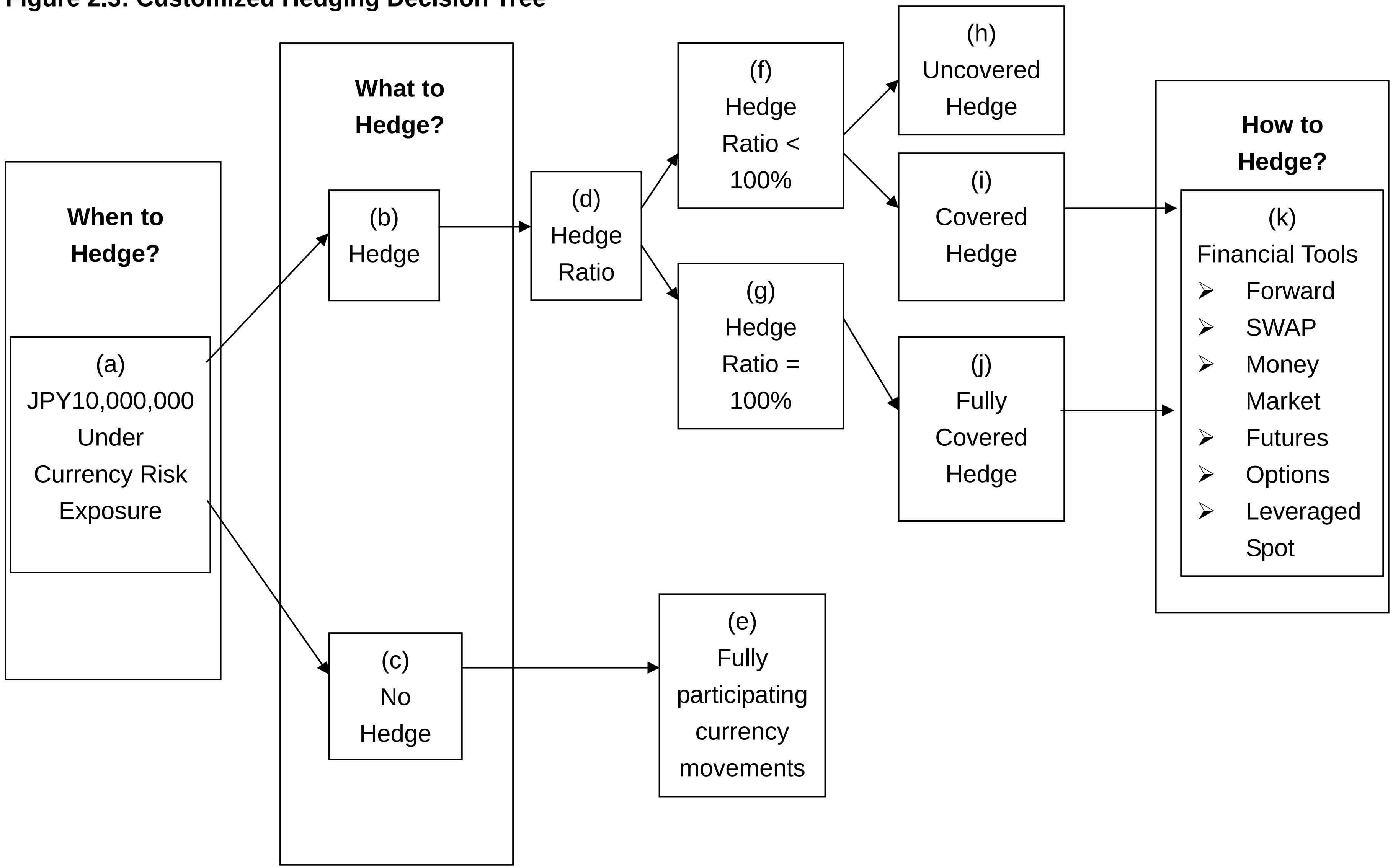
As the chief financial officer decides on the hedging strategy that can minimize the company's currency exposure, he/she typically faces three questions: (1) when to hedge, (2) what to hedge, and (3) how to hedge. The first question ("when to hedge") depends on the estimation of the future currency movements. For our example, if Company A expects the Japanese yen to become stronger against the Australian dollar at the end of June, then the company should prepare a hedging strategy that can minimize the currency exposure due to the expected adverse currency movements. Otherwise, if Company A expects the Australian dollar to appreciate against the Japanese yen, then there is no need for the company to hedge. In fact, Company A can benefit from the favorable currency movement by using less Australian dollars to pay off the Japanese yen account.

The second question ("what to hedge") refers to the portfolio or account in which the company will hedge, including the amount and the currency to be hedged. For our example, the currency to be hedged is the Japanese yen. The decision on the amount to be hedged can be affected by the hedger's tolerance to risks. Depending on the chief financial officer's risk tolerance, he/she can decide to hedge 100% of the JPY10,000,000, 50%, or 10%. In fact, technically, the hedge ratio can be any ratio between 0.1% and 99.9%. If the chief financial officer of Company A decided to not hedge their account, then the company is fully participating in the currency movement. If the decision is to hedge the account, then there are several alternatives available to Company A to manage this currency exposure. The company can hedge using financial tools and non-financial tools. Since our purpose in this thesis is to derive a contemporary hedging model using leveraged spot contracts, we focus our discussion on those hedging alternatives that use financial tools.

The third question ("how to hedge") refers to the mechanism of hedging. It involves choosing from those currently available financial tools, such as forward, futures, options, swaps, money market, and leveraged spot contracts. Indeed, once Company A decides to hedge their account, a decision then will be made regarding which financial tool(s) will be used to best manage the currency exposure. The company can use a plain single financial tool or a combination of several.

The value created by hedging strategies depends on the answers to the above questions. The following Figure 2.3 is a customized hedging decision tree for the example. As shown in the figure, if Company A chooses not to hedge, then the result will be fully dependant on market movement, the interaction between the Australian dollar and the Japanese yen. If Company A chooses to hedge, the value created by their strategies will depend on their hedge ratio as well as the financial tools they select. If the hedge ratio is less than 100%, the company will be faced with a portion of exposed hedge and a portion of covered hedge. For instance, if the hedge ratio is 50%, then the company will be faced with 50% uncovered and 50% covered hedge. The uncovered portion will be exposed to currency risk and fully dependant on the market movements. If the hedge ratio is 100%, then the company will be fully covered for any currency risk. Note that as we mentioned earlier in this chapter, by hedging (notably when hedging 100%), Company A is not only protected from losses caused by adverse currency movement, but is also denied any gains from favorable currency movement.

Figure 2.3: Customized Hedging Decision Tree



2.2.3 Hedging with Financial Derivatives

The mechanism of hedging is actually accomplished through the utilization of financial derivative contracts, such as forward, futures, options, and money market instruments. Hence, it is important to understand that in order to formulate effective strategies, hedgers must not only be fully aware of the surrounding economics/business environment, but must also gain sufficient knowledge on each of those currently available financial instruments and the operating mechanism of the financial markets to be fully equipped to choose the most efficient tools that will best fit the company's profile. Based on this reasoning, we must discuss the background of financial derivatives markets and what are those non-financial instrument alternatives that firms can choose as risk minimizing tools. Further we discuss:

(1) what are those financial tools that are currently available;

(2) why do firms choose one derivative over another;

(3) what are the strengths and weaknesses of those currently available derivatives, especially when compared to the proposed Leveraged Spot technique;

(4) what are those commonly adopted financial models; and

(5) the limitations of these classical financial models.

2.2.3.1 Financial Derivatives Markets

With the ever increasing total notional value of derivative contracts outstanding worldwide, it is little wonder that there has been continuous interest in unlocking the "mystery" of hedging using financial derivatives. Studies have shown that in 1994, the total value of hedging was USD 18 trillion (Nguyen and Faff, 2002; Hughes and MacDonald, 2002, p.153). This is more than the combined total value of shares listed on the New York Stock Exchange and the Tokyo Stock Exchange. The amount exceeded USD 55 trillion in 1996, and in 1998, the figure had already reached USD 70 trillion, which is almost four times more than in 1994. Moreover, according to BIS (2005), from 1995 to 1998, spot foreign exchange transactions increased by 15%, reaching a total of USD 600 billion-a day, while over-the-counter currency options doubled to a total outstanding daily value of USD 141 billion. According to the Triennial Central Bank Survey 2004[2], the average daily turnover in foreign exchange derivatives contracts rose to $1,292 billion in April 2004 compared to only $853 billion in April 2001 (BIS, 2005). Table 2.1 shows that outright forward and foreign exchange swaps hold the record as the most popular derivatives traded over the counter. As such figures continue to climb strongly, it is important to understand the mechanism of the foreign exchange derivatives markets, including what motivates companies to enter the market, and how corporations utilize the market as a hedging mechanism.

2 The 2004 survey is the sixth global survey since April 1989 of foreign exchange market activity and the fourth survey since March/April 1995 covering also the over-the-counter (OTC) derivatives market activity. The survey includes information on global foreign exchange market turnover and the final statistics on OTC derivatives market turnover and amounts outstanding.

Table 2.1: Global OTC Derivative Market Turnover, 1995-2004

Daily averages in April, in billions of US dollars				
	1995	**1998**	**2001**	**2004**
Foreign exchange power	688	959	853	1,292
Outright forwards and foreign exchange swaps	643	862	786	1,152
Currency swaps	4	10	7	21
Options	41	87	60	117
Other	1	0	0	2
Interest rate turnover	151	265	489	1,025
FRAs	66	74	129	233
Swaps	63	155	331	621
Options	21	36	29	171
Other	2	0	0	0
Total derivatives turnover[2]	880	1,265	1,385	2,410
Memo:				
Turnover at April 2004 exchange rates	825	1,350	1,600	2,410
Exchange-traded derivatives[3]	1,221	1,382	2,180	4,657
Currency contracts	17	11	10	23
Interest rate contracts	1,204	1,371	2,170	4,634

[1] Adjusted for local and cross-border double-counting. [2] Including estimates for gaps in reporting. [3] Sources: FOW TRADEdata; Futures Industry Association; various futures and options exchanges. Reported monthly data were converted into daily averages on the assumption of 18.5 trading days in 1995, 20.5 days in 1998, 19.5 days in 2001 and 20 days in 2004 Table C.2

Source: Bank for International Settlements (BIS), 2005.

According to Robert W. Kolb, "a derivative is a financial instrument based upon another more elementary financial instrument. The value of the financial derivative depends upon, or derives from the more basic instrument. The base instrument is usually a cash market financial instrument, such as a bond or a share of stock" (Hughes and MacDonald, 2002, p.153). The underlying instrument can also be based on movements of financial markets, interest rates, the market index, commodities, or a combination of these (Dinwoodie and Morris, 2003). For example, consider the derivative value of oil, which indicates that the price of an oil futures contract would be derived from the market price of oil, reflecting supply and demand for the commodity. In fact, as oil prices rise, so does the associated futures contract. It is noted that in order for the derivative market to be operational, the underlying asset prices have to be sufficiently volatile. This is because derivatives are risk management tools. Hence, if there is no risk in the market, there would be no need for the existence of any risk management tool. In other words, without manageable risk, the use of derivatives would be meaningless.

Derivatives commonly used as hedging instruments include the foundational form of: (1) forward contracts, (2) futures contracts, (3) options contracts, and (4) swaps, which involve a combination of forward and spot contracts or two forward contracts. However, with the rapidly changing business environment, many hedgers have also given increasing attention to other more sophisticated and “exotic” derivatives which evolved from these basic contracts and often consist of a combined use of two or more foundational contracts, such as Options Futures (Hull, 2006, p.199, p.529).

2.2.3.2 Types of Players in Derivatives Markets

There are three categories of players in a functioning derivatives market: (1) hedgers, (2) speculators, and (3) arbitrageurs. While each of these players use the market with varying intention, their combined and balanced influence ensure the market liquidity and volatility that allows the derivatives market to operate. It is easy yet important to differentiate the varying motives of these players. In terms of their level of risk aversion, arbitrageurs are by definition highly risk intolerant (risk averse individuals) who only trade in risk-free transactions; whereas speculators are on the other side of the spectrum (risk-seeking individuals), as they make profit by taking risk; hedgers are risk neutral individuals, as they choose their strategies by ranking the expected value of any given strategy (Dinwoodie and Morris, 2003; Jüttner, 2000, p.35, pp.302-303; Homaifar, 2004, p.82; Hallwood and MacDonald, 2000).

Based on their varying attitude towards risk these players tend to engage in the derivatives market with very different transaction patterns. More specifically, an arbitrageur who seeks risk-free profits will simultaneously take up a position in two or more markets, for instance, simultaneously buy spot and sell forward the Australian dollar, in an attempt to exploit mis-pricings due to a market that is not in equilibrium. However, according to Dinwoodie and Morris (2003), such price differentials are almost non-existent in a well-functioning market, mainly because supply and demand tend to rapidly restore market equilibrium. As opposed to the arbitrageur, a speculator seeks profit by taking risk. For example, speculators who anticipate an appreciating Australian dollar will put their "bets" on the rising Australian dollar. They can do so by buying the Australian dollar at a lower value, and then selling it when the value is higher should the prediction come true. A hedger enters derivatives markets mainly with intention to insure against price volatility beyond their control. Based on this intention, it is not surprising that hedgers are mostly acting on behalf of corporations. The mechanism of hedging mainly transfers risk to others who are willing to accept the risk. Indeed, the risk is never nullified but merely transferred from one party to another. In most cases, speculators are those who absorb the risks transferred by hedgers. It is perhaps due to these notions that some have referred to the derivatives market as the 'zero-sum game market, where the gain of one party is exactly equal to loss of another party' (Dinwoodie and Morris, 2003; Jüttner, 2000, p.35, pp.302-303; Homaifar, 2004, p.82; Hallwood and MacDonald, 2000, p.32).

Over the last decades, the foreign exchange markets have experienced explosive growth. Indeed, according to the Triennial Central Bank Survey 2004, the average daily turnover in traditional foreign exchange markets rose to $US 1,880 billion in April 2004 compared to $US 1,200 billion in April 2001 (BIS, 2005; see Table 2.2). Certain authors, including Hughes and MacDonald (2002, pp.209-210), believe that the partial reason for the rapid growth of the foreign exchange market is due to the entrance of new players – institutional investors with huge portfolios of assets and capital. These institutional investors include hedge funds, pension funds, insurance companies and other participants. As these funds are generally unregulated and operate primarily by taking highly leveraged, speculative positions, they are generating much greater transaction flow than those traditional players, such as large international banks, securities houses, corporate treasurers and central banks, which are heavily regulated and closely observed by stock analysts and shareholders (Hughes and MacDonald, 2002, p.212; Hull, 2006, p.9). According to Hughes and MacDonald (2002, p.212), there are 3000 hedge funds actively operating around the globe currency, with a combined capital (money from investors) estimated at USD400 billion. Further insights into the operation of hedge funds can be found in Hull (2006, chap. 1).

Table 2.2: Global Foreign Exchange Market Turnover 1989-2004

Daily averages in April, in billions of US dollars						
	1989	**1992**	**1995**	**1998**	**2001**	**2004**
Spot Transactions	317	394	494	568	387	621
Outright forwards	27	58	97	128	131	208
Foreign exchange swaps	190	324	546	734	656	944
Estimated gaps in reporting	56	44	53	60	26	107
Total "traditional" turnover	590	820	1,190	1,490	1,200	1,880
Memo: Turnover at April 2004 Exchange rates[2]	650	840	1,120	1,590	1,380	1,880

[1] Adjusted for local and cross-border double-counting. [2] Non-US dollar legs of foreign currency transactions were converted from current US dollar amounts into original currency amounts at average exchange rates for April of each survey year and then reconverted into US dollar amounts at average April 2004 exchange rates. Table B.1

Source: Bank for International Settlements (BIS), 2005.

Despite the name "hedge funds", these funds are infamous for their speculative activities in the foreign exchange markets. George Soros's Quantum Fund topped the chart of money market speculators when the fund speculatively attacked the Bank of England in 1992 by betting against the British pound and won approximately $US1 billion (Hughes and MacDonald, 2002, pp.211-212). It is perhaps such speculative incidents that trigger constant debates over the role of these new players in the currency markets. Indeed, these hedge funds sometimes have the power to destabilize and even break a nation's currency, especially those of emerging market countries. However, most of those victimized countries normally reform their economies and adopt more sensible economic and financial policies, in turn rectifying the market inefficiencies. The continuous debates about the possible good and evil role of these speculative newcomers appear similar to those concerning the role of hedging. Indeed, while the fundamental principal of hedging is to assist hedgers in minimizing their risk exposure in the currency market, imprudent and unethical usage can nonetheless be financially fatal.

2.2.3.3 Non-financial Tools Hedge (Natural Hedge)

It is perhaps due to these conflicting aspects of hedging that, despite its fundamental function of transferring hedgers' unwanted risks to those who are willing to absorb them, not all corporate treasurers are fond of using financial derivatives as risk management alternatives. Their reluctance is understandable especially in the wake of those failed hedging attempts (see Appendix A3).

As an alternative to hedging using financial derivatives, some treasurers choose to tighten up receivable policies, that is, limiting the outstanding period to an average of 30 days (Alster, 2003). According to Chew, the Chief Financial Officer of National Semiconductor Corporation, this method has been useful in minimizing the company's vulnerability to currency fluctuations. However, during the uncovered period, the company is still exposed to currency fluctuations. Therefore, we believe that such methods, even if executed very efficiently, can only partially offset the company's currency exposure.

Huffman and Makar (2004) have reported that multinational corporations (MNCs) in the United States generally use foreign-denominated debt as their alternative to hedging with financial derivatives. The MNCs also matched their foreign sales and foreign assets as an attempt to naturally minimize their companies' foreign currency risks (Huffman and Makar, 2004; Becker and Fabbro, 2006). Another alternative to hedging using financial derivatives is to control the currency risk exposure by modifying the company's capital structure and maintaining a low level of debt. Nonetheless, this risk management alternative is claimed to rarely be used in reality, due mainly to the significant transaction costs involved (Nguyen and Faff, 2002).

Despite the higher transaction costs, authors like Chowdhry (1995) and Nance et al. (1993) generally remained supportive of the use of the abovementioned natural hedging techniques. Indeed, they highlighted that the benefits of natural hedging is especially noticeable when future currency movements and the associated exposure to changing exchange rates are unknown. These methods are also particularly cost efficient when dealing with long-term exposure, mainly because most derivatives contracts tend to be limited by their contractual terms and amount (Huffman and Makar, 2004). The limitations of common financial tools will be further discussed in subsequent sections.

2.2.4 Hedging Tools and Techniques

We continue the discussion on hedging to cover:

(1) what are the financial tools currently available;

(2) why do firms choose one instrument over another;

(3) what are the strengths and weaknesses of currently available derivatives, especially when compared to the proposed leveraged spot technique;

(4) what are the commonly adopted financial models; and

(5) the limitations of these classical financial models.

There are mainly five types of transactions in the foreign exchange derivatives markets, namely: (1) forward, (2) futures, (3) options, (4) swaps, and (5) money (spot) market. However, most hedging transactions occur in the forward and swaps[3]. In both their 2001 and 2005 study of Australian hedging practices, the Australian Bureau of Statistics (ABS) found that forward and swaps contracts continue to be the most popular hedging instruments for non-financial[4] Australian companies. Similar surveys of non-financial companies across the United States, Germany, Switzerland, Sweden and Korea also found that forward contracts are the clear preference for these companies (Bodnar et al, 1996; Bodnar et al, 1998; Bodnar and Gebhardt, 1999; Loderer and Pichler, 2000; Pramborg, 2005; Becker and Fabbro, 2006). The popularity of the forward contracts is perhaps due to their longer existence when compared to other derivatives.

We have not come across any previous literature that had been written on leveraged spot contracts. This comes as a surprise, as leveraged spot contracts have been widely adopted in overseas markets, such as Hong Kong and China. We therefore believe that limited (if any) effort has been invested in exploring the leveraged spot market, let alone utilizing leveraged spot contracts to implement corporate hedging strategies.

3 A conclusion drawn from Batten et al. (1993), Dawson and Rodney (1994), Hallwood and MacDonald (2000), Kawaller (2001), Kyte (2002), Hughes and MacDonald (2002), Anac and Gozen, (2003), Alster (@003), Huffman and Makar (2004), Homaifar (2004), ABS (2005), BIS (2005) and Hull (2006).

4 Non-financial companies refer to corporations and governments, whereas financial companies refer to financial institutions including commercial and investment banks, securities houses, mutual funds, pension funds, hedge funds, currency funds, money market funds, building societies, leasing companies, insurance companies, other financial subsidiaries of corporate firms and central banks.

In the following sections, we will discuss all of these contemporary financial derivatives, including forward, futures, options, swaps and money market instruments, and introduce the mechanism of the leveraged spot market.

2.2.4.1 Contemporary Financial Derivatives

Financial derivatives, also known as financial instruments, tools or techniques, exist to serve three main groups of players, (1) hedgers, (2) speculators and (3) arbitragers. Our research also identified forward, futures, options, money market instruments, and swaps as the key financial derivatives[5]. Many authors, for example Kyte (2002) and Hull (2006, p.611), recognize the interest rate as one of the derivatives commonly used. However, since this thesis aims to derive a hedging mechanism specifically for assisting corporations to minimize their currency risk exposure, the discussion on contemporary financial derivatives will not concern interest rates.

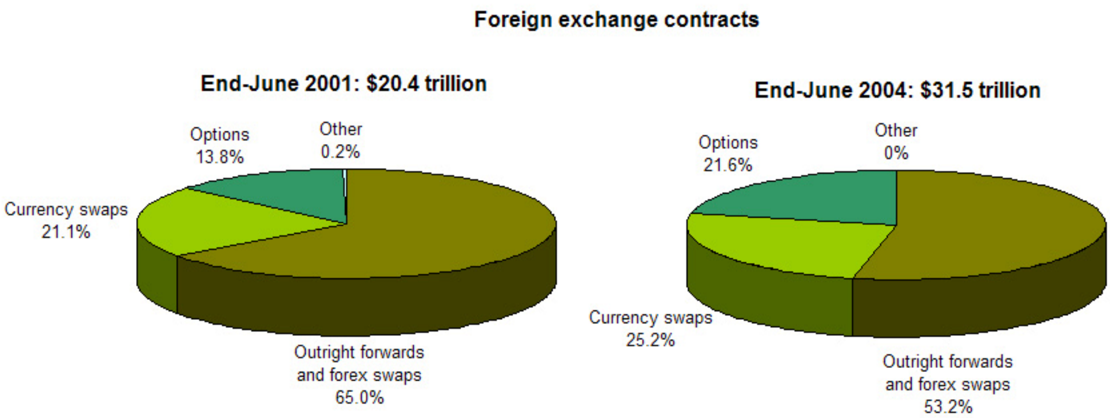
The abovementioned key financial derivatives are sometimes referred to as the plain vanilla contracts. As the commercial trading market continues to evolve, many “exotic” contracts are being derived from these plain vanilla contracts. These exotic contracts normally refer to the combined use of two or more financial instruments (Kawaller, 2001). The use of these “exotic” contracts have increased; nevertheless, many authors in the financial field still acknowledge forward contracts as the most extensively used empirical hedging instrument (See, for example, Batten et al., 1993).

5 Refer to Dawson and Rodney (1994), Hallwood and MacDonald (2000), Hughes and MacDonald (2002), Anac and Gozen (2003), Alster (2003), Huffman and Makar (2004), Homaifar (2004), ABS (2005), and BIS (2005).

Forward contracts are undeniably the most commonly used hedging instrument. In 1992, forward contracts accounted for 47% of the total derivative trading in London. This is significant especially if we compare it to the mere 3% of total trading of futures and options contracts in the same year (Hallwood and MacDonald, 2000, p.14). In a 2002 study of 469 Australian companies also found a significant distribution difference between the usage of forward and other financial derivatives as hedging instruments. In their findings, Nguyen and Faff (2002) showed that out of the 469 Australian companies, 264 companies reportedly used forward/futures contracts as hedging instruments. They also showed that 263 companies adopted swaps and 127 companies utilized options contracts as hedging instruments. In other words, from the 469 Australian companies reportedly using financial derivatives as hedging instruments, almost 76% claimed that they used forward/futures contracts, about 75% used swaps and only 36% utilized options contracts. The findings of this research have been summarized in the following Table 2.3. Similar findings from ABS (2005), BIS (2005) and Becker and Fabbro (2006) are shown in Figures 2.4 and 2.5.

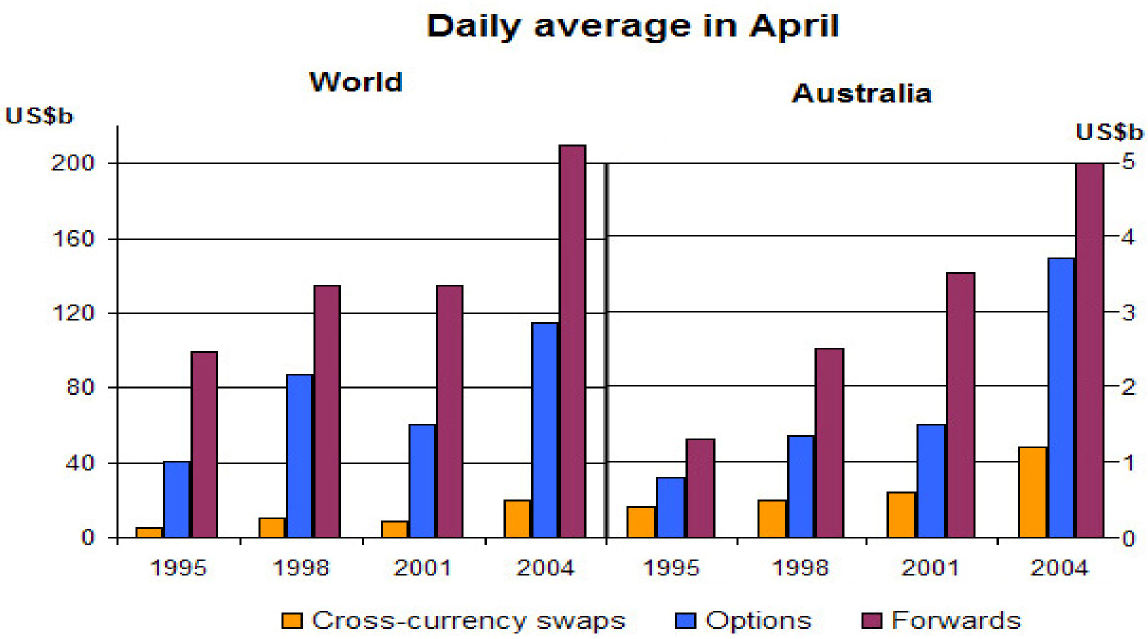
Our research found that many authors documented the functions of these financial instruments in assisting hedgers to reduce risk as well as supplementing profits generated by traditional banking activities. Indeed, financial derivatives allow hedgers to “lock in” exchange rates, for instance, using a forward contract to lock in a specified exchange rate for a specified amount of currency to be delivered by a specified date. Hence, for these financial derivatives to perform their function, it is important that hedgers have the sound judgment and knowledge on the surrounding environment (such as expected future currency movements as well as the economic and financial circumstances), in order to accurately “lock in” the correct exchange rate direction. Otherwise, locking in the wrong exchange rate due to bad estimation on the currency movement can be fatal to any corporation (Kyte, 2002; Huffman and Makar, 2004). Furthermore, it is also vital for hedgers to understand the strengths and weaknesses of the selected financial tool(s), as their unique characters generate different responses to a given set of contract parameters (such as contract size, maturity, and transaction cost) and can either help amplify the benefits of hedging or expose the company to even more risk. The following section will discuss the most commonly used financial tools of financial derivatives traders.

Figure 2.4: Reported Global Average Daily Turnover in OTC Derivatives Market by Instrument



Source: BIS (2005).

Figure 2.5: Foreign Exchange Derivatives Turnover



Source: ABS (2005) and Becker and Fabro (2006).

Table 2.3: Financial Derivatives Usage by Australian Companies

Descriptive Statistics for Derivative Users and Non-users		
Derivative Use by Type of Instruments		
	Absolute Value	Percentage
Total Sample	469	100.00
Derivative Users	348	74.20
Non-users	121	25.80
Derivative Users	348	100.00
Interest Rate Derivative Users	239	68.68
Foreign Currency Derivative Users	291	83.62
Commodity Derivative Users	124	35.63
Swap Users	263	75.57
Option Users	127	36.50
Future/Forward Users	264	75.86

Source: Nguyen and Faff (2002).

2.2.4.2 Forward Contracts

In 1982, Mathur conducted a study based on the random sampling of the Fortune 500 companies (cited in Batten et al., 1993). In that study, Mathur (1982) found extensive adoption of forward contracts amongst Fortune 500 companies that were involved in currency hedging, it is by far the most commonly adopted hedging instruments. This popularity is perhaps due to the long history of usage, dating back to the early days of civilization and the trading of crop producers. Forward contracts were the first financial derivatives derived from those early “buy now but pay and deliver later” agreements.

In contemporary business world, forward contracts are commonly known as over-the-counter transactions between two or more parties where both buyer and seller enter into an agreement for future delivery of specified amount of currency at an exchange rate agreed today. They are generally privately negotiated between two parties, not necessarily having standardized contract size and maturity. Both parties in the forward contracts are obligated to perform according to the terms and conditions as negotiated in the contracts even if the parties’ circumstances have changed. In other words, once a forward contract has been negotiated, both parties have to wait for the delivery date to realize the profit or loss on their positions. Nothing happens between the contracting date and delivery date. Indeed, a forward contract cannot be resold or marked to market (where all potential profits and losses are immediately realized), because there is no secondary market for a forward contract (Solnik and McLeavey, 2004, p.509; Hallwood and MacDonald, 2000, p.13). Although, technically, the forward contract can be re-negotiated with the original counterparty, it is usually practically too costly to proceed with. In fact, the counterparty is not obliged to proceed with the renegotiation.

Forward contracts have one obvious limitation: they lack flexibility, and therefore do not allow companies to react in a timely manner to favorable market movements. This disadvantage is widely acknowledged and often criticism by authors and hedgers. So, why are forward contracts still the most popular hedging instrument? We believe this is mainly because forward contracts allow the hedging of large volumes of transactions with extremely low costs. Indeed, the parties involved in negotiating a forward contract are typically companies that are exposed to currency risk and their nominated banks. The nominated bank typically charges a service fee, of less than 1% of the face value of the hedge amount, for acting as the counter-party in the transaction. So it is the nominal service fee that is the low cost (Alster, 2003). Appendix A7.1 provides further discussion on the calculation of forward rates for a currency as well as example of typical forward transaction.

2.2.4.3 Futures Markets

Futures contracts are the first descendant of forward contracts. Futures contracts were derived, based on the fundamental of forward contracts, but with standardized quality, quantity, time (maturity), as well as place for delivery. Like other financial derivatives, futures contracts were initially designed for commodity trading, but as commercial trading continually evolved, the initial definition of “commodity” broadened to include floating world currencies. In 1972, the Chicago Mercantile Exchange pioneered the industry by introducing the first currency futures contract. Today, currency futures contracts are common financial derivatives available to all global investors (CME, 2005a, 2005b).

Futures contracts inherited many significant traits of forward contracts, in that futures transactions are also commitments to purchase or deliver a specified amount of currency on a specified date at a price (exchange rate) agreed when the contract is negotiated (Dawson and Rodney, 1994; Hallwood and MacDonald, 2000, p.13; Hughes and MacDonald, 2002, p.355, pp.407-408; Homaifar, 2004, pp.231-232). However, the futures contracts also possess certain traits which are absent in forward contracts and are thought to promote more efficient trading. In fact, unlike forward contracts, futures contracts are seldom used to take physical delivery. These futures contracts are commonly used by both speculators and hedgers. It allows the traders to take advantage of price movements. Table 2.4 provides a clearer summary of the major differences between forward and futures contracts.

Table 2.4: Major Differences between Forward and Futures Contracts

Forward Contracts	***Futures Contracts***
Customized contracts in terms of size and delivery dates	Standardized contracts in terms of size and delivery dates
Private contracts between two parties	Standardized contracts between a customer and a clearinghouse
Difficult to reverse a contract	Contract may be freely traded on the market
Profit and loss on a position is realized only on the delivery date	All contracts are marked to market – the profit and loss are realized immediately
No explicit collateral, but standard bank relationship necessary	Collateral (margins) must be maintained to reflect price movements
Delivery or final cash settlement	Contract is usually closed out prior to

usually takes place	maturity

Source: Hull (2006, p.6, pp.40-41), Moffett et al. (2006, p.6, p.177) and Solnik and McLeavey (2004, p.4, p.510).

The integrity of futures markets is safeguarded by clearinghouses, which are created by member participants of the organized exchanges (such as the New York Mercantile Exchange (NYMEX), the Chicago Mercantile Exchange (CME), and the Sydney Future Exchange). These clearinghouses handle both sides of the transactions, acting as the middlemen for both buyers and sellers of futures contracts. To eliminate the counterparty risk, the clearinghouses exercise marked-to-market practices, that is, to mark individual transactions to market on a daily basis, which then requires transfer of value from one individual to another individual in a zero-sum game. In other words, as the spot rate of that currency changes daily, the profit/loss is recognized and is posted to an individual account by the clearinghouse. These daily profits or losses are then added (or subtracted) to the contract holder's margin account (Hallwood and MacDonald, 2000, p.13; Homaifar, 2004, p.9; Hull, 2006, pp.29-30).

There are two kinds of players in the futures markets, hedgers and speculators (CME, 2005b). Hedgers open a position to protect themselves against adverse changes in the underlying asset price that may negatively impact on their business. Speculators, on the other hand, accept these price risks that hedgers wish to avoid. In order to trade a futures contract, there has to be two parties opening the exact opposing positions with their resulting contracts registered with the Australian Clearing House (ACH) (ASX, 2005c). For more information on the mechanism of futures markets, please refer to Appendix

A7.2.

Futures contract holders do not pay or receive the full value of the contract when it is first established. Indeed, contract holders only pay a small initial margin, and over the life of the contract, buyers/sellers (of the contract) will either pay or receive variation margins as the price of the futures contract varies (Dawson and Rodney, 1994; ASX, 2005b, 2005c). The profit or loss on the futures contract is determined by the difference between the price of the opening position and the price at which the position is closed. As futures contracts are legal contracts that obligate the contract holder to deliver at a specified time and price, contracts holders have to settle the positions at maturity regardless of the profit/loss status (Hallwood and MacDonald, 2000, p.13; Hughes and MacDonald, 2002, p.355; Homaifar, 2004, p.9). However, as an alternative to settling the position at maturity, contract holders can close out the position prior to maturity. For instance, if the holder bought futures, then he/she can close out the position by selling futures with the same maturity date, and vice-versa. Such closing out activity will effectively cancel the opened positions. Table 2.5 includes some of those specifications of futures contracts as traded in the Australian Stock Exchange.

Table 2.5: Futures Contracts Specifications

Name	ASX Mini Index Futures
Underlying Index	Contracts are over the S&P/ASX200 Index, the S&P/ASX 50 Index and the S&P/ASX 200 Property Trusts Index.
Contract Code	The futures contract code is a five character code. The first three letters are the ASX code of the underlying index. The fourth character is a number designating the year of maturity and the fifth character represents the maturity month.

Contract Multiplier	Valued at AUD$10 per index point.
Quotation/Tick Size	Prices quoted as the number of points, with a minimum price movement of 1 index point = AUD$10.
Contract Months	March, June, September, December cycle.
Expiry Day	The third Thursday of the contract month, unless otherwise specified by ASX.
Last Trading Day	Trading will cease at 12 noon on expiry Thursday.
Trading Hours	6.00 am to 5.00 pm and 5.30 pm to 8.00 pm (Sydney time)
Cash Settlement	Cash settlement is based on the opening prices of the stock in the Underlying Index on expiry morning. An index calculation (the Opening Price Index Calculation (OPIC)) is made using these opening prices. This means trading will continue after the settlement price has been determined.
Settlement Method	The cash settlement amount is calculated by the calculation agent (Standard and Poors) and forwarded to the Australian Clearing House (ACH). The settlement amount is then paid to receive net of margins on the next business day.
Initial Margin	Initial margins for both buyers and sellers are determined by ACH according to the volatility of the underlying index and are reviewed regularly.
Daily Variation Margin	Futures options for both buyers and sellers are settled to market each day and subject to variation margins. An intro-day margin call may also be made by ACH.
Margin Cover	Settlement to market margin obligation must be settled daily by the payment of cash. Initial margin can be cash or collateral covered.

Source: ASX (2005a).

2.2.4.4 Options Markets

Similar to futures markets, options markets provide impersonal transactions between two participants in an organized, orderly and cost-efficient open outcry auction market (Homaifar, 2004, p.8). Examples of these markets are the Chicago Mercantile Exchange (CME), the New York Mercantile Exchange (NYMEX) and the Australian Stock Exchange (ASX). An options contract gives the contract holder *the right but not obligation* to buy or sell an asset at a will be specific price and delivery date[6]. For a currency options contract, that asset will be a currency. The contract holder is also known as the options buyer. The counterparty of a contract holder is known as the contract writer or contract seller, who is obligated to respond to the contract holder. In other words, if the contract holder chooses to exercise the contract, the writer is obligated to respond. Table 2.6 and 2.7 are provided in an attempt to clearly differentiate the rights and obligations of options buyer (holder) and seller (writer).

6 Refer to Batten et al. (1993), Dawson and Rodney (1994), Hallwood and MacDonald (2000), Kawaller (2001), Kyte (2002), Hughes and MacDonald (2002), Anac and Gozen (2003), Alster (2003), Huffman and Makar (2004), Homaifar (2004), ABS (2005), BIS (2005), Hull (2006).

Table 2.6: Call Options Rights and Obligations

Buyer (holder)	Seller (writer)
Has the right to buy a futures contract at a predetermined price on or before a defined date.	Grants right to buyer, so has obligation to sell futures at a predetermined price at buyer's sole option.
Expectation: Rising prices	Expectation: Neutral or falling prices

Source: NYMEX (2005).

Table 2.7: Put Options Rights and Obligations

Buyer (holder)	Seller (writer)
Has the right to sell a futures contract at a predetermined price on or before a defined date.	Grants right to buyer, so has obligation to buy futures at a predetermined price at buyer's sole option.
Expectation: Falling prices	Expectation: Neutral or rising prices

Source: NYMEX (2005).

The Options markets offer two styles of contracts: the American and the European. The style of an options contract dictates when it can be exercised. The *American options contract* gives the buyer (holder) the *right to exercise* the option at *any time* between the date of writing and the expiry date; the *European options contract*, on the other hand, can *only be exercised on its expiration date*, but *not before* the expiry date (Moffett et al., 2006, p.178). Further information on how to quote a currency options contract and the factors affecting the pricing of options contracts can be found in Appendix A7.3.

In Australia, the Australian Stock Exchange (ASX) only offers standardized options contracts. However, overseas options markets do offer options contracts in two forms: customized and standardized. The customized options contracts are also known as the over-the-counter (OTC) options. It is usually written by banks for US dollars against the British pound sterling, Swiss francs, Japanese yen, Canadian dollars and the euro. These customized options contracts can be tailored to suit individual needs, in terms of delivery dates, contract size and strike price. Moffett et al. (2006, pp.178-179) claimed that the contract size of these over-the-counter options contracts can reach $1 million or more with maturity of up to one or two years. The standardized options contracts are also known as exchange traded options (ETOs). These standardized options contracts were first introduced in the United States by the Philadelphia Stock Exchange (PHLX) in December 1982. Other markets such as the Chicago Mercantile Exchange later followed suit. Like the futures contracts, these exchange traded options are settled through a clearinghouse. The clearinghouse acts as the middleman and handles both sides of an options transaction. Acting as the counterparty of all options contracts, the clearinghouse guarantees the fulfillment of these contracts.

Until this time, currency options contracts are still not available for trading through the Australian Stock Exchange. In fact, the Australian Stock Exchange only offers equity options and index options. For traders wanting to speculate or hedge using currency options contracts, they can utilize overseas options markets that offer currency options contracts, for example the Philadelphia Stock Exchange (PHLX). The exchange traded currency options offer standardized features such as expiration months and contract size. The following Table 2.8 consists of some of the standardized features of an exchange traded currency options contract as listed by the Philadelphia Stock Exchange (PHLX).

Table 2.8: Features of Exchange Traded Currency Options Contracts

	Australian Dollar	**British Pound**	**Canadian Dollar**	**Euro**	**Japanese Yen**	**Swiss Franc**
Contract Size	50,000	31,250	50,000	62,500	6,250,000	62,500
Position and Exercise Limits	200,000	200,000	200,000	200,000	200,000	200,000
Base Currency	USD	USD	USD	USD	USD	USD
Underlying Currency	AUD	GBP	CAD	EUR	JPY	CHF
Exercise Price Intervals (for 3 nearest months)	1 ¢	1 ¢	0.5 ¢	1 ¢	0.005 ¢	0.5 ¢
Exercise Price Intervals (for 6, 9 or 12 months)	1 ¢	2 ¢	0.5 ¢	1 ¢	0.01 ¢	1 ¢
Premium Quotations	Cents per unit	Cents per unit	Cents per unit	Cents per unit	Hundredths of cents per unit	Cents per unit
Minimum Premium Change	$.(00)01 per unit = $5.00	$.(00)01 per unit = $3.125	$.(00)01 per unit = $5.00	$.(00)01 per unit = $6.25	$.(00)01 per unit = $6.25	$.(00)01 per unit = $6.25

Expiration Months	March, June, September, December + two near-term months	March, June, September, December + two near-term months	March, June, September, December + two near-term months	March, June, September, December + two near-term months	March, June, September, December + two near-term months	March, June, September, December + two near-term months
Exercise Style	American and European	American and European	American and European	American and European	American and European	American and European

Source: PHLX (2005b).

2.2.4.5 Swaps

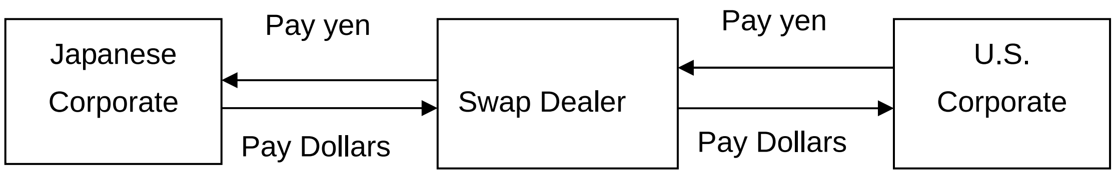
First introduced in the early 1980s, swaps have grown to become one of the mainstream financial instruments in the world (Moffett et al., 2006, p.155; Solnik and McLeavey, 2004, p.528). In 2001, the Australian Bureau of Statistics (ABS) conducted a survey which showed that swaps were the second most popular derivative amongst Australian companies involved in hedging (ABS, 2001).

Swaps are not exchange-traded derivatives (ISDA, 2002; Moffett et al., 2006, p.155; Solnik and McLeavey, 2004, p.528). They are over-the-counter transactions; the main participants include major commercial and investment banks, which belong to the International Swaps and Derivatives Association (ISDA). This association has pioneered efforts in identifying and reducing risk associated with using swaps. Chartered in 1985, their work actually began in 1984 when a group of 18 swap dealers and their counsel started to develop standard terms of interest rate swaps (ISDA, 2006). Today, the ISDA represents 725 member institutions from 50 countries on six continents. It is the largest global financial trade association, in terms of number of member firms. These member institutions range from the world's major institutions that deal in privately negotiated derivatives to end users that rely on over-the-counter derivatives to efficiently manage their exposure to financial risk. For further information regarding the role of ISDA, please refer to Appendix A7.4.

Companies adopt swaps to manage their long-term exposure to currency and interest rate risk (Solnik and McLeavey, 2004, p.528; Hull, 2006, p.149). Currency swaps can be negotiated for a wide range of maturities for up to ten years (Hughes and MacDonald, 2002, p.211). If funds are more expensive in one country than another, a fee may be required to compensate for the interest differential.

There are several types of swaps available in the swaps market. Currency swaps, interest rate swaps, and currency-interest rate swaps are amongst the most popular swap transactions (Hughes and MacDonald, 2002, pp.357-358; Kyte, 2002; Moffett et al., 2006, p.365; Solnik and McLeavey, 2004, p.529; Homaifar, 2004, p.178; BIS, 2005; Becker and Fabbro, 2006; Hull, 2006, p.149, p.173). Other swaps include (but are not limited to) commodity swaps, equity swaps, bullion swaps, and total return swaps (ISDA, 2002). As the focus of this thesis is on the foreign exchange market, it is only logical for our following discussion to be on currency swaps. Figure 2.6 provides an example of a typical currency swap transaction while further discussion regarding the mechanism of currency swaps are included in Appendix A7.4.

Figure 2.6: Typical Example of Currency Swaps



A typical currency swap first requires two firms to borrow funds in the markets and currencies in which they are best known. For example, a Japanese firm would typically borrow yen on a regular basis in its home market. If the Japanese firms were exporting to the United States and earning U.S. dollars, however, it might wish to construct a natural hedge that would allow it to use the U.S. dollar earned to make regular debt service payments on U.S. dollar debt. If the Japanese firm is not well known in the U.S. financial markets, though, it may have no ready access to U.S. dollar debt. Thus, it could participate in a currency swap. The Japanese corporate could swap its yen-denominated debt service payments with another firm that has U.S. dollar debt service payments. The Japanese corporate would then have dollar debt service without actually borrowing U.S. dollar. The swap agreement can be arranged by professional swap dealer who will generally search out matching currency exposures, in terms of currency, amount, and timing. In other words, the swap dealer plays the role of middleman, providing a valuable currency management service for both firms.

Source: Hughes, and MacDonald (2002, p.211) and Moffett, et al. (2006, p.250).

One of the limitations of using swaps is that, just like the forward contracts, there is no organized secondary market for swaps transactions. Solnik and McLeavey (2004, p.529) claim that there are however three alternatives for companies to exit a swaps contract. The first alternative is a voluntary termination with the original counterparty. This is a popular choice, as it is simple and implies only a lum-sum payment to reflect the changes in market conditions. A condition for this alternative is that it requires the consent of the other party. The second alternative is to write a mirror swap with the original counterparty, that is, to write an opposite (mirror) swap with the same maturity and amount but at a current condition. This alternative is different from the first alternative in that the settlement is paid over the remaining maturity of the swap instead of a lum-sum payment. Moreover, for the second alternative, some credit risk tends to remain on the differential interest rate payment. The third alternative of exiting of a swap contract is to write a reverse swap in the market with a new counterparty. It is the easiest way amongst these three alternatives. However, it also had two main disadvantages. Firstly, it is difficult and expensive to find a new counterparty that can offset the exact amount of the previous swap contract; secondly, engaging in two swaps at the same time exposes the company to even more credit risk (Solnik and McLeavey, 2004, p.529).

2.2.4.6 Money Markets

Money markets refer to financial markets in which short-term funds are bought and sold. The maturity of these money market instruments normally are less than twelve months. There are two major money markets: the local money markets and the Eurocurrency markets (Eng et al., 1998, pp.325-327). Each currency sector has its own interest rate pattern that is usually linked to the interest rates in its country of origin. For example, the Eurodollar interest rate tends to follow the interest rate movement in the United States. In this market, the commodities traded are mostly term-deposits with short-term maturities. Table 2.9 provides a list of commonly used money market instruments.

Table 2.9: Commonly Used Money Market Instruments

Instruments	Descriptions
Bankers' Acceptance	A draft or bill of exchange accepted by a bank to guarantee payment of the bill.
Certificate of Deposit	A time deposit with a specific maturity date shown on a certificate; large-denomination certificates of deposit can be sold before maturity.
Commercial Paper	An unsecured promissory note with a fixed maturity of one to 270 days; usually it is sold at a discount from face value.
Eurodollar Deposit	Deposits made in US dollars at a bank or bank branch located outside the United States.
Federal Agency Short-term Securities	Short-term securities issued by government sponsored enterprises such as the Farm Credit System, the Federal Home Loan Banks and the Federal National Mortgage Association.
Federal Funds (in the US)	Interest-bearing deposits held by banks and other depository institutions at the Federal Reserve; these are immediately available funds that institutions borrow or lend, usually on an overnight basis. They are lent at the federal funds rate.
Municipal Notes (in the US)	Short-term notes issued by municipalities in anticipation of tax receipts or other revenues.
Repurchase Agreements	Short-term loans, normally for less than two weeks and frequently for one day, arranged by selling securities to an investor with an agreement to repurchase them at a fixed price on a fixed date.
Treasury Bills (T-Bills)	Short-term debt obligations of a national government that are issued to mature in 3 to 12months.

Source: Eng et al., 1998, pp.325-327

The trading of money market instruments requires international banks to operate an international money trading desk (Eng et al., 1998, p.325-327). In some cases, these trading desks are filled with dozens of dealers, each specialized in particular money market instruments, such as Treasury Bills, foreign currencies or Eurocurrencies. These trading desks are scattered around the globe. It is because of this wide distribution of trading desks that investors in the money markets have access to around-the-clock trading. The need for sophisticated computer and telecommunications hardware and software (required for effective handling of each dealing position) means that these dealing room operations generally represent substantial investments for banks and financial institutes.

The money market and forward market are identical because interest rate parity holds. So hedging in the money market is like hedging in the forward market. A money market hedge also includes a contract and a source of funds to fulfill the contract. Those hedgers who use money market hedges borrow in one currency and convert the borrowing into another currency. We have included a discussion on the mechanism of hedging using the money market in Appendix A7.5.

2.2.4.7 Leveraged Spot Market

The leveraged spot contract is fundamentally the same as a spot contract. Indeed, the mechanism of trading a leveraged spot contract involves borrowing a certain amount of money from a country, say, Japan, for a specific period at a specific interest rate, then converting the amount of Japanese yen into another currency, say, the Australian dollar, at the existing spot rate and investing the Australian dollar in the Australian money market at the Australian interest rate, and finally converting the Australian dollar back to Japanese yen to repay the Japanese yen borrowing.

The only difference between the leveraged spot contract and a spot contract is the leverage ratio available in all leveraged spot contracts. The leverage ratio can range from twenty (1:20) to two hundred (1:200), and is specified by the trading financial institutions. This leverage ratio is a powerful feature of the leveraged spot contracts. Indeed, if the leverage ratio is twenty (1:20), this means that the leveraged spot contract trader will have access to a credit line twenty times larger than his/her initial collateral. It is obvious that this distinct feature of the leveraged spot contracts will allow traders to trade at a significantly lower capital requirement when compared to the spot market. In the following chapters, we will illustrate in further detail regarding the mechanism of leveraged spot market and how the leveraged spot contract can be utilized as an effective speculative and hedging financial instrument.

2.2.5 Determinants of Derivative Selection

A survey based on four hundred and sixty nine (469) Australian firms found that the industry in which a company operates can influence their attitude and usage of financial derivatives (Nguyen and Faff, 2002). For example, the use of derivatives is most prevalent among firms in the following industries: (1) other metals; (2) diversified resources; (3) alcohol and tobacco; (4) transport; and (5) insurance; whereas firms operating in the telecommunication industry are seemingly less attracted to using financial derivatives, with less than 50% of the sample telecommunication firms reporting derivative usage. Table 2.10 provides a snapshot of the use of derivatives by 372 *Fortune 500* companies.

Table 2.10: Frequency of Use of Derivative Instruments by Size and Industry

Frequency of use of derivative instruments by 372 large US firms for fiscal year-end 1991 that have foreign exchange rate exposure as of fiscal year-end 1990. Companies are among the 500 largest firms (by sales) in the Fortune 500. A firm has foreign exchange rate exposure if it has nonzero foreign pretax income, positive foreign sales or debt, or is in the upper quartile of the sample firms on the basis of imports as a percentage of total industry sales. Currency Derivatives include currency swaps and foreign exchange forwards, futures, and options. Any Derivatives include interest rate, commodity, and currency derivatives. All data on derivatives use are from annual reports and 10-K disclosures. The 1st quartile for firm size includes the smallest firms based on 1990 sales; the 4th quartile includes the largest firms.

	N	**Currency derivatives**	**Any derivatives**
All Firms	372	41.4%	59.1%
Panel A: By Firm Size (by 1990 sales)			
4^{th} quartile	93	75.3	90.3
3^{rd} quartile	93	38.7	64.5
2^{nd} quartile	93	34.4	48.4
1^{st} quartile	93	17.2	33.3
Panel B: By *Fortune's* Industry Grouping			
Consumer Goods	47	66.0%	78.7%
Beverages	6	83.3	100.0
Food	22	59.1	81.8
Pharmaceuticals	14	85.7	85.7
Tobacco	5	20.0	20.0
Electronics	71	56.3%	63.4%
Computers, office equipment	18	83.3	88.9
Electronics, electrical equipment	35	42.9	48.6
Scientific, photographic and control equipment	18	55.6	66.7
Energy	32	34.4%	68.8%
Mining, crude oil production	12	8.3	58.3
Petroleum refining	20	50.0	75.0
Metals	32	21.9%	50.0%
Jewelry, silverware	1	0.0	0.0
Metal products	19	21.1	47.4
Metals	12	25.0	58.3
Nondurable consumer products	35	28.6%	42.8%
Apparel	11	27.3	36.4
Furniture	5	0.0	20.0

Soaps, cosmetics	11	36.4	36.4
Textiles	6	16.7	16.7
Toys, sporting goods	2	100.0	100.0
Paper	41	17.1%	39.0%
Forest and paper products	27	18.5	44.4
Publishing, printing	14	14.3	28.6
Production materials	50	44.0%	62.0%
Building materials, glass	7	57.1	100.0
Chemicals	33	42.4	57.6
Rubber and plastic products	10	40.0	50.0
Transportation	64	40.6%	59.4%
Aerospace	16	12.5	43.8
Industrial and farm equipment	32	53.1	65.6
Motor vehicles and parts	13	38.5	53.8
Transportation equipment	3	66.7	100.0

Source: Geczy, et al. (1997).

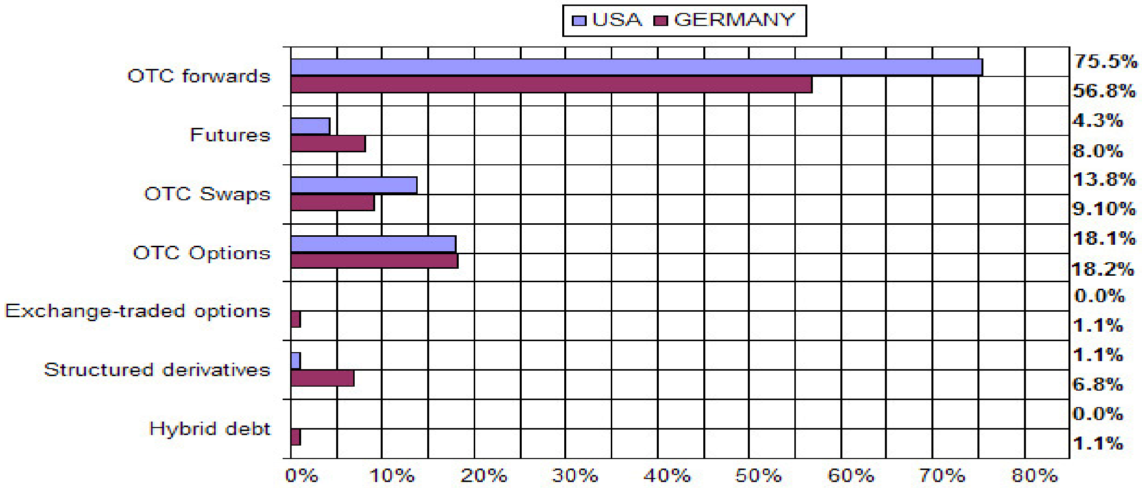
Research also found that the nationality of the company can influence attitudes toward financial derivatives. In fact, varying economic circumstances, taxation systems, derivative usage reporting systems, as well as other legal and legislation systems can affect the choice of derivatives adopted by companies. For instance, when compared to the US firms, the New Zealand and German firms are more likely to adopt foreign currency hedges. This is because both New Zealand and Germany are relatively smaller open economies compared to the United States, leading to greater exposure of the New Zealand and German firms to financial price risk (Berkman et al., 1997; Bodnar and Gebhardt, 1999). Moreover, US companies generally enjoy a much larger single-currency home market when compared to companies from other countries; therefore, US companies typically face less exposure, which can further reduce their motivation for hedging.

Batten et al. (1993), Bodnar and Gebhardt (1999), and Nguyen and Faff (2002, 2003a, 2003b) also identified three other factors that tend to influence the company's derivative selection: (1) leverage level; (2) liquidity level; and (3) company size (in terms of financial distress and setup costs and foreign exchange turnover). According to their observations, currency derivatives are more likely to be used by large companies that have more debt within their capital structure; whereas interest rate derivatives are more likely used by large companies that are more levered, more liquid and pay higher dividends. Furthermore, currency derivatives are more likely to be utilized by smaller-sized companies that pay higher dividends and have more debt. The authors also found that the high fixed cost of a hedging program can make derivative usage uneconomic for smaller-sized companies, in turns discouraging their usage of derivative.

In terms of financial instruments selection, a survey on derivative usage and financial risk management in New Zealand found that currency forward is the most popular derivative for hedgers (Chan et al., 2003). Figure 2.7 shows that a similar preference for over-the-counter (OTC) forward contracts is also found amongst US and German firms (Bodnar and Gebhardt, 1999). The popularity of forward contracts and swaps is definitely also shared among Australian businesses. Indeed, Reserve Bank of Australia reported in 2002 that Australian international businesses predominantly utilize forward foreign exchange contracts to manage their foreign currency exposure with the second most used derivative contracts being cross-currency interest rate swaps. Data gathered from the Australian Bureau of Statistics (ABS) revealed that in 2005 the total principal value of outstanding bought derivative contracts (of both forward and cross currency interest rate swaps) was $1080 billion; whereas the total principal value of outstanding sold derivative contract was $950.9 billions[7]. More data from the 2005 ABS survey is included in Appendix A6.

7 In 2001, data gathered from the Australian Bureau of Statistics (ABS) showed that the combined value of the usage of these two derivatives contracts only accounted from almost $935 billions of the total notional sum of outstanding bought and sold derivative contracts.

Figure 2.7: Preference among FX Derivative Instruments



Source: Bodnar and Gebhardt (1999).

2.2.6 Financial Models

Much literature have been written on financial models, with the most commonly available discussions surrounding models such as Black-Scholes, Black, Merton, Cox-Ross-Rubinstein (commonly known as the Binomial Model) and Garman-Kohlhagen (Black and Scholes, 1973; Merton, 1973; Cox and Ross, 1976; Cox, Ross and Rubinstein, 1979; Garman and Kohlhagen, 1983; Hull and White, 1987, 1988, 1993; Rubinstein, 1994). Others had either derived models as extension of those classic models, for example the Ekvall et al. (1997) model is a revision of the Garman-Kohlhagen currency option pricing model, or proposed their own models based on studies and research conducted on corporate hedging strategies, such as Brown and Toft (2002). The following section will point out differences, in terms of application and intention, between these models and our model.

According to the Australian Stock Exchange (ASX) (2005), the Australian market adopted two main models for pricing equity options: (1) the Black-Scholes model and (2) the Cox-Ross-Rubinstein model (the Binomial option pricing model) (ASX, 2005j). The Black-Scholes model, which was first proposed by Fischer Black and Myron Scholes in 1973, is considered to be a revolutionary step in option pricing theory originally formulated in the early 1900s (Merton, 1973; Cox and Rubinstein, 1985; Cox et al., 1979). The fundamental principal behind the Black-Scholes model is that 'if options are correctly priced in the market, it should not be possible to make profits by creating portfolios of long and short positions in options and their underlying stocks' (Black and Scholes, 1973, p. 637). In their original paper, Black and Scholes claimed that their model is applicable to valuation of common stock, corporate bonds and warrants (Black and Scholes, 1973). However, in practice, this model is commonly recognised as an analytic solution to pricing the European options (ASX, 2005j).

As the marketplace evolved, many researchers attempted to derive financial models capable of enabling corporations in making better hedging decisions. However, studies have revealed certain feelings of disenchantment among currency traders with the performance of these models. This may be due to the fact that majority of the existing models (especially those classical models mentioned above) had been derived based on the original Black-Scholes Option Pricing Model; being descendents, these models also inherited many traits and flaws of the Black-Scholes model (Ekvall et al., 1997). For instance, the Black, the Binomial, and the Garman-Kohlhagen models all suffer the same weakness as the Black-Scholes, where they all assume that the volatility and interest rate will remain constant during the option's lifetime (Black and Scholes, 1973; Black, 1976; Kohlhagen, 1978; Cox et al., 1979; Ekvall et al., 1997). This assumption is decidedly unrealistic and has resulted in the underpricing of many options. Moreover, like the Black-Scholes model, the Garman-Kohlhagen model also assumes that transaction cost and taxes are zero (Ekvall et al., 1997; Jüttner, 2000, p.353). These assumptions are also far from being realistic as taxes are an implied part of our daily life, and transaction costs are unavoidable in most, if not all, transactions.

Moreover, amongst those models mentioned above, the Garman-Kohlhagen model is the only one designed to be applicable in the foreign exchange market, while the others are focused on the share markets. It is also interesting to note that all models mentioned above are option pricing models; in this implies, they were all developed to enable hedgers to make judgments on "*when to hedge*", but not "*how to hedge optimally*". According to these models, mathematical formulae can assist corporations or traders in valuing the prices of any commodity options (or currency options in the case of the Garman-Kohlhagen model), in turn ruling out any arbitrage opportunities. In simpler terms, these option pricing models enable hedgers to calculate the theoretical 'fair value on an option to get an indication of whether the current market price is higher or lower than fair value', this in turn, allows hedgers to make judgment on trading of the particular options contract (ASX, 2005c). This is a major difference between these classical models and our model, as our model is intended to assist companies and individuals to deal with the "*how to hedge*" facet of hedging, but not "*when to hedge*". Our model will be designed and developed specifically for the trading of foreign currency using leveraged spot markets. We also aimed to develop a more realistic model for currency traders (both speculators and hedgers); by taking into account currency volatility among other things.

2.3 Exchange Rate Volatility

Since Australia adopted the free-floating currency system in 1983, countless researches, such as Edison et al (2003), Sheen (1989) and Aruman and Dungey (2003), has been conducted to better understand the volatility of the Australian exchange rate movement against other currencies and its effects on Australian international businesses. Authors such as Dawson and Rodney (1994) and Hunter and Timme (1992) claim that Australian companies which trade internationally would almost inevitably expose themselves to changes in value of currencies. More specifically, these companies are more likely to face large fluctuations on their annual profit statement. The effects of these currency exposures will be most apparent if the company is operating without a proper currency risk management mechanism such as proper a hedging strategy. Note that the currency risk exposure applies to Australian importers and exporters, as well as Australian companies with foreign subsidiaries because these Australian headquarters will, at some point of time, exchange cash flow or funds in foreign currency with their foreign subsidiary.

International businesses are exposed to currency risk because of exchange rate volatility. In fact, the higher exchange rate volatility, the higher currency risk for companies. In order to manage the currency risk, it is important that companies understand the underlying economic and financial fundamentals. As we mentioned earlier, these issues are peripheral to the main theme of this thesis, however, they do need to be addressed. Therefore, in the following section, we will commence with a brief background of the economic and other fundamentals that determine the value of the Australian dollar as well as the risk to it is exposed to in the international market. We will discuss the intervention of the Reserve Bank of Australia since Australia adopted the free-floating system in 1983. For those interested in the background of the international monetary system, please refer to Appendix A5. We note in passing that this thesis will mainly focus on the Australian exchange rate system. For more insights into the international exchange rate system including exchange rate volatility and dynamics, see, for example, Stockman (1980) for exchange rate determination, Stockman (1988a) for the roles of the international financial markets, Obstfeld and Rogoff (1996) for the foundation of international macroeconomics, and Obstfeld and Stockman (1985) for exchange rate dynamics.

2.3.1 Exchange Rate Determination, Dynamics and Responses

Researchers including the Reserve Bank of Australia (RBA) have been attempting to model and explain the volatility of the Australian dollar (AUD) (Sheen, 1989; Aruman and Dungey, 2003; Edison et al., 2003). For example, Simpson and Evans (2003) attempted to verify the importance of the relationship between the nominal Australia/US exchange rate and an index of commodity prices. The authors concluded that Australia is a commodity rich country; therefore, movements in commodity prices are reflected the volatility of the exchange rate. The authors also concluded that their study found evidence that commodity price changes can lead to movements in the Australian dollar versus US dollar exchange rate. An earlier study by Karfakis and Kim (1995) investigated the effects of the status of the Australian current account on the Australian dollar and interest rates. The authors concluded the study by claiming that before the easing of monetary policy in January 1990, ‘interest rate may not have been allowed to rise in response to a larger deficit announcement, and so the effects of the current account news on exchange rates and interest rates were insignificant’ (Karfakis and Kim, 1995, p.593). In their paper, Aruman and Dungey (2003) devoted their efforts to examining the ‘ancestral development of the current model of the Australian Trade Weighted Index used at the RBA’. The authors suggested that the one aspect of the Australian dollar which differentiates it from other floating currencies is ‘the observed strong relationship between the value of the currency and the terms of trade, particularly over longer time horizons’ (pp.56-57).

Having identified some of the previous research done in an attempt to model and explain the volatility of the Australian dollar, we now continue to examine the following factors that are important in analyzing the volatility in the movement of the exchange rate:

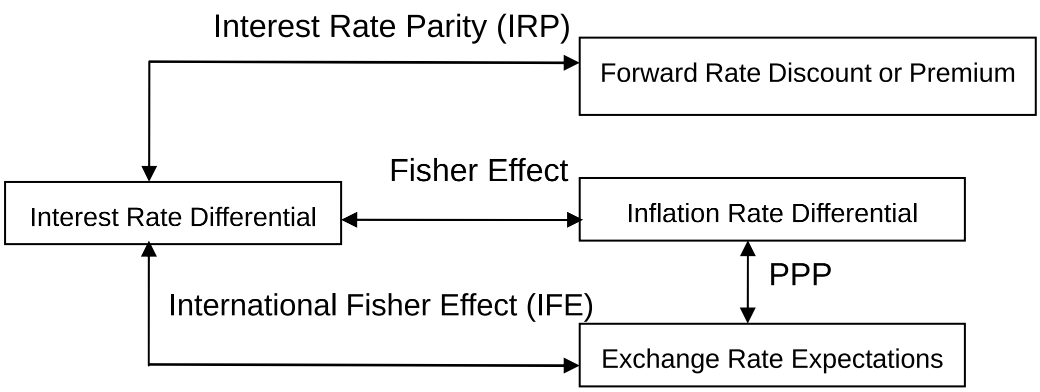
1. parity relationships;
2. flow of balance of payment model;
3. portfolio balance model; and
4. covered interest arbitrage (CIA).

2.3.1.1 Parity Relationships

The parity condition in international finance attempts to establish relationships that explain inflation, exchange rates and interest rate movements (Eng et al, 1998, pp.98-102; Madura, 2003, p.235). As Figure 2.8 shows, there are four parity relationship, including (1) interest rate parity (IRP), (2) international

Fisher effect, (3) the Fisher effect, and (4) the purchasing power parity (PPP). These form the basis for a simple model of the international monetary environment. A brief discussion on these four parity relationship is provided in Appendix A8.

Figure 2.8: Parity Relationships Model



Source: Madura, (2003, p.256).

2.3.1.2 Balance of Payments (BOP) Flow Model

The balance of international payments presents a summarized accounting statement of international economic transactions between the reporting country and the rest of the world during a given time period (Kim, 1993; Kim and Kim, 2006, p.57). If a nation sends more currency abroad than it receives, it will have a deficit in its balance of payments, and vice versa.

There are three major components of balance of payment: the first component is the current account that records imports, exports and income flows; the second component is the capital account that records financial flows that involve: (1) banking transactions, (2) transactions by foreigners in Australian securities such as shares or government bonds, and (3) overseas borrowing by Australian companies; and the third component is official settlement (reserves) account, which measures changes in the so-called balancing items, as well as holdings of gold and foreign currencies (reserve assets) by the nation's official monetary institutions. In Australia, this official monetary institution refers to the RBA.

The balance of payments flow model basically presents the importance of capital inflows and outflows in foreign exchange markets. It reflects the sensitivity of the value of the Australian dollar with respect to interest rate differentials, financial deregulation, or terms of trade, etc. (Rankin, 2004; Blundell-Wignall et al., 1993; Kearns and Rigobon, 2002). We can also say that the balance of payment model represents the capital inflow and outflow with regard to government policies, financial deregulation and changes in economic fundamentals. These in turn determine the Australian dollar exchange rate from a national perspective.

There are broader implications within the balance of payment flow model. For instance, current account deficits triggered hot debates due to public concerns (Pitchford, 1989; Corden, 1991; Steward, 1994). Research found that unexpected current account deficit news leads to exchange rate depreciation as well as increases interest rates. Therefore, as a policy decision, the effects of raising interest rates tend to be considered irrespective of whether it was consistent with monetary policy from 1985 to 1992 in Australia. However, after 1990, the news of account deficits lost its effects on both exchange rates and interest rates (Karfakis and Kim, 1995).

2.3.1.3 Portfolio Balance Model (PBM)

The portfolio balance model suggests that the exchange rate is the relative price of bonds denominated in different currencies (Eng et al., 1998, p.104). In other words, the exchange rate can be determined by the supply and demand of financial assets that are denominated in different currencies. Under the portfolio balance model, these assets should include not only domestic and foreign currency and bonds, but also equities and other securities (Jüttner, 2000, p.418). This is different from other model, as most models restrict the term “asset” to include only domestic and foreign currency and bonds. Due to the behavior of the portfolio balance model, there may be a positive relationship between exchange rate changes and interest rate differentials across countries. For instance, the capital movement from country to country in seeking the highest return on investment (ROI) is actually seen as a large source of foreign exchange transactions (Conway and Franulovich, 2002).

The portfolio balance model also includes people's expectations of those economic fundamentals across countries. Note that this model is based on maximizing the return on investment in those assets that mostly account for bonds, and domestic and foreign currencies. According to Karfakis and Kim (1995), the portfolio balance model assumes imperfect substitutability and attributes changes in exchange rates to a change in the relative supplies of money and bonds at home and overseas.

2.3.1.4 Covered Interest Arbitrage (CIA)

With the constantly changing supply and demand, the spot and forward currency markets are not always in a state of equilibrium. When the markets are imbalanced, the potential for "risk-free" or arbitrage profit exists. Arbitrageurs that recognise the disequilibrium will take advantage of such imbalance by investing in whichever currency that offers the higher return on a covered basis. This mechanism is known as the covered interest arbitrage (CIA), or the covered interest rate parity (Hughes and MacDonald, 2002, pp.209-210; Moffett et al., 2006, pp.104-106).

The potential of covered interest arbitrage would be subject to the following:

(1) the status of equilibrium or in-equilibrium of international money markets; in other words, it relies on the conditions of IRP, and

(2) transaction cost: in practice, this would be the main problem of covered interest arbitrage. Indeed, there are many opportunities of covered interest arbitrage for speculators within one minute travel time from international money markets. However, transaction cost has become a major technical

barrier of covered interest arbitrage for speculators.

2.3.2 Government Policies

Since Australia adopted a free-floating exchange rate, the Reserve Bank of Australia has devoted considerable effort into not only understanding the movement of the Australian dollar, but also applying that relevant knowledge to its intervention and impact on the value of the Australian dollar (Aruman and Dungey, 2003; Edison et al., 2003; Macfarlane, 1993; Rankin, 2004). Indeed, according to the Reserve Bank of Australia, it can intervene in the foreign exchange market, using either direct or indirect intervention (for further discussion on governments' direct and indirect intervention, please refer to Appendix 9), to influence the Australian dollar exchange rate for the following reasons:

(1) to reverse an apparent overshoot, in either direction, in the exchange rate;

(2) to calm markets threatening to become disorderly; and

(3) to give monetary policy greater room for maneuver (Kearns and Rigobon, 2002, 2005; Kim and Sheen, 2002).

According to the International Monetary Fund, the Reserve Bank of Australia also tended to intervene when the central bank wanted to maintain an inventory of net foreign currency assets; that is, reserve building can also motivate the Reserve Bank of Australia to intervene in currency markets (Edison et al., 2003).

2.3.2.1 Reserve Bank of Australia Intervention Techniques since 1983

In practice, the Reserve Bank of Australia (RBA) tends to sterilize all its operations and conduct all of its interventions in the spot market versus the US dollar (Edison et al., 2003). In recent years, the RBA has made substantial changes in the way it conducts its foreign currency operations. Historically, the central bank used open market transactions in Australian government securities to sterilize its operation. However, the rapid growth of foreign exchange markets and the dwindling supply of Australian government securities have induced the central bank to change its practices For instance, during the Russian financial crisis and the collapse of Long Term Capital Management in 1998, the RBA purchased call options on the Australian dollar, which gave the central bank the right to buy Australian dollar at a predetermined price, rather than buying the Australian dollar outright. As a result, dealers who sold the options wanted to hedge their position against the possibility that the options would be exercised. The intervention, therefore, encouraged significant market demand for Australian dollars (Edison et al., 2003).

The changes in the method in which the RBA intervenes are not limited to their operation mechanism, but also their operation motivation. Indeed, concurrent intervention seems to aim more at supporting the Australian dollar. Moreover, the RBA also seems to have reduced their intervention frequency, a common trends amongst OECD nations. According to data, between July 1995 to December 2001, the RBA only intervened 0.26% of all trading days, compared to its intervention on 67% of all trading days between July 1986-September 1991 (Edison et al., 2003). Table 2.11 provides a more comprehensive comparison and understanding of the changes in the RBA’s intervention.

Table 2.11: Summary Statistic on Reserve Bank of Australia Foreign Exchange Market Operations

(January 1984 – December 2001)

	January 1984-December 2001	January 1984-June 1986	July 1986-September 1991	October 1991-November 1993	December 1993- June 1995	July 1995 – December 2001
Number of trading days	4696	651	1370	566	413	1696
Number of intervention days	1817	322	923	131	0	441
Probability of intervention	0.39	0.49	0.67	0.23	0	0.26
Average absolute value of transactions, $Am	57	14	63	144	0	51
Number of purchases of foreign currency	1283	99	780	15	0	389
Average value of purchases of foreign currency, $Am	47	9	56	35	0	37
Number of sales of foreign currency	534	223	143	116	0	52
Average value of sales of foreign currency, $Am	83	16	100	159	0	158
Maximum daily sale of foreign currency, $Am	1305	90	1026	1305	0	1189
Maximum daily purchase of foreign currency, $Am	661	44	661	150	0	286

Source: Edison et al. (2003).

2.3.2.2 Effectiveness of Government Intervention

From Table 2.14, we can clearly see that the RBA has been actively intervening in the foreign exchange market since the Australian dollar began floating in December 1983. So, how effective have those intervention been? Amongst the literature written on government intervention, there are generally three main divisions on the effectiveness of the central banks' efforts: (1) those who discredit the intervention, arguing that not only is the intervention ineffective, but also counterproductive since it increases the volatility within the market; (2) those who stand by the intervention, supporting that the central banks' intervention can effectively calm disorderly markets, and thereby reduce market volatility; and (3) those who are in between, claiming that government intervention is of little significance in affecting the market movement (Dominguez and Frankel, 1993; Edison, 1993; Kaminsky and Lewis, 1996; Chang and Taylor, 1998; Neely, 2000; Sarno and Taylor, 2001; Edison et al, 2003; Kearns and Rigobon, 2005; Kim and Pham, 2006).

Makin and Shaw (1997), and Rogers and Siklos (2003) belong to the first group who discredit the intervention as they concluded that the RBA intervention between the 1980s and 1990s had been rather insignificant in influencing the direction of the exchange rate or smoothing exchange rate volatility. Kim and Pham (2006), Kearns and Rigobon (2002, 2005), Kim and Sheen (2002), and Kim, Kortian, and Sheen (2000) belong to the second group of authors that support the effectiveness of government intervention. Kearns and Rigobon (2002) claimed that over the period 1986-93, 'Reserve Bank of Australia intervention did have an economically significant contemporaneous effect in moving the level of exchange rate'; while Kim and

Sheen (2002) and Kim et al. (2000) used daily data covering the 1983-97 period, and gave credit to the RBA's intervention efforts by claiming that the central bank was prudent in choosing its timing for intervention, and their interventions were typically capable of stabilizing the exchange rate volatility (cited in Edison et al., 2003, p. 4). Kim and Pham (2006) also found that during 1986-2003, the effects of RBA intervention are especially noticeable when the central bank executed large and cumulative interventions.

According to the RBA (2006), their interventions are frequent as they attempt to manipulate the trend of the Australian dollar to be in alignment with monetary policy. This statement seemingly gives readers an impression that on-going central bank intervention has been successful in controlling the movement of the Australian dollar. However, this impression is not widely shared (Kearns and Rigobon, 2005). In fact, in the International Monetary Fund study of the effectiveness of RBA intervention, Edison et al. (2003) concluded that the effects of this intervention are actually quite modest in influencing the level as well as volatility of the Australian dollar exchange rate.

While government intervention is seen as one of the determinants of the Australian dollar, we recognize that questions of the effectiveness of RBA intervention in controlling the Australian Dollar will always remain. There is no doubt that the effectiveness of government intervention can be increased with collaboration between nations, for example, between the G7 nations. Nevertheless, no single factor, including government intervention, is capable of dominating the value of currencies in the long term.

2.4 Summary and Conclusion

In this chapter, we have discussed hedging and exchange rate volatility. In the first part of this chapter, we provided a background to hedging and the common applications and techniques of hedging, such as the forward, futures, options, swaps, and money market instruments. Note that in this thesis, we focus on currency movement hedges, not interest rate hedges. In the second part of this chapter, we addressed exchange rate volatility by discussing the economic fundamentals of exchange rate determination and the dynamics and government interventions for the Australian dollar.

Guided by Aliprantis and Chakrabarti's theorem on Expected Utility Theorem (Aliprantis and Chakrabarti, 2000, pp.26-38), we identified three different types of individuals based on their tolerance to risk. These three types are risk neutral, risk averse or risk seeking (risk loving). We also explained that because hedgers typically choose their hedging strategies by ranking the expected results according to their expected values, they are acting in a risk neutral manner and therefore, in this thesis, we see hedgers as risk neutral individuals. We utilized the “seesaw effect” to illustrate the ideal result for a hedge, where one effect will cancel out another. We mentioned that because of the “seesaw effect”, companies or individuals can protect their proceeds from any adverse currency movements; however, they are also blocked from any potential profits when the currency movement moves in their favor. Therefore, we recommend a pre-requisite for entering the financial markets to perform hedging activities is that the company or individual foresees or expects the currency to *move against their favor*.

Following a review of the available literature, there appears to be a noticeable gap between theory and practice. The limitations of existing classical financial models, such as Black-Scholes, Black, Merton, Cox-Ross-Rubinstein (which is also commonly known as the Binomial Model) and Garman-Kohlhagen, is that these models are mainly designed for stocks, indexes or bonds options pricings. These models assume that during the options' life-time, volatility and interest rates are constant, and transaction costs are set at zero. The model of Garman and Kohlhagen (1983) was developed for evaluating currency options; however, this model also inherited many of the deficiencies of the Black-Scholes model. It is obvious that, given the above assumptions, these classical financial models are inadequate to reflect volatile movements in foreign currency markets.

Having gone through the background, mechanism and features of these traditional financial instruments and models, it is clear to us that the leveraged spot market possesses certain competitive advantages when compared to traditional methods. These competitive advantages are the leveraging ratio and the opportunity to earn risk-free interest. Taken individually, these two features are not unique to the leveraged spot markets; indeed, in the futures or options markets, traders are only required to pay a small amount of premium (which is similar in function to the leverage ratio), and in the money market, traders can earn risk-free interest by investing in a treasury bill (T-Bill). However, the leveraged spot market is unique in that it possesses the combination of both features, and traders in this market will, firstly, have access to a credit line that can range from twenty to two hundred times larger than their own collateral, and secondly, have the opportunity to yield risk-free interest on their “amplified” collateral. It is obvious that as their collateral has been amplified, the interest earned on their collateral will also be magnified. These combined advantages have not been seen in the forward, futures, options, swaps, or money market instruments.

Similar to these traditional financial instruments, the leveraged spot contracts can be used as both speculating and hedging tools. In fact, this financial tool has been widely adopted in financial markets such as Hong Kong, China, the United States and Europe. However, as we noted earlier, following the review of available literature we did not come across any literature written on the use of leveraged spot contracts as a hedging instrument. Therefore, in the following chapters, we will present a model which is developed to illustrate how to fully explore the superiority of the leveraged spot market as a powerful speculating and hedging instrument. We aimed to take a more realistic approach in our model by taking into account exchange rate volatility and interest rate movement; in fact, we assumed that the exchange rate movements follow a stochastic process.

Chapter Three

Speculation Using the Leveraged Spot Market

3.1 Introduction

With the increasing popularity of foreign exchange trading in the global financial system, the volumes of daily turnover as of April 2004 rose to $1.9 trillion from $1.2 trillion in April 2001 (Federal Reserve Bank of New York, 2006). Popular financial instruments commonly used for speculating in currency markets have included forward, futures, options and swaps. However, speculating via a 100% spot transaction (spot market) has not been a recommended practice (Das, 2004, p.1286; Hollein, 2002). This chapter describes how the leveraged spot market can be used for speculative activities in the foreign exchange market. The receipt of a risk free income based on interest rate differentials between countries distinguishes this method from traditional speculation using the spot market.

The description of the procedure for speculation using the leveraged spot market in this chapter is developed in two stages. Firstly, to clarify the intuition behind the procedure, a numerical example is presented. Secondly, this example is translated into a rigorous mathematical model. The possibility of obtaining risk free interest income lowers the riskiness of speculating in the foreign exchange market relative to an unleveraged spot market transaction; this can allow a speculator to achieve a specific expected return at a lower risk, or a higher expected return at a given level of risk. This feature makes speculation using the leveraged spot market an attractive proposition for risk neutral as well as risk averse individuals.

3.2 Methodology

3.2.1 Finite Horizon, Discrete Time Compounding Version

Suppose the investor borrows K contracts in Japanese yen (JPY), where the size of each contract is JPY V. The amount of yen borrowed is, therefore, KV. In reality, let's say the value of one contract in the leveraged spot market equals JPY12,500,000. So, for example, if the investor borrows three contracts, the amount of yen borrowed is JPY37,500,000. The next step in the procedure is to convert the Japanese currency borrowed into US dollars. To illustrate how the leveraged spot market works, consider a simple example when an investor borrows one contract. This is shown in the first column of Table 3.1, when the investor borrows JPY12,500,000 (KV) from a bank at the borrowing interest rate of 2% per annum. To convert Japanese yen into US dollars, we have to use the spot rate. The spot rate, denoted by $S = \left(\frac{JPY}{USD}\right)$ is assumed to be equal to 115, that is, one US dollar exchanges for 115 Japanese yen in the spot market. Thus, the amount of Japanese yen borrowed translates to USD108,695,65 (notationally, $B_{USD} = \frac{KV}{S} = 108{,}695.65$); this is shown in the first column of Table 3.1. Borrowing one contract in Japanese yen requires collateral, or in other words, an initial margin. The fraction of the amount borrowed that is required as collateral is denoted by δ. Therefore, $C_L = \delta KV$, where C_L shows the Japanese yen value of the collateral. As shown in Table 3.1, we assume that δ is 5%, that is, δ = 0.05. The collateral (initial margin) in US dollars is then $C_{LUS} = \frac{\delta KV}{S} = USD5{,}434.78$ (see column 1 of Table 3.1).

Table 3.1: Operation in Leveraged Spot Market

Leveraged Spot Market							
Currency Amount	Number day(s) in market:		1				
JPY				JPY			
12,500,000.00	→	2.00%	→	12,500,684.93	JPY interest paid	684.93	JPY
Borrowing							
S1	spot currency movement			S2			
115.00	→			115.80	Profit/Loss	$750.92	USD
USD				USD			
$ 108,695.65	→	5.00%	→	$ 108,710.54	USD interest received	$ 14.89	USD
Saving							
					Interest (gain/loss):	$ 8.93	USD
-750.9198768					Total (Profit/Loss) + (Interest)	$759.85	USD
initial margin:		$ 5,434.78					
maintenance margin:		$ 3,260.87					

Source: Author's calculations.

Assuming a Japanese yen borrowing rate of 2%, the daily interest repayment on the amount borrowing of JPY12,500,000 is JPY684.93. If the amount borrowed in Japanese yen is converted to USD108,695.65 and invested in the US money market where it earns 5% per annum, the daily interest earnings in US dollars are USD14.89. Thus, the interest rate differential between Japanese yen and US dollars on a daily basis is USD8.93, which converts to JPY1,026.95 at the spot rate of 115JPY/USD. This part of the procedure yields the certain risk free interest differential return for one day on this contract:

$$E_r = (r_{US} - r_J)KV = (5\% - 2\%) \times \left(\frac{1}{365}\right) \times 108{,}695.65 = \text{US\$}8.93$$

where E_r is the net interest rate earned for one day on the amount borrowed (*KV*). An important feature of this contract is that an initial margin of 5%, allows us to leverage interest earnings by a factor of 20, which is known as the leveraging ratio. Suppose the spot exchange rate S1 changes to S2 within the day, from 115 to 115.80. The profit/loss resulting from this currency movement is,

$$E_m = \left(\frac{KV}{S1} - \frac{KV}{S2} \right) = \text{US\$750.92}$$

where E_m is the profit of currency movement earned for one day on the amount borrowed (*KV).* The total profit/loss in this numerical example involves two parts: the first arises from the interest differential between the money market in Japan and the United States, while the second arises from the exchange rate movements. In this example, the currency movement is favourable for the investor; the total daily profit is therefore USD759.85. It is easily seen, however, that if the currency movement were unfavourable, then the differential interest income would mitigate the extent of the loss.

We now proceed to develop a mathematical model based on the leveraged spot technique. To begin with, consider the case where an investor has a one-year fixed term investment opportunity, where interest is compounded annually. Suppose the investor borrows *K* contracts in Japanese yen, where the size of each contract is JPY *V*. The amount of Japanese yen borrowed is therefore *KV.* If the interest rate on the amount borrowed is r_J, the amount that has to be repaid at the end of the year is:

(3.1) JPY $KV(1+r_J)$

In order to borrow this amount of funds, the investor is required to put forward some collateral, or margin, which is a certain percentage of the funds borrowed. Let this margin be denoted δ. The cost to the investor *c* of borrowing funds, is a function $c(\delta KV)$, which depends on the volume of funds borrowed (*KV)*, and the margin percentage (δ). If the only cost to the investor of this collateral were the interest rate foregone, then we would expect a simple linear function to describe $c(.)$. Typically, however, the opportunity cost of acquiring funds for the speculative activity that we are considering is significantly greater than just the nominal value of interest foregone. For example, a small investor may need to sacrifice a stream of consumption with marginal benefits that exceed the interest rate. To allow for this sort of situation, we allow for the cost function to be convex in *K*. Indeed, if the cost function is linear in *K*, then the optimum will involve a corner solution, rather than the interior one we derive below. However, please refer to Appendix C for the details of the corner solution if we choose different cost function. For analytical tractability, we assume a simple form for this cost function:

(3.2) $$c(\delta KV) = \frac{1}{2}\delta VK^2$$

The next step to this investment activity involves converting the Japanese yen funds borrowed into US dollars at the existing spot rate of *S*, where the spot rate is described as the price of 1 USD in terms of JPY. The funds borrowed thus yield $USD\frac{KV}{S}$. This is then invested in the United States at interest rate r_{US}. The US dollar amount that is received at the end of the year is, therefore:

(3.3) $$\text{USD } \frac{KV}{S}(1 + r_{US})$$

To compare this with the Japanese yen amount that must be repaid, the investor has to anticipate the Japanese yen value of the US dollars receipts in

(3.3). Assuming that the expected future spot rate is denoted S^e, the expected returns in Japanese yen is:

(3.4) JPY $\frac{KV}{S}(1+r_{US})S^e$

Letting the expected change in the spot rate be $E(\dot{S})=\frac{S^e-S}{S}$, it follows that $\frac{S^e}{S}=1+E(\dot{S})$. Subsituting this back into (3.4), we get that the receipt denominated in Japanese yen is:

(3.5) $KV(1+r_{US})(1+E(\dot{S}))$

The expected gross profits denominated in Japanese yen π is:

(3.6) $\pi = KV(1+r_{US})(1+E(\dot{S})) - KV(1+r_J) = KV[(r_{US}-r_J)+(1+r_{US})E(\dot{S})]$

If uncovered interest parity holds, the expected rate of depreciation of the US dollars will (approximately) equal the interest rate differential, that is, $E(\dot{S})=r_J-r_{US}$. In this case, approximately, $\pi = KV(r_{US}E(\dot{S}))\cong 0$, and the gross profits are expected to be very small. However, despite being one of the core topics in the studies of international finance, the validity of the uncovered interest parity remains a question. In fact, as Flood and Rose (2001) stated, there has been a strong consensus among existing literature that the uncovered interest parity works poorly in practice. Other literature, such as Bilson (1981), Longworth (1981), Meese and Rogoff (1983), Chinn and Meredith (2004) and Moosa (2004, pp.296-305) also question the empirical validity of the uncovered interest parity. Chinn and Meredith (2004) actually concluded in their 2004 paper that the uncovered interest parity is useless in predicting short-term exchange rate movements. Given that the evidence on uncovered interest parity holding in spot markets is less than convincing, there is reason to believe that the scheme described above will yield non-trivial gross profits. The expected net profit denominated in Japanese yen *π* is:

(3.7) $$\Pi = KV[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] - \frac{1}{2}\delta VK^2$$

The investor will choose *K* in order to maximize *π*, which yields the first order condition:

(3.8) $$\frac{\partial \Pi}{\partial K} = V[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] - \delta VK^* = 0$$

The optimal number of contracts is:

(3.9) $$K_F^* = \frac{(r_{US} - r_J) + (1 + r_{US})E(\dot{S})}{\delta}$$

Here the subscript 'F' denotes the fact that the optimal contract has been derived for the finite horizon case.

3.2.2 Infinite Horizon, Continuous Compounding Version

Now consider the case where the investment can be made over an infinite time horizon and interest rates are compounded continuously. Given the infinite horizon of the investment, the rate at which future profits are discounted becomes important, and we let the (subjective) discount rate of the investor be ρ. In order to get an interior solution, we require that $\rho > \max\{r_{US}, r_J\}$. If this is not the case, then the investor will arrive at a corner solution where the investor will speculate all available funds in this investment strategy. In what follows, we assume that $\rho > \max\{r_{US}, r_J\}$.

The change to an infinite horizon, continuous compounding model entails the following changes to (3.1) and (3.5):

(3.1’) $$KV\int_0^\infty e^{(r_J-\rho)t}dt$$

(3.5’) $$KV(1+E(\dot{S}))\int_0^\infty e^{(r_{us}-\rho)t}dt$$

Note that $E(\dot{S})$ is the expected appreciation or depreciation of the US dollars over the entire, infinite horizon. We note in passing that while it may seem difficult to estimate the expected rate of appreciation or depreciation over an infinite horizon, the theoretical model we present in the Section 3.2.4 involves bands on the exchange rate, which makes this equation less problematic.

The expected gross profit is:

(3.6’) $$\pi = KV(1+E(\dot{S}))\int_0^\infty e^{(r_{us}-\rho)t}dt - KV\int_0^\infty e^{(r_J-\rho)t}dt$$

$$= KV[\int_0^\infty e^{-(\rho-r_{us})t}dt - \int_0^\infty e^{-(\rho-r_J)t}dt + E(\dot{S})\int_0^\infty e^{-(\rho-r_{us})t}dt]$$

$$= KV[\frac{1}{(\rho-r_{us})} - \frac{1}{(\rho-r_J)} + \frac{E(\dot{S})}{(\rho-r_{us})}]$$

The expected net profit is:

(3.7’) $$\Pi = KV[\frac{(r_{us} - r_J)}{(\rho - r_{us})(\rho - r_j)} + \frac{E(\dot{S})}{(\rho - r_{us})}] - \frac{1}{2}\delta V K^2$$

Maximizing $\prod$ with respect to *K*, we get:

(3.8’) $$K_I^* = \frac{1}{\delta}[\frac{(r_{us} - r_J)}{(\rho - r_{us})(\rho - r_j)} + \frac{E(\dot{S})}{(\rho - r_{us})}]$$

Here the subscript ‘I’ denotes the fact that the optimal contract has been derived for the finite horizon case.

3.2.3 Comparative Static

In this section, we derive some comparative static results to see how the size of the optimal contract responds to changes in parameter values. The main parameters in our model are $r_{US,} r_J, \delta$ and ρ . We treat $E\left(\dot{S}\right)$ as an exogenous variable to begin with in this section; subsequently, in Section 3.2.4, we will explicitly model the behaviour of the exchange rates.

Taking the partial derivatives of K_F^* and K_I^* with respect to the parameters, and checking the signs, we get:

$$\frac{\partial K_F^*}{\partial r_{US}} = \frac{1}{\delta}\left[1 + E\left(\dot{S}\right)\right] \geq 0 \text{, since } E\left(\dot{S}\right) \in [-1,1]$$

$$\frac{\partial K_F^*}{\partial r_J} = -\frac{1}{\delta} < 0$$

$$\frac{\partial K_F^*}{\partial \delta} = -\left[\frac{(r_{US} - r_J) + (1 + r_{US})E\left(\dot{S}\right)}{\delta^2}\right] \leq 0$$

$$\frac{\partial K_F^*}{\partial E\left(\dot{S}\right)} = \frac{(1 + r_{US})}{\delta} > 0$$

$$\frac{\partial K_I^*}{\partial r_{US}} = \frac{1}{\delta(\rho - r_{US})^2}\left[1 + E\left(\dot{S}\right)\right] \geq 0 \text{ since } E\left(\dot{S}\right) \in [-1,1]$$

$$\frac{\partial K_I^*}{\partial r_J} = -\frac{1}{\delta}\left[\frac{1}{(\rho - r_J)^2}\right] < 0$$

$$\frac{\partial K_I^*}{\partial \delta} = -\frac{1}{\delta^2}\left[\frac{(r_{US} - r_J)}{(\rho - r_{US})(\rho - r_J)} + \frac{E\left(\dot{S}\right)}{(\rho - r_{US})}\right] < 0$$

$$\frac{\partial K_I^*}{\partial E\left(\dot{S}\right)} = \frac{1}{\delta}\left[\frac{1}{(\rho - r_{US})}\right] > 0$$

$$\frac{\partial K_I^*}{\partial \rho} = -\frac{1}{\delta}\left[\frac{(r_{US} - r_J)[(\rho - r_{US}) + (\rho - r_J)]}{(\rho - r_{US})^2(\rho - r_J)^2} + \frac{E\left(\dot{S}\right)}{(\rho - r_{US})^2}\right] < 0$$

Intuitively, the comparative static results provide the basis for determining how to alter the size of the contract as exogenous variables, such as interest rates, change. The comparative static results above indicate that, ceteris paribus, irrespective of whether the time horizon is finite or infinite, the size of the optimal contract increases when r_{US} increases and decreases when r_J

increases. An increase in the expected appreciation of the US dollar also results in an increase in the size of the optimal contract. Moreover, an increase in the margin requirement, δ, reduces the size of the optimal contract. Finally, for the infinite horizon case, an increase in the discount factor (ρ) will reduce the size of the optimal contract.

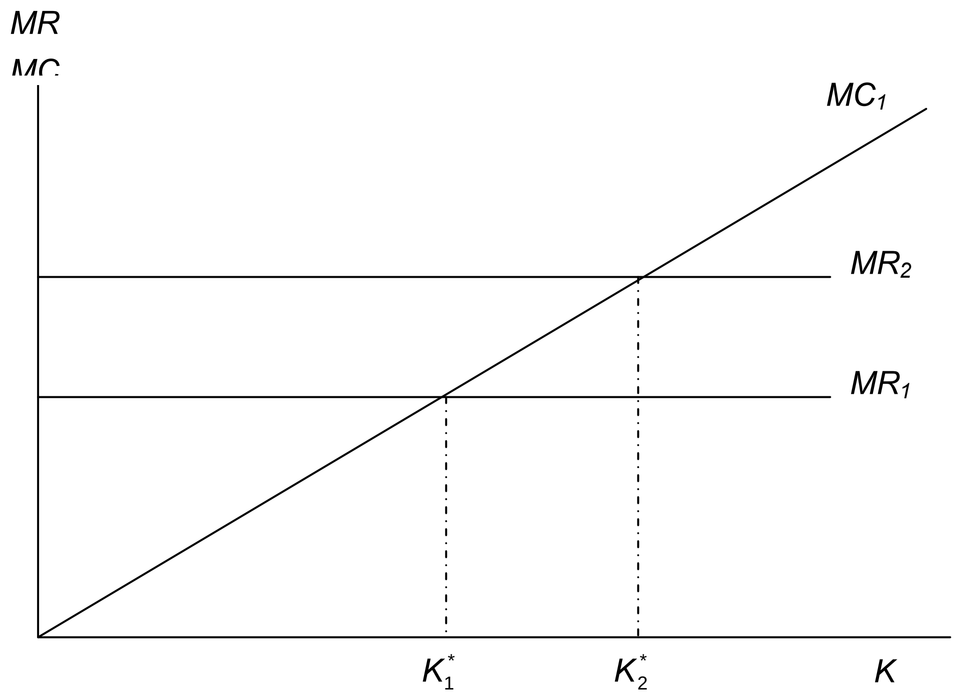
Figure 3.1 below describes how these changes in the optimal size of the contract come about. Consider the finite horizon case. Equation (3.8) indicates the rule for optimization behaviour:

$$\frac{\partial \Pi}{\partial K} = V\left[\left(r_{US} - r_J\right) + \left(1 + r_{US}\right)E\left(\dot{S}\right)\right] - \delta V K^* = 0$$

$$\Rightarrow V\left[\left(r_{US} - r_J\right) + \left(1 + r_{US}\right)E\left(\dot{S}\right)\right] = \delta V K^*$$

Recognising that $V\left[\left(r_{US} - r_J\right) + \left(1 + r_{US}\right)E\left(\dot{S}\right)\right]$ is the expected marginal revenue from a small increment in the size of the contract and δVK is the marginal cost from this increment, equation (3.8) gives the familiar rule for optimization that the marginal revenue equals the marginal cost at the optimal contract size K^*. Figure 3.1 below shows the marginal revenue and cost as the contract size varies. The initial marginal revenue is MR_1; this is a flat line (since the marginal revenue is independent of *K*) with the vertical intercept equal to $V\left[\left(r_{US} - r_J\right) + \left(1 + r_{US}\right)E\left(\dot{S}\right)\right]$. The marginal cost ($\delta VK$) is a straight line passing through the origin with slope δV. The initial marginal cost is represented by MC_1. At the optimum, K_1^* is the size of the contract that maximizes profits, and is identified graphically by the point of intersection of MR_1 with MC_1. Now suppose some parameters change, for example, the interest rate in the US rises. This results in an upward shift of the marginal revenue line to MR_2; correspondingly, the optimal contract size rises to K_2^*. The other comparative static results can be depicted graphically in a similar manner.

Figure 3.1: The Optimal Number of Contracts in Leveraged Spot



3.2.4 Exchange Rate Behaviour

In this section, we present a model of exchange rate behaviour based on Krugman's (1991) model of exchange rate dynamics within a target zone. Following Krugman (1991) we assume that the exchange rate movement follows the pattern of a random walk. It is a stochastic process (random function), which is used to model a series of successive movements that occur in random directions. The random walk model is commonly used in economics and finance, so we do not elaborate on the techniques of this modelling framework. (see, for example, Dixit and Pindyck (1994) for an application of random walk processes in economics and Hull (1993) for its application in finance.) The variation in the exchange rate S is assumed to follow the pattern of a random walk. Krugman (1991) employs the following equation for the spot exchange rate:

(3.10) $$S = m + v + \gamma E\left(\frac{dS}{dt}\right)$$

where S denotes the log of the spot rate for foreign exchange, m the domestic money supply, v a shift term representing velocity shocks, and the last term is the expected rate change in the spot rate. Krugman's model assumes the existence of an explicit or implicit target zone for the exchange rate. The presence of a target zone provides a lower and upper bound on the movement in the exchange rate. Intuitively, it can be seen that the target zone also provides a bounding mechanism on profit and loss that can arise in our model of speculation using the leveraged spot market.

The stochastic nature of the spot rate arises from the fact that v follows a random walk process:

(3.11) $$dv = \sigma dz$$

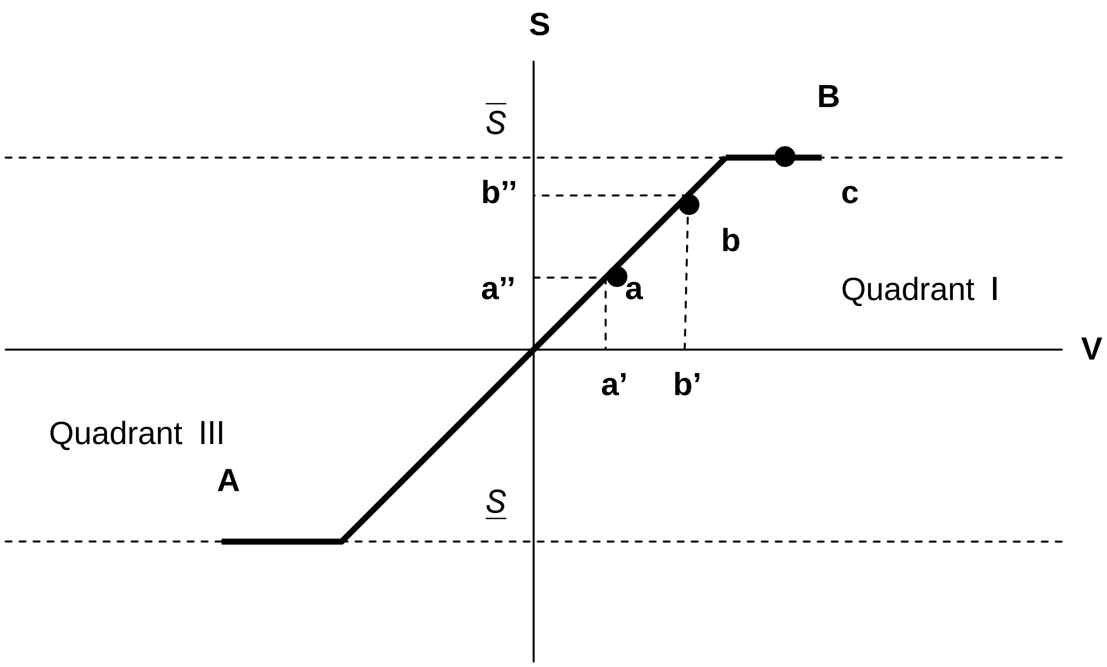
As v evolves randomly over time, the spot rate fluctuates stochastically within the target zone. This elegant model involving random walk processes allows us to obtain a neat solution to the problem of analysing the volatility of the foreign exchange market.

Before we proceed to provide the formal solution for the process of a random walk, it is important to highlight the intuition behind the process captured in the above equation. In Figure 3.2, the horizontal axis represents the values of v and the vertical axis the values of the spot rate S. The upper bound on S (denoted by $\bar{S}$) is shown by the horizontal line drawn from $\bar{S}$ in the first and second quadrant in Figure 3.2. The lower bound of the target zone is shown in the third and fourth quadrant with the horizontal line denoted $\underline{S}$.

In Figure 3.2, the solid line A-B (which is a reference line) shows the relationship between v and S. This line has the slope of 45^o. At the end points, it merges with the bounds. On the 45^o line, the movement in volatility is matched exactly by the movement in the spot rate, as shown by a' b', and a'' b''. However, in a target zone model the relation between v and S does not follow the pattern of the 45^oline. Following Krugman (1991), consider the situation at point b. Supposed v falls from this point, then the exchange rate will also fall along the 45^oline. However, this is not the case for a rise in v as the monetary authority would like to defend the target zone. Hence, the exchange rate will move to a point like c. This implies an asymmetric outcome where a fall in v reduces S more than a rise in v increases S. This drags down a point such as b to a lower point. The same process will occur in quadrant III. This will lead to a S-shape curve which is concave in quadrant I and convex in quadrant III. It should be noted that in a model in which there are no target zones, v and S will always move along the 45^{o}line. It is important to note that the S-shape curve is flatter than the 45^{o}line.

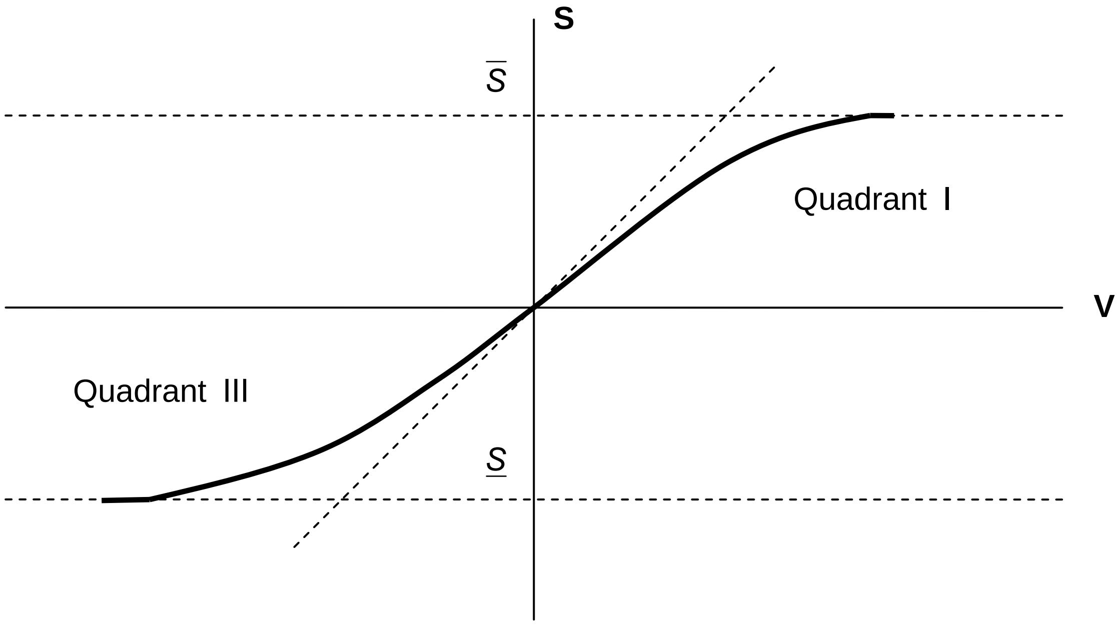
Therefore, any shocks to the velocity have a smaller effect on the exchange rate in the target zone model in comparison with a model where the exchange rate is allowed to move freely. This is a very important point in our analysis as it limits the volatility of the exchange rates.

Figure 3.2: Effects of a Target Zone on Exchange Rate Behavior



Source: Author's calculations

Figure 3.3: S-Curve of Exchange Rate Behaviour



Source: Author's calculations

Following Krugman (1991), we can express S as a function of money supply, velocity, upper bound and lower bound of the exchange rate. Let this function be given by:

(3.12) $$S = g(m, v, \bar{S}, \underline{S})$$

It should be noted that the S curve in Figure 3.3 represents a relation between v and S for a given value of m.

If we assume that the money supply is held constant within the bands of the target zone, this implies that when S belongs to the interior of the band (that is $S \varepsilon]B[$), the only source for changes in the spot rate is caused by variation in v. Therefore, by applying the rules of stochastic calculus, Krugman (1991) arrives at the following equation to describe the exchange rate behaviour within the target zone:

(3.13) $$E\left[\frac{dS}{dt}\right] = \frac{\sigma^2}{2} g_{vv}$$

In Section 3.3, we will simulate the value of g_{vv} based on real exchange rate data.

By putting the above equation for the expected change in the spot rate in equation (3.8'), we obtain:

(3.14) $$K^* = \frac{1}{\delta}[\frac{(r_{us} - r_J)}{(\rho - r_{us})(\rho - r_j)} + \frac{1}{(\rho - r_{us})}\frac{\sigma^2}{2} g_{vv}]$$

Equation (3.14) shows that K^* is an increasing function of the interest rate differential and a decreasing function of exchange rate volatility for $g_{vv} < 0$. A profit maximizing agent would take both these considerations into account in choosing the optimal amount of K^*. In equation (3.14), we do not know the value of the second derivative of the spot function, that is, g_{vv}. As mentioned before, we will use certain simulation techniques to obtain a value for g_{vv}; we turn to this next. The values of the other parameters can be easily obtained from the historical data set of interest rates and exchange rates.

3.3 Model Simulation

Testing this model empirically in a rigorous manner would require sophisticated econometric techniques; however, by using a simple simulation we can derive insight into how real world data will affect the optimal number of contracts.

We can obtain real world data for interest rate, and historical spot rates. However, for the subjective discount rate ρ and the calculation of the function g_{vv} real world data are difficult, if not impossible, to obtain. Therefore, in order to perform the simulation, we will assume various different values for ρ and g_{vv}, and use historical data for interest rates and spot rates, to obtain the optimal number of contracts (K^*).

The S-shape curve in Figure 3.3 represents a relation between v and S for a given value of m, and describes the function $g(\cdot)$ in Krugman's model. It is important to note in Figure 3.3 that the portion of the $g(\cdot)$ curve which is concave in quadrant I, means $g_{vv} < 0$, and the portion of the g_{vv} curve which is convex in quadrant III, indicates $g_{vv} > 0$.

In order to obtain the optimal number of contracts (K^*) in this model simulation, the spot rate is described by the number of JPY trading in USD $\left(\frac{JPY}{USD}\right)$. The model simulation requires the following data: (1) interest rates of Japanese yen and US dollars; (2) leveraged ratio; (3) variance of spot rate; (4) discount factor; and (5) the value of g_{vv}.

From historical data, we get a borrowing interest rate of 2% per annum for the

Japanese yen, a saving interest rate of 5.25% per annum for the US dollar, and a leverage ratio of 5%. Appendix B describes how the variance of historical spot rates is calculated. The discount factor is assumed to be 0.7. Moreover, we choose the concave portion of the g_{vv} function in quadrant I of Figure 3.3 by assuming that g_{vv} can take values of -0.01, -0.03, -0.05, and -0.1 for the model simulation.

We now calculate the optimal number of contracts (K^*) based on the data given below:

(1) Japanese yen borrowing interest rate r_J: 2%;

(2) US dollars saving interest rate r_{US}: 5.25%;

(3) leveraged ratio δ: 0.05 (5%), which implies that the investor must provide an initial margin equal to $\frac{KV}{20}$, where KV is the principal borrowed in Japanese yen (recall that K is the number of contracts and V is the size of a contract in Japanese yen);

(4) discount factor ρ: 0.7;

(5) variance σ^2 : 0.342041;

The equation (3.14), $K^* = \frac{1}{\delta}[\frac{(r_{us} - r_J)}{(\rho - r_{us})(\rho - r_j)} + \frac{1}{(\rho - r_{us})}\frac{\sigma^2}{2}g_{vv}]$, gives the optimal number of contracts. (1) to (5) above provide us with values for $r_{US}, r_J, \rho, \delta$, and σ^2, leaving g_{vv} the only unknown independent variable. By assuming various different values of g_{vv}, and calculating the value of K^*, we obtain Table 3.2 which shows how K^* varies due to changes in g_{vv}.

Table 3.2: Simulation for K^*

Values of g_{vv}	$\left(K^*\right)$
-0.01	**0.66**
-0.03	**0.62**
-0.05	**0.57**
-0.1	**0.46**

It is worth reiterating that testing this model empirically in a rigorous manner would require sophisticated econometric techniques. However, the thesis applies this simple ‘rule of thumb’ method described above to derive the optimal number of leveraged spot contracts.

Chapter Four

Hedging Model

4.1 Introduction

In this chapter, we focus on two issues related to the hedging of open positions. The first issue deals with how an investor can hedge an open position in the leveraged spot market with a simultaneous position in the forward market. In this case, we will see that as interest rates change, the leveraged spot market position can yield substantial income. The second issue relates to how an existing transaction exposure can be hedged using the leveraged spot market. We will show that in some circumstances, hedging the transaction exposure with the leveraged spot contract can be superior to traditional methods such as forward and money market hedges.

A trader's attitude towards risk is also known as his/her risk aversion. As mentioned in the previous chapter, there are three categories of players in a functioning derivative market: hedgers, speculators and arbitrageurs; and each of these players use the market with varying intention, due mainly to their different risk aversion level (Dinwoodie and Morris, 2003; Jüttner, 2000, p.35; Hallwood and MacDonald, 2000, p.32). Arbitrageurs are by definition highly risk intolerant (risk averse individuals), and they only trade in risk-free transactions; whereas speculators are on the other side of the spectrum (risk takers), as they make profit by taking risk; hedgers are in between the low and high risk averse groups, with their tolerance to risks determining the amount to which they hedge, also known as the hedge ratio (Dinwoodie and Morris, 2003; Homaifar, 2004, p.93).

It is based on their varying attitude towards risk that these players tend to engage in the derivative market with very different transaction patterns. More specifically, an arbitrageur who seeks risk-free profits will simultaneously take up a position in two or more markets, for instance, and simultaneously buy spot and sell forward Australian dollars, in an attempt to exploit mis-pricings due to a market that is not in equilibrium. However, according to Dinwoodie and Morris (2003), such price differentials are almost non-existent in a well-functioning market, mainly because supply and demand tend to rapidly restore market equilibrium.

As opposed to an arbitrageur, a speculator seeks profit by taking risk (Dinwoodie and Morris, 2003; Jüttner, 2000, p.35; Hallwood and MacDonald, 2000, p.32). In other words, speculators who anticipate an appreciating Australian dollar will put their “bets” on the rising Australian dollar by buying it at a lower value, then selling when the value is higher should the prediction come true (otherwise, the speculator will lose all his/her bets on the Australian dollar movement).

Hedgers enter the derivative markets mainly with the intention to insure against price volatility beyond their control. Based on this intention, it is not surprising that hedgers are mostly acting on behalf of corporations. The mechanism of hedging mainly transfers risk to others who are willing to accept that risk. Indeed, the risk is never nullified but merely transferred from one party to another. In most cases, speculators are those who absorb the risks transferred by hedgers (Dinwoodie and Morris, 2003; Hallwood and MacDonald, 2000, p.32). It is perhaps due to these notions that some have referred to the derivative market as the zero-sum game market, where the gain of one party is exactly equal to loss of another party (Homaifar, 2004, p.75).

In the following sections, we shall first construct a numerical example to show the working of the hedging model as a new method of making profit from a favourable interest rate movement. Secondly, we show how an existing transaction exposure can be hedged using the leveraged spot market, providing a new hedging method that can be superior to traditional methods such as forward and money market hedges, under some circumstances. It is noted that due mainly to the unpredictable nature of the currency market, the effectiveness of this new technique can be reduced under certain unforeseeable circumstances.

4.2 Hedging the Returns from Speculation in the Leveraged Spot Market

In Chapter 3, we introduced a model to show how the leveraged spot market can be used for speculation. To summarize the procedure: first, a certain amount of Japanese yen (JPY) is borrowed, say for a year, at an interest rate of r_J; next, these Japanese yen are converted to US dollars (USD) at the existing spot rate of S(JPY/USD); the US dollars amount obtained is then invested in the US money markets at an interest rate of r_{US}; finally, the Japanese yen amount borrowed is repaid (with interest) at the end of the year. As Chapter 3 showed, this procedure yields a risk free income determined by the interest rate differential $r_{US} - r_J$; however, the fact that the spot market is utilised to convert US dollars to Japanese yen at the end of the year introduces an element of risk arising from changes in the exchange rate over the course of the year.

In this section, we show how the risk can be eliminated using a forward contract. Indeed, if covered interest parity holds, and interest rates in Japan and the United States do not change over the course of the year, using the forward contract to hedge the speculation will eliminate any profit. However, if interest rates do change favourably, this procedure can yield significant profits. The extent of the profits depends on the leverage ratio, the higher the leverage ratio the higher the profit will be from interest rate changes.

We illustrate these ideas using a simple example, where one contract is borrowed and the length of speculation is 360 days. Suppose, for instance, that the contract begins on 5th January 2005 and expires at the end of 2005. In reality, this period was characterised by an unchanging Japanese yen interest rate, while the US dollar interest rate increased steadily. For the purpose of our example, it is assumed that the Japanese yen borrowing interest rate is 2%. To begin with, we assume that the US dollar interest rate for saving is constant at 2.25%. Finally, we assume that the leverage ratio is 5%, which implies that the investor must provide an initial margin equal to $\frac{KV}{20}$, where KV is the principal borrowed in Japanese yen (recall that K is the number of contracts and V is the size of a contract in Japanese yen). In our example, $K = 1$ and $V = JPY12{,}500{,}000$.

Table 4.1a: Arbitrage from Interest Change in Leveraged Spot Market (one day)

Arbitrage Model in Leveraged Spot Market							
Currency Amount	Number day(s) in market:		1				
JPY				JPY			
12,500,000.00		2.00%		12,500,684.93	JPY interest paid	684.93	JPY
Borrowing							
		spot currency movement					
103.80				117.90	Profit/Loss	$14,401.84	USD
USD				USD			
$ 120,423.89		2.25%		$ 120,431.32	USD interest received	$ 7.42	USD
Saving							
					Interest (gain/loss):	$ 0.82	USD
					Total (Profit/Loss) + (Interest)	$14,402.66	USD
initial margin:		$ 6,021.19					
maintenance margin:		$ 3,612.72					

Source: Author's calculations

Table 4.1a and b illustrate the procedure. We assume that the spot exchange rate on 5th January 2005 stood at 103.80 Japanese yen for 1 US dollar. At this exchange rate, the collateral denominated in US dollars is equal to $\frac{KV \times 0.05}{103.80} = US\$6021.19$, and the total principal denominated in US dollars equals USD120,423.89 (refer to Table 4.1a).

On the amount borrowed of JPY12,500,000 at borrowing interest of 2%, the daily interest paid equals to JPY684.93. The borrowed Japanese yen amount is converted into USD120,423.89 and invested in the US money market where it earns 2.25% per annum. Hence, the daily interest earnings in US dollars equal to USD7.42. Thus, the net earnings due to the interest rate differential between the US dollars and Japanese yen on a daily basis is USD0.82, which converts to JPY85.62 at the spot rate of 103.80 JPY/USD (see Table 4.1a); for the course of 360 days the net earnings equals USD 296.94 or JPY30821.92 at the spot rate of 103.80 JPY/USD(see Table 4.1b). This corresponds to equation (3.7) in Chapter 3, where $KV[(r_{us} - r_J)$ represent the certain income due to the interest rate differential $r_{US} - r_J$. This part of the exercise may be written as the certain return on this contract:

(4.1 $E = (r_{US} - r_J)KV = (2.25\% - 2\%) \times \left(\frac{360}{365}\right) \times 12{,}500{,}000 = JPY30{,}821.92$

where E is the net earnings due to the interest rate differential denominated in Japanese yen over 360 days on the amount borrowed KV. At the spot rate of 103.80JPY/USD, this translates to USD296.94 (Table 4.1b).

We now proceed to analyse the risky part of this contract which arises from the volatility of the exchange rate. At the time we decide to close the contract (in our example, this is the 31st December 2005), the amount equal to JPY12,500,000 has to be repaid. If the currency moves in/against our favour then we make a capital gain/loss at the time we liquidate the contract. We now show how to eliminate the risk arising from interest rate volatility and still make substantial profit from the interest rate differential.

Table 4.1b: Different Currency Movement in Leveraged Spot Market (360 days)

Arbitrage Model in Leveraged Spot Market							
Currency Amount	Number day(s) in market:		360				
JPY				JPY			
12,500,000.00		2.00%		12,746,575.34	JPY interest paid	246,575.34	JPY
Borrowing							
					Profit/Loss		
		spot currency movement		117.90		$14,401.84	USD
103.80				92.73		-$14,376.06	USD
USD				USD			
$ 120,423.89		2.25%		$ 123,096.31	USD interest received	$ 2,672.42	USD
Saving					Interest (gain/loss):	$ 296.94	USD
			Total (Profit/Loss) + (Interest):		If JPY 117.90	$ 14,698.78	USD
					If JPY 92.73	-$14,079.13	USD
initial margin:		$ 6,021.19					
maintenance margin:		$ 3,612.72					

Source: Author's calculations

Consider, first, the impact of exchange rate volatility on the overall profit or loss experienced by the investor. As Table 4.1b shows, the ending spot rate on December 31st is assumed to be 117.90 JPY/USD. On January 5th the investor borrowed JPY12,500,000. Converting to US dollars at the spot rate existing on that day (103.80), this translates to USD120,423.89. At the end of the year, the investor requires $USD\frac{12{,}500{,}000}{117.90} = USD106{,}022.05$. This implies an overall profit of USD14,401.84 from the leveraged spot contract which arises entirely due to the fact the investor holds US dollars, which have appreciated in the spot market.

Suppose, instead, that on December 31st, the spot rate is 92.73 JPY/USD. Then the investor would require $USD\frac{12{,}500{,}000}{92.73} = USD134{,}799.96$ in order to repay the principal. In this case, the investor experiences a loss of

USD14,376.06 due to adverse currency movements (see Table 4.1b).

The investor can protect himself from exchange rate volatility by employing a forward contract. The link between the spot rate and the forward rate is generally provided by IRP theory, which states that at equilibrium:

(4.2) $$\frac{S}{F} = \frac{1+r}{1+r^*}$$

where:

r = interest rate in the home country (assumed to be the US);

r^* = interest rate in the foreign country (assumed to be Japan);

S = spot exchange rate (described as the number of foreign currency units/domestic currency units); and

F = forward exchange rate (described as the number of foreign currency units/domestic currency units)

thus, $$F = \frac{1+r^*}{1+r} S$$

If spot rate of Japanese yen for 1 US dollar is 103.80, and the Japanese yen and US dollar interest rates are 2% and 2.25% respectively, thus, the forward rate of Japanese yen for 1 US dollar for 360 days becomes:

(4.3) $$F = \frac{1+\left[\left(\frac{360}{365}\right)\times 2\%\right]}{1+\left[\left(\frac{360}{365}\right)\times 2.25\%\right]} 103.80 = 103.55$$

The IRP condition is an equilibrium condition; if it holds, then there exist no possibility for an investor to make arbitrage profits. If it does not hold, then there exists a covered interest arbitrage, which implies that investors can take advantage of financial market anomalies to make risk free arbitrage profits. The IRP condition that $F = \frac{1+r^*}{1+r}S$, therefore, represents a no-arbitrage condition: when the spot rate, forward rate and interest rates are aligned in a manner described by this condition, arbitrage opportunities are non-existent. In our example, if $F = 103.55$, then no arbitrage is possible, whereas, if $F \neq 103.55$, arbitrage opportunities exist.

Assuming then that IRP holds, the forward rate offered in the market will equal $F = 103.55$. In order to hedge the leveraged spot market position, the investor can purchase JPY12,500,000 in the forward market for delivery on December 31st.

We now consider how the forward contract eliminates the possibility of profits; in doing so, we also summarize the procedure. On January 5th, the investor borrows $KV = JPY12{,}500{,}000$. At an interest rate of $r_J = 2\%$, this requires repaying $KV(1+r_J) = JPY12{,}500{,}000(1.02) = JPY12{,}750{,}000$, of which JPY12,500,000 is the principal and JPY250,000 is the interest payment. Next, the investor converts KV in Japanese yen into US dollars using the spot rate $S = 103.80$. This yields $USD\frac{KV}{S} = USD120{,}423.89$.

This is then invested in the US money market at $r_{US} = 2.25\%$. Thus, at the end of the year the investor has $USD\frac{KV}{S}(1+r_{US}) = USD123{,}096.31$ (360 days). If the investor takes out a forward contract to sell this US dollars amount at the forward rate of $F = 103.55$, the investor will have

$\frac{FKV}{S}(1+r_{US}) = JPY12{,}750{,}000$ (approximately). This is exactly equal to the Japanese yen amount that must be repaid, so the investor makes zero profit. Mathematically, it can be seen that:

$$(4.4) \qquad KV(1+r_J) = \frac{FKV}{S}(1+r_{US})$$

$$\Rightarrow (1+r_J) = \frac{F}{S}(1+r_{US}),$$

which is the condition for IRP.

Even though profits are eliminated by taking a forward contract when IRP holds, this assumes that interest rates are assumed to be constant. In reality however, interest rates vary over time, and this is when the leveraged spot market speculation can yield substantial profits.

To see the impact of interest rate changes, consider how the US interest rate has changed over time. These changes are undertaken by the Federal Reserve Bank of New York. Table 4.2 below shows that between 30th June 2004 and 29th June 2006, there were several interest rate increases initiated by the Federal Reserve. Each rise increased r_{US} by 25 basis points; overall, the interest rate increased from 1.25% on 30th June, 2004, to 5.25% on 29th June, 2006. at the same time, the discount rate set by the Bank of Japan remained unchanged at 0.1% in 2005. Together, these imply constant increases in $(r_{US} - r_J)$, which allow the investor to earn risk free profits from rising interest rate differentials.

Table 4.2: US Interest Rate Changes

DATE	DISCOUNT RATE			FEDERAL FUNDS RATE	
	CHANGE	NEW LEVEL*		CHANGE	NEW LEVEL
		PRIMARY[1]	SECONDARY[2]		
2006					
Jun 29	+0.25	6.25	6.75	+0.25	5.25
May 10	+0.25	6.00	6.50	+0.25	5.00
Mar 28	+0.25	5.75	6.25	+0.25	4.75
Jan 31	+0.25	5.50	6.00	+0.25	4.50
2005					
Dec 13	+0.25	5.25	5.75	+0.25	4.25
Nov 1	+0.25	5.00	5.50	+0.25	4.00
Sep 20	+0.25	4.75	5.25	+0.25	3.75
Aug 9	+0.25	4.50	5.00	+0.25	3.50
Jun 30	+0.25	4.25	4.75	+0.25	3.25
May 3	+0.25	4.00	4.50	+0.25	3.00
Mar 22	+0.25	3.75	4.25	+0.25	2.75
Feb 2	+0.25	3.50	4.00	+0.25	2.50
2004					
Dec 14	+0.25	3.25	3.75	+0.25	2.25
Nov 10	+0.25	3.00	3.50	+0.25	2.00
Sep 21	+0.25	2.75	3.25	+0.25	1.75
Aug 10	+0.25	2.50	3.00	+0.25	1.50
Jun 30	+0.25	2.25	2.75	+0.25	1.25

Source: Federal Reserve Bank of New York (2006)

Table 4.3 below shows the impact of these interest rate changes for the investor engaged in speculation using the leveraged spot market along with a hedging strategy involving a forward contract in the manner described earlier in this section.

Table 4.3: Interest Differential and Gain

Date	Interest Rate	US Interest Changes from 2.25%	No. of Days in between Changes	Extra Interest Gained
5-Jan-05	2.25%			
2-Feb-05	2.50%	0.25%	48	39.59
22-Mar-05	2.75%	0.50%	42	69.29
3-May-05	3.00%	0.75%	58	143.53
30-Jun-05	3.25%	1.00%	40	131.98
9-Aug-05	3.50%	1.25%	42	173.22
20-Sep-05	3.75%	1.50%	42	207.87
1-Nov-05	4.00%	1.75%	42	242.51
13-Dec-05	4.25%	2.00%	18	118.78
31-Dec-05	4.25%	2.00%		
			332 days	**Total gain:US$1,126.78**

Source: Author's calculations.

Assuming that these interest rate rises had occurred, in order to calculate the impact of the changes in the interest rate on the income generated we have to calculate the number of days between interest rate changes in each successive period, for example between 2nd February, 2005 and 22nd March 2005. There are 48 days and as shown in Table 4.3, the United States interest rate increased by 25 basis points. There are a total of 332 days influenced by changing interest rate within the 360 days. The extra interest gained for this period is given by the following expression:

(4.5) $$\Delta \text{interest rate} \times \text{principal} \times \left(\frac{\text{no. of days in between changes}}{365} \right)$$

Based on the above expression 4.5, the extra interest gain equals USD39.59. It is very important to note that the extra income generated from the interest rate changes is not eliminated *even when IRP holds*. According to the IRP theory, as the Federal Reserve raises interest rates between January 5th and December 31st, the forward rate and spot rate adjust to ensure that IRP holds. However, in our example, the investor has entered into a forward contract on January 5th for the delivering of Japanese yen on December 31st at the fixed forward rate existing on January 5th. The investor is, therefore, immune to changes in the forward rate after January 5th. Thus, even though IRP implies zero profits when the investor opens a simultaneous leveraged spot position and offsetting forward position on January 5th and interest rates do not change, the investor can indeed make profits when interest rates change after these positions have been opened.

The combined operation of leveraged spot and forward contracts shows that a collateral of approximately USD6021 creates net earnings of USD1,126.78 with zero risk; even a risk averse individual would find this an attractive proposition. The amount of collateral on the leveraged spot position is determined by the leveraging ratio. In our example, the leveraging ratio is 20:1. The individual who wishes to operate in this leveraged spot market can find leveraging ratios which vary from 20:1 to 200:1. Thus, each individual investor has a choice of using a higher or lower leveraging ratio. This leveraging ratio has an important impact on the rate of return which each investor earns from this procedure.

The higher the leveraging ratio, the greater is the return for our methodology. If the leveraging ratio is 20:1, the annual rate of return is 16.46% given the movement in the interest rate. If this leveraging ratio is changed to 50:1

(leverage provided by some providers in the leveraged spot market), the annual rate of return derived would be 44.53% for the period under consideration. Note that in all these examples, the earnings are completely risk free and are contingent only upon a favourable movement of interest rates. Conversely, it is significant to understand that if positive interest rate differential $\left(r_{US} - r_J\right)$ is reduced after investor opened leveraged spot and forward contracts, this would lead the investor to encounter a loss in this portfolio.

4.3 Hedging Exposure using the Leveraged Spot Market

In the previous section, we examined how an open position in the leveraged spot market can be hedged using a forward contract. In this section, we highlight how the leveraged spot contract itself can be used as a hedging instrument to remove uncertainty from an existing open position. In other words, we investigate how the leveraged spot contract can *substitute* for a forward contract (or other traditional hedging methods) to reduce transaction exposure.

In general, there are two categories of hedging: (1) an interest rate hedge which aims to transfer away from the speculator, risks involved in any expected unfavourable interest rate movements – financial techniques, such as interest rate swap and cross currency swap are commonly used for this purpose and (2) a currency movement hedge which aims to reduce risks arising from expected unfavourable foreign currency movements – financial instruments such as forward contract, money market securities and options are commonly used to hedge currency movements. The method developed in this section is designed to assist hedgers (companies or individuals) who wish to hedge against any expected unfavourable *currency movements* mentioned in (2) above. Note that a pre-requisite exists for deciding to hedge against unfavourable currency movements, namely, the hedger must expect to encounter unfavourable currency movements in future, and must place a value on reducing the risk through a hedging mechanism over and above the costs of employing a hedge.

According to a survey from the Australian Bureau of Statistics (2001, 2005), among the available financial techniques, the forward hedge is the most commonly used in Australia and New Zealand, and interest rate swaps and option contracts are less popular (ABS, 2001; Chan et al., 2003; RBA, 2002). Evidence suggests that forward and swaps derivatives accounted for almost $935 billion of the total notional sum of outstanding bought and sold financial derivative contracts, with forward contracts accounting for 72% ($731.1 billion), and cross currency interest rate swaps making up 20% ($203.9 billion) (ABS, 2001; RBA, 2002).

To illustrate the subsequent analysis, consider a situation where an exporter (say, from the United States) is due to receive payment from a Japanese importer some time in the future. Suppose the currency of the invoice is Japanese yen. In this case, the exporter is exposed to foreign currency risk due to fluctuations in the JPY/USD exchange rate between the time the agreement is struck and the time when payment takes place for the export order.

To avoid foreign exchange risk, the exporter may well choose to hedge the accounts receivable. To illustrate the hedging process, we will focus on a comparison between the leveraged spot contract and the forward contract as hedging instruments; other traditional hedging mechanisms like the money market hedge are not included for the time being. At the end of this section, we will compare the leveraged spot market hedge with the money market hedge.

Our analysis suggests that hedging with the leveraged spot market can be superior to standard hedging methods, such as the forward contract. We will show this proposition using numerical simulations where hypothetical scenarios of export/import transactions are constructed. The simulations, however involve actual empirical data for JPY/AUD and USD/AUD exchange rates during the period 2003 to 2005. For an Australian company engaging in international transactions, any foreign currency revenue is normally converted into Australian dollars (AUD) and retrieved back to Australia at the end of financial year. Hence, fluctuations in the value of the Australian dollar against foreign currencies such as the US dollar and Japanese yen can have significant impact on earnings before interest and tax (EBITA) accruing to the Australian firm.

4.3.1 Hypothetical Scenario One

Consider the case where an Australia exporter is due to receive payment in Japanese yen from a Japanese importer in one year. The following elements will be required for constructing the hedging scenario:

- Sale revenue: JPY75,000,000
- Hedging period: 365 days from 13th October 2003 to 12th October 2004

- Interest rates on the Japanese yen and the Australian dollar are denoted as: r_J and r_{AU} respectively
- Spot currency rate; and
- Forward currency rate for Japanese yen against the Australian dollar

From the Australian company's perspective, the sale revenue increases when either the Japanese yen strengthens or the Australian dollar weakens, and conversely the sale revenue erodes when either the Japanese yen weakens or the Australian dollar strengthens. Therefore, this Australian company's Hedging Account must establish a position(s) to absorb unfavourable currency movements away from the sale revenue.

4.3.1.1 Forward Contract Hedging

Let us begin the hedging process with the Australian company signing a forward contract to hedge their sale revenue in Japanese yen. It is helpful to review IRP if we need to sign a forward contract over the counter from the bank. According to IRP:

(4.6) $$\frac{S}{F} = \frac{1+r}{1+r^*}$$

where:

r = interest rate in the home country

r^* = interest rate in the foreign country

S = spot exchange rate

F = forward exchange rate

thus, $$F = \frac{1+r^*}{1+r} S$$

On 13th October 2003, the spot rate of Japanese yen for 1 Australian dollar was 74.83, and the Japanese yen borrowing and the Australian dollar saving interest rates were 2% and 4.75% per annum respectively. Then, the forward rate of Japanese yen for 1 Australian dollar for 365 days becomes

(4.7) $$F = \frac{1+2\%}{1+4.75\%} 74.83 = 72.87$$

According to IRP, in our example, if

forward rate > 72.87 the so-called covered interest arbitrage occurs;

forward rate = 72.87 presents the equilibrium of IRP;

forward rate < 72.87 discount (loss).

Therefore, on 13th October 2003 the forward rate of Japanese yen for 1 Australian dollar should not be greater than 72.87, otherwise the so-called covered interest arbitrage (CIA) would occur via the following steps:

(1) borrowing JPY, for example JPY1,000,000 and exchanging to the Australian dollar, yields AUD13,363.62, at spot rate 74.83;

(2) by doing this, Japanese yen borrowing principal and interest payment for 1 year are JPY1,020,000 at interest rate 2% per annum;

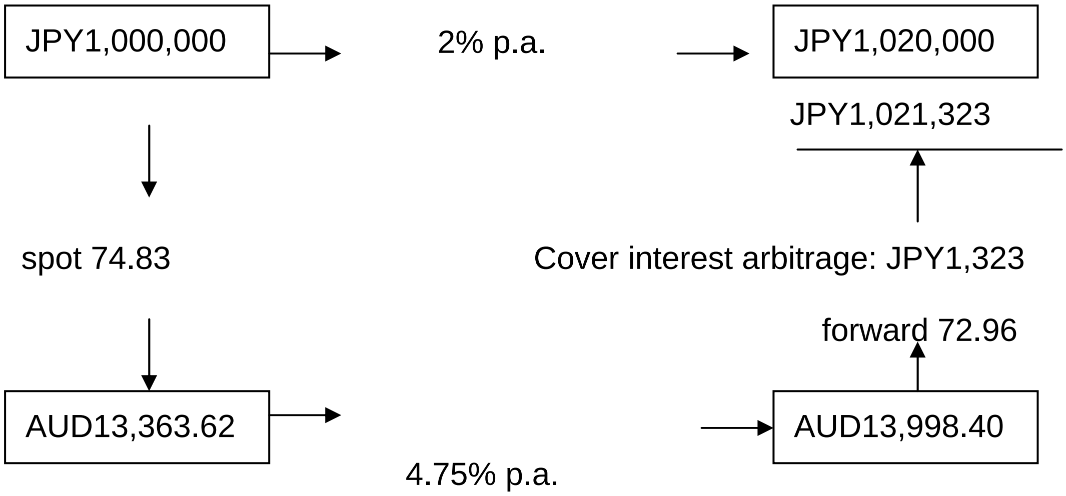
(3) simultaneously, signing a forward contract for 365 days at forward rate of say 72.96 (if greater than 72.87)

(4) the Australian dollar converted from Japanese yen with received interest income for 1 year is AUD13,998.40 at interest rate 4.75% per annum;

(5) the forward contract allows the AUD13,998.40 converting back to Japanese yen at 72.96 a year later, which are JPY1,021,323; and

(6) therefore, the covered interest arbitrage (CIA) occurs with profits in sum of JPY1,323 (as shown in the following Figure 4.1).

Figure 4.1: Covered Interest Arbitrage



Assuming that on 13th October 2003 this Australian company can only obtain a Japanese yen forward contract with the amount of JPY75,000,000 exchanged to Australian dollars at 72.87, and being delivered on 12th October 2004.

This Australian company using a forward contract to hedging the sale revenue JPY75,000,000 can firmly get sales revenue in Australian dollars, AUD1,029,230.14, regardless of the spot exchange rate on 12th October 2004. We now confirm the hedging result via the following steps. On 12th October 2004, the spot rate of Japanese yen for 1 Australian dollar was 80.30. Thus:

- Sales revenue JPY75,000,000 exchanged to the Australian dollar becomes:

JPY75,000,000/80.30 = AUD933,997.51………………………………...(4a)

- The Australian company's hedging account signed the forward contract, so this company would be able to exchange JPY75,000,000 to the

Australian dollar at the agreed rate of 72.87 on the delivery day of this forward contract. We then, can get a hedging gain:

$$\frac{JPY75{,}000{,}000}{72.87} - \frac{JPY75{,}000{,}000}{80.30} = A\$95{,}232.63 \ldots\ldots\ldots\ldots(4b)$$

Consequently, the sales revenue eroded by either a weaker Japanese yen or a stronger Australian dollar (equation (4a)) can be compensated by a hedging gain in equation (4b), that is, sales revenue can firmly be locked in the amount of (4a) + (4b) = AUD1,029,230.14 without any impact of currency movement.

This is the hedging mechanism via the forward contract technique which shows the Japanese yen sale revenue has been locked in via the utilization of the forward contract at the Australian dollar amount of AUD1,029,230.14, regardless of any fluctuation in the currency movement.

4.3.1.2 Leveraged Spot Hedging Model

We now demonstrate the leveraged spot hedging method for the sale revenue of the Australian company. For our illustrative purpose, we can open a position between the Australian dollar and Japanese yen for the amount of JPY75,000,000 from the leveraged spot market at the spot rate of 74.83 Japanese yen for 1 Australian dollar on 13th October. 2003. As we know by doing this, the hedger is able to receive the positive interest rate differential ($r_{AU} - r_J$ = 4.75% - 2% = 2.75%) on a daily basis from the second day the hedger opened the position until the end of this position on day 365.

Table 4.4: Scenario One Hedging in Leveraged Spot

Hedging Model in Leveraged Spot Market							
Currency Amount	number days in market:		365				
JPY				JPY			
75,000,000.00	→	2.00%	→	76,500,000.00	JPY interest Paid	1,500,000.00	JPY
Borrowing							
↓		spot currency movement		↑			
74.83		→		80.30	Profit/Loss:	$68,274.31	AUD
↓				↑			
AUD				AUD			
$ 1,002,271.82	→	4.75%	→	$ 1,049,879.73	AUD interest received	$ 47,607.91	AUD
Saving							
					Interest (gain/loss):	$ 27,562.47	AUD
				Total (Profit/Loss) + (Interest):		$95,836.78	AUD
initial margin:	AUD	$ 50,113.59					
maintenance margin:	AUD	$ 30,068.15					

Source: Author's calculations.

In Table 4.4, we summarized this hedging operation we borrowed JPY75,000,000 from the bank and converted to AUD1,002,271.82 at the spot rate of 74.83 on 13th October 2003. The positive interest rate differential of 2.75% can be received daily basis. On the day 12th October 2004, the Japanese yen spot rate for 1 Australian dollar was 80.30. Thus, according to equation (3.7), the profit for this currency movement and the interest differential gain are as listed below:

(1) profit from currency movement is AUD68,274.31; and

(2) profit from interest gain accumulated for 365 days is AUD27,562.47.

The total hedging profit in this leveraged spot market is AUD95,836.78.

We should mention here that the profit from the interest gain (item (2)) must be readjusted later if we compare the hedging results with the forward contracts technique because item (2) is calculated daily according to the market closing price. We actually converted the interest gain based on the entry price of this position, which is 74.83 Japanese yen for 1 Australian dollar. Again, we can re-confirm the hedging result via the following steps. On 12th October 2004, the spot rate of Japanese yen for 1 Australian dollar was 80.30. Thus:

- Sale revenue JPY75,000,000 exchanged to the Australian dollar became:

JPY75,000,000/80.30 = $933,997.51…………………………………….(4c)

- in this Australian company's hedging account, they opened a leveraged spot contract at 74.83 Japanese yen for 1 Australian dollar, so if the position is closed at 80.30 Japanese yen for 1 Australian dollar (Table 4.4) this Australian company can obtain the hedging profit as below:

  (1) profit from currency movement is AUD68,274.31

  (2) profit from interest gain accumulated for 365 days is AUD27,562.47

  The total profit in this leveraged spot market is AUD95,836.78…………………………………………………………..(4d)

Consequently, the sale revenue eroded by either the Japanese yen weakening or the Australian dollar strengthening in equation (4c) can be compensated by a hedging gain in equation (4d), that is, sale revenue is now locked at the amount of AUD1,029,834.29 ((4c)+(4d)).

This is hedging via the leveraged spot contract technique and shows how the Japanese yen sale revenue has been locked in at the Australian dollar amount of AUD1,029,834.29, regardless of any fluctuation of currency movement.

Let us summarize the hedging results between the forward and leverage spot techniques as follows in table 4.5a.

Table 4.5a: Scenario One Hedging Results Comparison

	(1) Sale revenue JPY75,000,000 converted to AUD on day 365	(2) Hedging account (hedging gain/loss)	(3)= (1)+(2) Hedge results (equity)
Forward contract	AUD933,997.51	AUD95,232.63	AUD1,029,230.14
Leveraged spot contract	AUD933,997.51	AUD95,836.78	AUD1,029,834.29

Source: Author's calculations.

We mentioned earlier that we should re-adjust the hedging gain from the leveraged spot contract because the calculation of daily interest gain is actually based on the every-day closing price within 365 days. For illustrative purpose, we use 74.83 Japanese yen for 1 Australian dollar for this calculation. According to IRP theory, the hedging gain of using a leveraged spot contract should not be better than a gain obtained using a forward contract. Thus, we now simplify and readjust the hedging result from the leveraged spot contract to be as the same as the forward contract so that we can simply compare the results between the forward and leveraged spot contracts. The re-adjusted hedging result is then listed in Table 4.5b as below.

Table 4.5b: Adjusted Scenario One Hedging Results

	(1) Sale revenue JPY75,000,000 converted to AUD on day 365	(2) Hedging account (hedging gain/loss)	(3)= (1)+(2) Hedge results (equity)
Forward contract	AUD933,997.51	AUD95,232.63	AUD1,029,230.14
Leveraged spot contract	AUD933,997.51	AUD95,232.63	AUD1,029,230.14

Source: Author's calculations.

We now proceed to show how the leveraged spot technique will be superior to the forward technique, as Table 4.5b shows there is no difference for hedging results between forward and leveraged spot markets. From the part of interest rate differential $\left(r_{AU} - r_J\right)$ in the leveraged spot contract, the discount rate of Japanese yen set by the Bank of Japan changed by only 0.1% from 19th September 2001 to 13th July 2006. If there is an expected upward movement in the Australian dollar interest rate, this hedging model can generate extra hedging gain from this interest rate movement.

It is critical to show how the interest rate in Australia has been changed over time by the Reserve Bank of Australia (RBA).

Table 4.6 below shows the interest rate changes from 8th May 2002 to 2nd August 2006. Each rise was 25 basis points and the interest rate has increased from 4.50% on 8th May 2002, to 6% on 2nd August 2006.

Table 4.6: Australia Interest Rate Changes

CASH RATE TARGET		
Released	Change in case rate (Per cent)	New cash rate target (per cent)
2 Aug 2006	+0.25	6.00
3 May 2006	+0.25	5.75
2 Mar 2005	+0.25	5.50
3 Dec 2003	+0.25	5.25
5 Nov 2003	+0.25	5.00
5 June 2002	+0.25	4.75
8 May 2002	+0.25	4.50

Source: RBA (2006).

Table 4.7: Interest Differential and Gain in Scenario One

Date	Interest rate	Interest changes from 4.75%	No. of days in between changes	Extra interest gained
13-Oct-03	4.75%			
5-Nov-03	5.00%	0.25%	28	192.22
3-Dec-03	5.25%	0.50%	314	4311.14
12-Oct-04	5.25%	0.50%		
			342 days	**Total gain: AUD4,503.36**

Source: Author's calculations.

In Table 4.7, we calculate the additional interest hedging gained from the changes of differential interest rate. We have to calculate the number of days in each successive period between the interest rate changes, for example between 5th November 2003 and 3rd December 2003. There are 28 days in this period and as shown in Table 4.7, Australia's interest rate increased by 25 basis points. There are a total of 342 days influenced by changing interest rate within the 365 days. The extra interest gained for this period is given by the following expression:

(4.8) $$\Delta \text{interest rate} \times \text{hedging amount} \times \left(\frac{\text{no. of days in between changes}}{365} \right)$$

Based on the above expression (4.8), the extra interest gain equals AUD192.22 in the first period of 28 days. As shown in Table 4.7, the extra total hedging gained is AUD4,503.36. This additional hedging gain is realised because the Australian interest rate changed after the leveraged spot hedging position opened.

We now compare the hedging results between forward and leveraged spot contracts. The details of the comparison are listed in Table 4.8 below.

Table 4.8: Comparison of Hedging Results in Scenario One

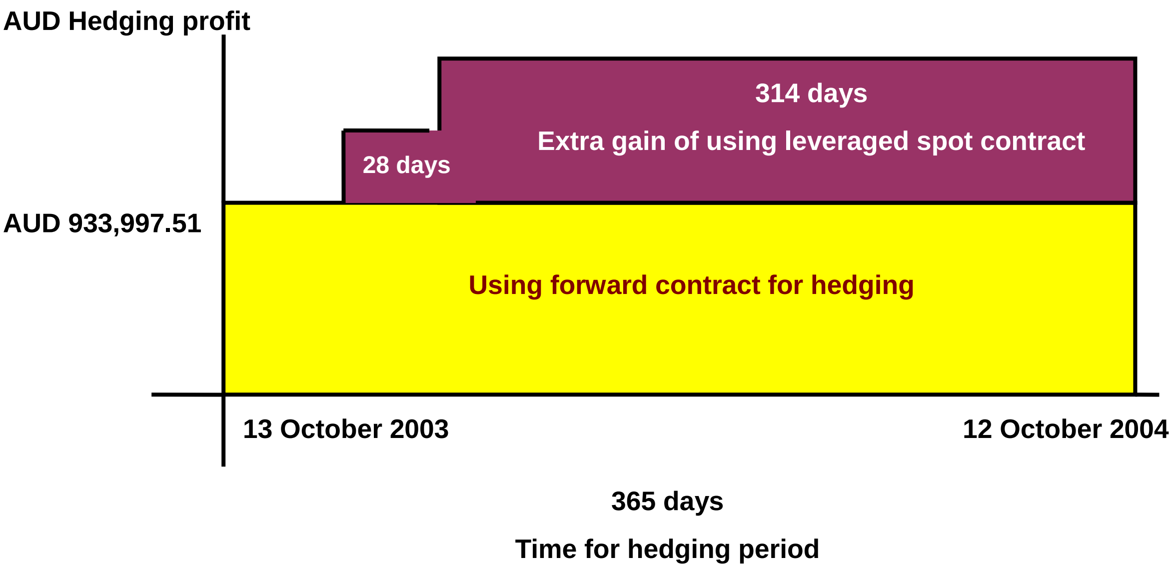
	(1) Sale revenue JPY75,000,000 converted to AUD on day 365	(2) Hedging account (hedging gain/loss)	(3)= (1)+(2) Hedge results (equity)
Forward contract	AUD933,997.51	AUD95,232.63	AUD1,029,230.14
Leveraged spot contract	AUD933,997.51	AUD95,232.63 **plus extra gain:AUD4,503.36**	AUD1,033,733.49

Source: Author’s calculations.

In scenario one the Australian company decided to hedge for minimizing either a weakening Japanese yen or strengthening Australian dollar. Clearly, the hedging outcomes for forward and leveraged spot markets have revealed that using the leveraged spot hedging technique is superior to using the forward contract, given the sales revenues of JPY75,000,000 and hedging period from 13th October 2003 to 12th October 2004. In this scenario use of the leveraged spot can internalise an extra AUD4,503.14 of hedging gain mainly due to the RBA having twice increased the interest rate during this hedging period.

Figure 4.2 demonstrates that using a leveraged spot for hedging can additionally derive approximately AUD4500 hedging gain compared with a forward contract.

Figure 4.2: Comparison of Hedging Outcomes in Scenario One



Source: Author’s calculations

4.3.2 Hypothetical Scenario Two

Scenario two simulates hedging for companies either in the United States or Australia because the currencies involved is the Australian dollar against the US dollar. The scenario will demonstrate how interest rate changes influence hedging outcomes utilizing leveraged spot components, for the Australian company. For illustrative purposes, we consider the following example for simulation, by assuming:

- Sale revenue: US$500,000
- Hedging period: 500 days from 3rd August 2004 to 16th December 2005
- Interest rates on the Australian dollar and the US dollar are denoted as r_{AU} and r_{US} respectively
- Spot currency rate
- Forward currency rate for the Australian dollar against the US dollar.

4.3.2.1 Forward Contract Hedging

Let us begin the hedging process with the signing of a forward contract where the Australian company chooses a forward contract to hedge their sales revenue in US dollars. It is important to consider interest rate parity if we need to sign a forward contract between the Australian and US dollars over the counter from the bank.

On the 3rd August 2004, the spot rate of the US dollar for 1 Australian dollar was 0.7013, and the US dollar borrowing and the Australian dollar saving interest rates were 3.25% and 5.25% respectively. Therefore, the forward rate of the US dollar for 1 Australian dollar for the hedging period of 500 days becomes:

(4.9) $$F = \frac{1+\left[\left(\frac{500}{365}\right)*3.25\%\right]}{1+\left[\left(\frac{500}{365}\right)*5.25\%\right]}0.7013 = 0.6834$$

According to IRP, in our simulation, if

forward rate > 0.6834 the so-called covered interest arbitrage occurs;

forward rate = 0.6834 presents the equilibrium of IRP; and

forward rate < 0.6834 discount (loss).

Therefore, on the 3rd August 2004 the forward rate of the US dollar for 1 Australian dollar should not be greater than 0.6834, otherwise the so-called covered interest arbitrage can occur (refer to Figure 4.1).

Assuming that in keeping with the equilibrium IRP condition on 3rd August 2004 this Australian company can only obtain an Australian dollar forward contract for the amount of USD500,000 exchanged to the Australian dollar at a rate of 0.6834, and being delivered on 16th December 2005.

This Australian company using the forward contract to hedge the sales revenue of USD500,000 can firmly get sales revenue of AUD731,635.94, regardless of the spot exchange rate on 16th December 2005. We confirm the hedging result via the following steps. On 16th December 2005, the spot rate of the US dollar for 1 Australian dollar was 0.7454. Thus,

- Sale revenue USD500,000 exchanged to the Australian dollar became USD500,000/ 0.7454= AUD670,780.79……………………..………….(4aa)
- In this Australian company's hedging account, they signed the forward contract, so they would be able to exchange USD500,000 to the

Australian dollar at the agreed rate of 0.6834 on the delivery day of this forward contract. The hedging gain can be obtained by:

$$\frac{USD500{,}000}{0.6834} - \frac{USD500{,}000}{0.7454} = \text{AUD}60{,}855.15 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(4bb)}$$

Consequently, the sales revenue eroded by either the US dollar weakening or the Australian dollar strengthening (equation (4aa)) can be compensated by the hedging gain (equation (4bb)), that is, sales revenue can firmly be locked in the amount of (4aa) + (4bb) = AUD731,635.94 without any impact from currency movement.

This is the hedging mechanism via the forward contract technique which shows the US dollar sale revenue has been locked via the utilization of the forward contract at AUD731,635.94, regardless of any fluctuation of currency movement.

4.3.2.2 Leveraged Spot Hedging Model

We now show the leveraged spot hedging method for sales revenue of the Australian company. For this illustrative example, we sign contracts between the US and Australian dollar to the amount of USD500,000 from the leveraged spot market at 0.7013 the spot rate of the US dollar for 1 Australian dollar on 3rd August 2004. That is, we opened a position of buying USD/AUD at 0.7013 on 3rd August 2004 from the leveraged spot market for hedging purposes. As we know by doing this, the hedger is able to receive the positive interest rate differential ($r_{AU} - r_{US}$ = 5.25% - 3.25% = 2%) on a daily basis from the second day the hedger opened the position until the end of this position, day 500.

In Table 4.9, we summarized this hedging operation discussed as below. We borrowed USD500,000 from the bank and converted it to AUD712,961.64 at the spot rate 0.7013 on 3rd August 2004. The positive interest rate differential 2% can be received on a daily base. On 16th December 2005, the US dollar spot rate for 1 Australian dollar was 0.7454. Thus, according to equation (3.7), the profit for this currency movement and the interest differential gain on the day of the 16th December 2005 are listed below:

Table 4.9: Scenario Two Hedging Model in Leveraged Spot Market

Hedging Model in Leveraged Spot Market							
Currency Amount	number days in market:		500				
USD				USD			
500,000.00	→	3.25%	→	522,260.27	USD interest Paid	22,260.27	USD
Borrowing							
↓				↑			
		spot currency movement					
0.7013		→		0.7454	Profit/Loss	$42,180.85	AUD
↓				↑			
AUD				AUD			
$ 712,961.64	→	5.25%	→	$ 764,236.28	AUD interest received	$ 51,274.64	AUD
Saving							
					Interest (gain/loss):	$ 19,533.20	AUD
					Total (Profit/Loss) + (Interest):	$61,714.05	AUD
initial margin:		$ 35,648.08					
maintenance margin:		$ 21,388.85					

Source: Author's calculations.

(1) profit from currency movement is AUD42,180.85, and

(2) profit from interest gain accumulated for 500 days is AUD19,533.20.

The total profit in this leveraged spot market is AUD61,714.05 We should mention here again that item (2), profit from interest gain, must be readjusted later if we compare these hedging results with the forward technique because this interest gain is calculated daily according to the market closing price. We actually converted the interest gain based on the entry price of this position, which is 0.7013 US dollar for 1 Australian dollar.

Again, we can re-confirm the hedging result via the following steps. On 16th December 2005, the spot rate of the US dollar for 1 Australian dollar was 0.7454. Thus:

- Sale revenue USD500,000 exchanged to Australian dollar becomes

USD500,000/ 0.7454= AUD670,780.79……………………………….(4cc)

- In this American company's hedging account, they opened a leveraged spot contract on 3rd Aug. 2004 and closed the contract on 16th December 2005 at spot rate US dollar 0.7454 for 1 Australian dollar, so this Australian company can obtain the hedging profit as below:

(1) profit from currency movement is AUD42,180.85

(2) profit from interest gain accumulated for 500 days is AUD19,533.20

The total profit in this leveraged spot market is AUD61,714.05…..………….(4dd)

Consequently, the sale revenue eroded by either a weaker US dollar or stronger Australian dollar (equation (4cc)) can be compensated by the hedging gain (equation (4dd)), that is, (4cc) + (4dd) = AUD732,494.84.

This is the hedging mechanism using the leveraged spot technique to show the US dollar sale revenue has been locked via the spot contract at the Australian dollar amount of AUD732,494.84, regardless of any fluctuation of currency movement.

Table 4.10a: Scenario Two Hedging Results Comparison

	(1) Sale revenue USD500,000 converted to AUD on day 500	(2) Hedging account (hedging gain/loss)	(3)= (1)+(2) Hedge results (equity)
Forward contract	AUD670,780.79	AUD60,855.15	AUD731,635.94
Leveraged spot contract	AUD670,780.79	AUD61,714.05	AUD732,494.84

Source: Author's calculations.

We mentioned earlier that we should re-adjust the hedging gain from the leveraged spot in Table 4.10a, because the calculation of daily interest gain from the leveraged spot is actually carried out on a daily basis using the closing price for each 500 days. According to IRP theory, the hedging gain using the leveraged spot contract should not be more than obtained using a forward contract. Thus, we now simplify and readjust the hedging result from the leveraged spot contract to be the same as a forward contract. The re-adjusted hedging result is listed in Table 4.10b.

Table 4.10b: Adjusted Scenario Two Hedging Results

	(1) Sale revenue USD500,000 converted to AUD on day 500	(2) Hedging account (hedging gain/loss)	(3)= (1)+(2) Hedge results (equity)
Forward contract	AUD670,780.79	AUD60,855.15	AUD731,635.94
Leveraged spot contract	AUD670,780.79	AUD60,855.15	AUD731,635.94

Source: Author's calculations.

We now proceed to show how the leveraged spot technique will not always be superior to the forward technique in this simulation, as Table 4.10b shows that it is possible to have no difference for hedging results between forward and leveraged spot markets. It is critical to show how the interest rates changed between the US and Australia. There were numerous consecutive interest rate increases undertaken by the Federal Reserve Bank of New York (refer to Table 4.2) from 30th June 2004 to 29th June 2006. Each rise was 25 basis points, so the interest rate increased from 1.25% on 30th June 2004, to 5.25% on 29th June 2006. Meanwhile, RBA increased the interest rate by 0.25% on 2nd March 2005 from 5.25% to 5.50% (refer to Table 4.6). The interaction of the interest rate differential between the US and Australia will be examined below, as it influenced the hedging result in this scenario two.

Initially, the interest differential between the US dollar and Australian dollar was 2% ($r_{AU} - r_{US}$ =5.25%-3.25%=2%) when we opened the position in the leveraged spot market. Table 4.11 shows US interest rate changes during the hedging period, which directly affected the borrowing cost of the US dollar in the operation of leveraged spot market. In contrast, there was only one interest rate increase on the Australian dollar during the hedging period, influencing the interest gain of the Australian dollar in the leveraged spot market.

Consequently, Table 4.11 is presented to show that the borrowing cost of the US dollar kept increasing, and the interest gain of the Australian dollar only increased once during the hedging period. That is, the initial positive interest differential was soon reversed because the US interest rate increased far more than the Australia rate increased during the hedging period in the leveraged spot market.

Table 4.11: Interest Differential and Loss in Scenario Two

Date	US interest rate	US interest changes from 1.25%	RBA interest rate changes from 5.25%	Interest rate differential	No. of days in between changes	Extra interest paid
3-Aug-04	1.25%					
10-Aug-04	1.50%	0.25%		0.25%	42	205.10
21-Sep-04	1.75%	0.50%		0.50%	50	488.33
10-Nov-04	2.00%	0.75%		0.75%	34	498.10
14-Dec-04	2.25%	1.00%		1.00%	50	976.66
2-Feb-05	2.50%	1.25%		1.25%	28	683.66
2-Mar-05			0.25%	1.00%	20	390.66
22-Mar-05	2.75%	1.50%		1.25%	42	1025.49
3-May-05	3.00%	1.75%		1.50%	58	1699.39
30-Jun-05	3.25%	2.00%		1.75%	40	1367.32
9-Aug-05	3.50%	2.25%		2.00%	42	1640.79
20-Sep-05	3.75%	2.50%		2.25%	42	1845.89
1-Nov-05	4.00%	2.75%		2.50%	42	2050.99
13-Dec-05	4.25%	3.00%		2.75%	3	161.15
16-Dec-05	4.25%					
					493 days	**AUD13,033.52**

Source: Author's calculations.

In Table 4.11, we calculate the changes of interest rate and the number of days in each successive period between interest rate changes. For example, between 10th August 2004 to 21st September 2004, the US interest rate increased by 25 basis points and there were 42 days in this period. There are a total of 493 days influenced by changing interest rate within the hedging period – 500 days. The extra interest cost calculation for this period is given by expression (4.8) above. Based on this expression, the extra interest loss for 42 days equals AUD205.10. As shown in Table 4.11, the total additional hedging cost (loss) from the interest rate differential is AUD13,033.52. The reason for the occurrence of this additional hedging loss is due to the fact that the US interest rate rose far faster than the Australian rate after the leveraged spot hedging position opened.

We now compare the hedging results between forward and leveraged spot contracts in this scenario two. The details of the comparison are listed in Table 4.12 below:

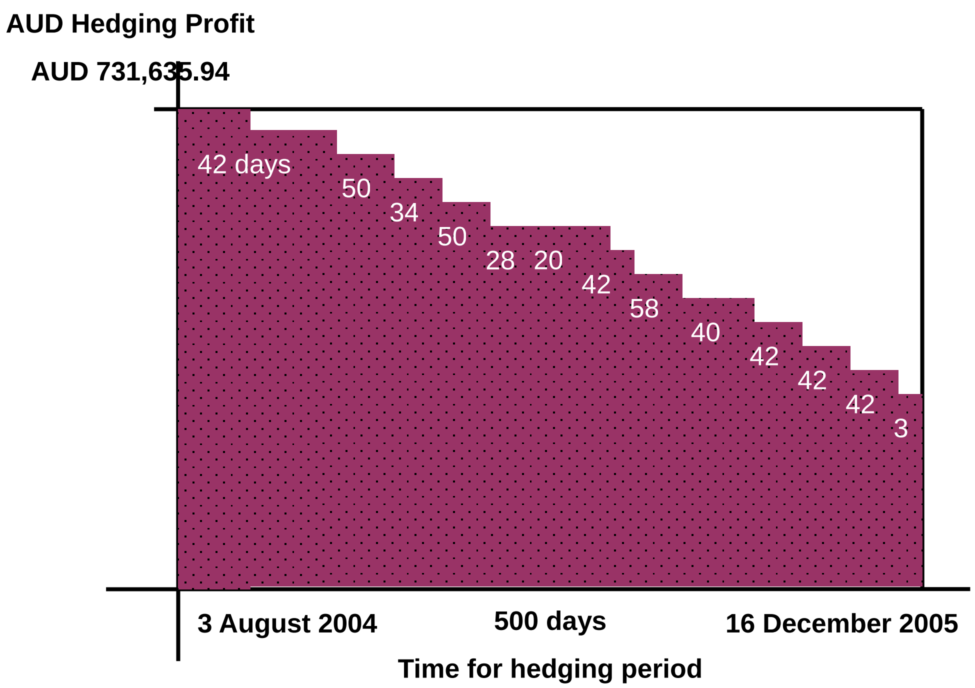
Table 4.12: Comparison of Hedging Results in Scenario Two

	(1) Sale revenue USD500,000 converted to AUD on Day-500	(2) Hedging account (hedging gain/loss)	(3)= (1)+(2) Hedge results (equity)
Forward contract	AUD670,780.79	AUD60,855.15	AUD731,635.94
Leveraged spot contract	AUD670,780.79	AUD60,855.15 **less AUD13,033.52**	AUD718,602.41

Source: Author’s calculations

In scenario two, the Australian company decided to hedge for minimizing either a weaker US dollar or stronger Australian dollar. Indeed, the hedging outcomes between forward and leveraged spot markets reveal that using the leveraged spot hedging technique is not always superior to using the forward contract as shown in Table 4.12. In scenario two the use of a leveraged spot can also internalise an extra US dollar borrowing cost to the sum of AUD13,033.52. This hedging loss is mainly due to the Federal Reserve Bank of New York rapidly increasing the interest rate during the hedging period. Figure 4.3 shows how the 12 US and single Australian interest rate increases (each of 0.25%) led the leveraged spot hedging to additionally derive AUD13,033.52 hedging cost (loss) compared with a forward contract in scenario two.

Figure 4.3: Comparison of Hedging Outcomes in Scenario Two



Source: Author’s calculations

4.4 Comparison between Forward, Leveraged Spot, and Money Markets

4.4.1 Comparison of Forward and Leveraged Spot

In terms of hedging, we have gone through the simulations with two pairs of currencies in an attempt to demonstrate the difference between forward and leveraged spot techniques. In our simulation outcomes of scenario one, we show that the leveraged spot hedging is superior to the forward technique only if the interest rate differential increases after the hedging position was opened. Conversely, the simulation of hedging scenario two shows that use of the leveraged spot for hedging is inferior to the forward technique only if the interest rate differential decreases after the hedging position was opened.

Looking at our net profit function for the leveraged spot market, (see equation (3.7) in Chapter 3), $\Pi = KV[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] - \frac{1}{2}\delta VK^2$, we can make some conclusions about its use for hedging purposes. Let us break down equation (3.7) into three components, which are listed below:

(1) $KV(r_{us} - r_J)$ shows the profit (loss) due to the interest rate differential and generates interest gain (payment) if the interest rate differential is positive (negative).

(2) $KV(1 + r_{US})E(\dot{S})$ shows the movement in the spot exchange rate and is the volatility of the leveraged spot contract.

(3) $\frac{1}{2}\delta VK^2$ is the cost function of operating in the leveraged spot market.

From the hedging perspective, the use of the leveraged spot contract is superior to a forward contract because (1) $KV(r_{us} - r_J)$ will be internalizing the additional interest gain if $(r_{us} - r_J)_t$ is greater than $(r_{us} - r_J)_{t-1}$ during the hedging period. Our simulations in hedging scenario one demonstrated this situation.

Conversely, use of the leveraged spot contract is *not* superior to the forward contract when the $KV(r_{us} - r_J)$ term is losing the additional interest gain because $(r_{us} - r_J)_t$ is less than $(r_{us} - r_J)_{t-1}$ during the hedging period, i.e. $\Delta(r_{US} - r_J) < 0$. Scenario two reflects this hedging result. Having compared the feasibility of forward and leveraged spot techniques for hedging, we conclude that using the leveraged spot is superior to the forward only if the interest rate differential $(r_{us} - r_J)_t$ is greater than $(r_{us} - r_J)_{t-1}$ within the hedging period, .i.e. $\Delta(r_{US} - r_J) > 0$.

4.4.2 Comparison of the Money Market and Leveraged Spot

Hedging in the money market is like hedging in the forward market, as both include a contract and a source of funds to fulfill the contract. For example those hedgers who are seeking a money market hedge to borrow in one currency and exchange the proceeds for another currency, will need to have a loan agreement. This loan agreement can be repaid from business operations, such as an account receivable within 180 days. Indeed, in an efficient market the forward market and money market are actually identical because the IRP holds. The difference is that the cost of a money market hedge is determined by the differential interest rate, while the cost of a forward hedge is a function of the forward rate quotation. Therefore, the money market can rapidly adapt to the interest rate differential as the interest rate changes.

The financial tools available in the money market are commonly known as:

treasury bills, eurodollar, euroyen, certificate of deposit (CD) and commercial paper. Indeed, interest rates on these money market tools are generally an accurate reflection of interest rate movements. The easiest way to hedge in mitigating currency movement exposure using the money market is to establish a loan agreement. Using loan credit to borrow one currency and convert to another in the money market for hedging purposes will be exactly the same as using the leveraged spot. Basically, the only difference between the leveraged spot and money market is that while the leveraged spot transaction is completed within two business days, the transaction in the money market is completed in months (normally less than 12), such as the T-bill, eurodollar, and euroyen in money market. Generally, the characteristics of the leveraged spot are very similar to the characteristics of financial tools in the money market. The following is presented to show the major differences.

In terms of hedging, there are only a few significant differences between a loan agreement from the money market and the leveraged spot market. These differences are listed below:

(1) Leverage ratio –

- Depending on the financial providers, the leveraging ratio can vary from 20 to 200 so the leverages spot can access a credit line between 20 and 200 times the initial margin (collateral). This is practically the most significant difference.
- A loan agreement can only be accessed based on the credit limit as given.

(2) Currency availability

- A leveraged spot can trade across many currencies and depends on the financial provider, for instance, the Bank of America can trade up to 12 currencies (Australian dollar, British pound, Canadian dollar, The euro, Japanese yen, New Zealand dollar, Swiss franc, U.S. dollar, Danish krone, Norwegian krone, Swedish krona and Hong Kong dollar), providing a larger selection of currencies for hedging purposes.
- A loan agreement depends on the regulations of the market where the loan is contracted.

(3) Flexibility and trading hours

- A leveraged spot market can be traded in a 24 hour service pattern. That is, a position it can be opened without time constraint and held permanently if the holder wants, or liquidated within few minutes.
- A loan agreement normally can only be accessed within office hours from 8:00 am to 5:00 pm.

(4) Liquidity

- A leveraged spot contract can be liquidated within a very short time manner, normally, a trading position in leveraged spot market can be opened and closed within quite a few minutes at any time if trader wants.
- A loan agreement is normally less flexible than leveraged spot market. It takes perhaps two business days to complete a transaction.

(5) Counterparty default

- A leveraged spot contract can normally be provided by either financial institutions or banks. It is obvious to note that a counterparty default risk of financial institution would be greater than banks.

- A loan agreement is well known as the service is normally provided by banks.

Indeed, foreign exchange market is usually extremely volatile and the currency movement can dramatically change from one minute to the next. Therefore, the lack of time constraint for opening or closing a position in the market can be critical. The leveraged spot can simply complete a transaction by opening a position and closing the position within a few minutes, by the click of a mouse button over the internet. In contrast, there is little flexibility in a loan facility.

Chapter Five

Summary and Conclusion

5.1 Introduction

In the existing literature, the most commonly used financial tools for speculating and hedging include forward, swaps, options, futures and money market instruments. When hedging, these financial tools are actually used to insure against unfavourable movements of interest rates and currencies. The hedging model in this thesis is only developed for covering unfavourable currency movement from a hedger's perspective, while the speculating model can be a profitable speculative method.

5.2 Major Findings and Implications

This research has produced results relevant to speculating and hedging activities in the leveraged spot market. The major findings and their implications are summarised below.

5.2.1 Speculating Model

The income received from speculating in the leveraged spot market can be divided into two conceptually distinct parts: the first relates to the positive, risk-free income differential between the borrowings and investing currencies; the second is dependent on favourable currency movements and is the risky portion of the speculative activity. However, the possibility of obtaining risk-free interest income lowers the riskiness of speculating in the foreign exchange market relative to an unleveraged spot market transaction. This can allow a speculator to achieve a specific desired return at a lower risk, or a higher expected return at a given level of risk, which makes speculation using the leveraged spot market an attractive proposition for risk neutral as well as risk averse individuals.

5.2.2 Hedging Model

The thesis also examined the use of the leveraged spot market as part of an overall hedging strategy. In Chapter 3 (3.7), $\Pi = KV[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] - \frac{1}{2}\delta VK^2$, we can make some conclusions about its use for hedging purposes. There are three components in equation (3.7):

(1) $KV(r_{us} - r_J)$ shows the profit (loss) due to the interest rate differential and generates interest gain (payment) if the interest rate differential is positive (negative).

(2) $KV(1 + r_{US})E(\dot{S})$ shows the movement in the spot exchange rate and is the volatility of the leveraged spot contract.

(3) $\frac{1}{2}\delta VK^2$ is the cost function of operating in the leveraged spot market.

According to equation (3.7), the role of hedging was investigated in two different ways. First, extending the earlier results on speculation, the thesis analysed how an open, speculative position in the leveraged market can be hedged using a forward contract. In essence, the forward contract can be used to eliminate the risk involved with an open leveraged spot position. Indeed, if covered interest parity holds, and interest rates, for example, in Japan and the United States do not change over the term of the contract, using the forward contract to hedge the speculation will eliminate any profit. However, if interest rates do change favourably, this procedure can yield significant profits. The extent of the profits depends on the leverage ratio, the higher the leverage ratio the higher the profit will be from interest rate changes.

Second, the thesis examines how the leveraged spot market can serve as a hedging instrument to eliminate, or mitigate, transaction exposure. Moreover, we show that under certain circumstances, hedging with the leveraged spot market can yield superior results compared to traditional hedging mechanisms including forward contracts and money market instruments.

From the hedging perspective, the use of the leveraged spot contract is superior to a forward contract because (1) $KV(r_{us} - r_J)$ will be internalizing the additional interest gain if $(r_{us} - r_J)_t$ is greater than $(r_{us} - r_J)_{t-1}$ during the hedging period. Our simulations in hedging scenario one demonstrated this situation.

Conversely, use of the leveraged spot contract is *not* superior to the forward contract when the $KV(r_{us} - r_J)$ term is losing the additional interest gain because $(r_{us} - r_J)_t$ is less than $(r_{us} - r_J)_{t-1}$ during the hedging period, i.e. $\Delta(r_{US} - r_J) < 0$. Scenario two reflects this hedging result. Having compared the feasibility of forward and leveraged spot techniques for hedging, we conclude that using the leveraged spot is superior to the forward only if the interest rate differential $(r_{us} - r_J)_t$ is greater than $(r_{us} - r_J)_{t-1}$ within the hedging period, .i.e. $\Delta(r_{US} - r_J) > 0$.

5.3 Significance

The thesis has developed a new speculating and hedging approach in the foreign exchange market using leveraged spot markets, an application which has received scant attention in the literature. Speculators can have a broader range of financial alternatives that allow them to take advantage of favourable currency movement, while at the same time reducing the riskiness of speculation by receiving risk-free income from a positive interest rate differential between two countries. From a hedger's perspective, hedging using the leveraged spot market can yield a superior outcome when compared to traditional hedging tools such as unleveraged forward contracts.

5.4 Recommendations

As discussed in Chapter 3, the model for speculation can be a very profitable financial model when used with the selective trading recommendations which are listed below.

1. According to equation (3.7), we can maximise the risk-free profit from an interest differential by choosing the largest possible interest rate differential, for example, borrowing Japanese yen at 2% per annum, and investing the borrowed amount into the US money market which earns 5.25% per annum. This yields a differential interest rate given by:

$$r_{US} - r_J = 5.25\% - 2\% = 3.25\%$$

2. Concern will arise if the exchange rate movement goes against the trader. The trader (hedgers and speculators) can still profit in this transaction if the maintenance margin is sufficient to meet the demands arising from volatility in

the market movement.

3. Liquidate the position *only* if currency movement is in a favourable status. The total proceeds for this transaction will be the sum of profits due to the interest rate differential and movements in the currency market.

5.5 Limitations

In reality, not all currencies are available to be traded in the leveraged spot market. The leveraged spot market mainly offers trading in the Australian dollar, British pound sterling, Canadian dollar, euro, Japanese yen, New Zealand dollar, Swiss franc, U.S. dollar, Danish krone, Norwegian krone, Swedish krona and Hong Kong dollar. The availability of a currency for trade will thus depend on financial providers.

In developing a model which uses the leveraged spot market for speculation, the thesis examined the effect of different values of g_{vv}. A more rigorous approach would require the use of sophisticated econometric techniques for establishing model variables and testing their efficacy.

5.6 Conclusion

The completion of this thesis contributes to the studies of global finance and economics in two ways. Firstly, we showed here that the leveraged spot market can be used for both speculating and hedging purposes, and under certain circumstances, the leveraged spot contract can generate risk-free profit. Secondly, we showed that the leveraged spot contract is a better hedging tool than traditional financial instruments, such as the forward and money market hedges. Its use is viable under the specific condition that the interest rate differential at time t must be greater than the differential at time t-1.

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Appendices

Appendix A

Appendix A1 Origin of Hedging

We now proceed with a brief history of hedging. The recent flaws in corporate governance, particularly the 1997 Asian financial crisis, the collapse of the London Barings Bank and the fall of Enron, have highlighted the importance of good hedging practices.

Information collected from the Chicago Mercantile Exchange (CME) has unveiled the long history of hedging, which could be traced back to early agrarian societies. At the beginning of commodity markets where producers and buyers of agricultural goods began meeting in a common place to trade, the often volatile and mismatched supply and demand generally lead to unpredictable commodity prices. Hence, in an attempt to allow more efficient and predictable trading, producers and buyers in the agrarian societies began using agreements in which they were allowed to “buy now, but pay and deliver later” (CME, 2005a). These agreements were individually dictated with details of established prices and delivery terms agreed between the buyer and producer (seller). These agreements were the origin of hedging. They were the beginning of forward contracts and ancestor to other currently available hedging techniques, such as the futures contracts, options contracts and swaps. In the seventeenth century, the use of “forward agreements” was recorded in the Japanese rice markets (CME, 2005a). It is now a common belief that forward agreements are the “original” form of financial derivatives.

This long history may explain why forward contracts have been reported by the

Australian Bureau of Statistics (ABS) in 2001 to be the most commonly used hedging tool (for further insight to this report, please refer to ABS 2001).

As our society continued to evolve, our trading marketplace became more sophisticated. We started from the initial trading of solely agricultural commodities, to the current expanded definition of “commodity” which includes not only manufactured goods but also the floating world currencies, global interest rates, and share market indexes (CME, 2005a, 2005b). We moved from the individually negotiated contracts to internationally standardized contracts as we try to streamline contract processing and delivery. It is no wonder why authors such as, ABS (2001), Alster (2003), Anac and Gozen (2003), Batten et al. (1993), CME (2005a, 2005b), Dawson and Rodney (1994), Kyte (2002) and Murray (2004), have suggested that the continuous evolution of trading is a reflection of how we try to improve the effectiveness of the commercial marketplace.

Appendix A2 The Role of Gold in Hedging

Throughout the evolution of hedging, various tools have been utilized. However, one ought not to overlook the important role of gold in acting as insurance against inflation and political instability. Indeed, from the Pure Gold Standard prior to World War I when all countries fixed an exchange rate between national currencies and gold to establish currency cross rates, to the post-1973 floating currency systems where Central Banks around the globe held gold primarily as a hedge against the devaluation of reserves held in key currencies, gold bullion has played a key role as a hedging tool (ASX, 2005d). Throughout their history, Central Banks have used gold bullion as a reserve during times when the nation's currency had suffered extensive devaluation. Indeed, using gold bullion as reserve has always been an essential monetary policy for public confidence.

However, as our society evolved, our perception and utilization of gold as a hedging tool has also changed. Some authors (such as Faff and Chan, 1998) claim the change occurred during the 1970s when the floating system began, whereas others (including the Australian Stock Exchange) suggest the change occurred later during the late 1990s. Regardless of the different time frame suggested, the diminishing role of gold as a hedging tool is undeniable. In fact, during the latter part of the 1990s, Central Banks worldwide began selling their gold reserves and investing the proceeds into foreign currency assets (Faff and Chan, 1998; ASX, 2005d). Among them, the Reserve Bank of Australia (RBA) sold 167 tonnes of gold in 1997, reducing its gold holdings from 247 tonnes to merely 80 tonnes (ASX, 2005d). The sales were triggered by the costs associated with holding gold as an asset. These costs include but are not limited to: (1) opportunity cost of interest foregone on the substitute currency reserve, and (2) storing and transportation costs of gold bullion. The proceeds of the 167 tonnes of gold sales were immediately invested in foreign currency assets such as government securities denominated in US dollars, Japanese yen, and German marks.

Gold has unquestionably had a historic role in the risk management industry as it has long been regarded as essential insurance in the monetary system. However, as our society evolves, our demand for gold bullion as a hedging tool has also changed. It is these changing roles of various commodities (such as agriculture, gold or currencies) that have allowed the continuous evolution in corporate hedging. The changing commodity roles also reflect the changing era in the financial markets as people continue their efforts in refining the commercial marketplace through more effective and efficient hedging mechanisms. Indeed, Alster (2003) suggested the unification of Europe by adopting one single currency has simplified the normal mechanism of hedging which corporate treasurers would generally endure when faced with cross-nation trading. Such simplification not only indicates easier risk management for corporate treasurers, but also more predictable corporate revenue, and encourages a better managed corporation.

Appendix A3 Consequences of Imprudent Hedging

Hedging is not to be conducted in a gambling or speculative manner[8].Indeed, many companies that have been adopting hedging as a tool for minimizing their currency exposure normally include statements proclaiming that the company's involvement in currency hedging activities is not for profit but is an insurance against the volatile currency market. However, during the course of research, we realized there has been no shortage of cases in which companies misused the basic function of hedging. Amongst these cases, almost no company survived without substantial loses; most actually suffered irreversible financial damage. Cases of misusing hedging strategies are noted in Australia as well as overseas. The collapse of Enron in the United States and the fall of Pasminco in Australia are just two recent infamous cases (Brown and Ma, 2006; Wilson and Campbell, 2003; Whyte, 2001).

It is the object of this thesis to derive a contemporary hedging model that will assist any investor or international company to manage and minimize their exposure to any adverse exchange rate movements. However, we recognize that, in any successful hedging strategy, there are at least two key factors. The first key success factor is a thorough understanding of the economic fundamentals. Indeed, a lack of understanding of these economic fundamentals will blur or even jeopardize judgment on the currency movement. An imprecise estimation on the future currency trends will lead hedgers to derive hedging strategies that are unfit to insure the currency exposure.

8 Anac and Gozen (2003), Alster (2003), Dawson and Rodney (1994), De Roon et al (2003), Dinwoodie and Morris (2003), Lalancette et al. (2004), Nguyen and Faff (2002, 2003a), and O'Leary (2004) are just some of those authors noting this view.

The result of any under-insured exposure can be disastrous. The second key success factor relates to the attitude of the hedger. Indeed, some of those failed hedging attempts are caused by imprudent, unethical or irresponsible hedgers. Hedging attempts undertaken by irresponsible hedgers normally create more currency exposure for the company as opposed to reducing risk for the company. Likewise witnessed in the case of Enron, most damages reported due to failed hedging attempts can involve large sums of money, sometimes large enough to cause business failure. These irresponsible activities certainly can discourage the use of hedging amongst ordinary corporate treasurers. In the following section, we will reveal some of those cases in which international companies, mainly Australian multinational corporations, suffered losses as a result of their own hedging practices.

We now proceed with the costly consequences of imprudent hedging, with Pasminco being the first case we will discuss in this section. In September 2001, Pasminco joined a string of big, failed Australian companies like HIH and Ansett as the company filed for voluntary administration[9]. Pasminco insisted that, after the appointment of John Spark and Peter McCluskey as the Pasminco Group's Voluntary Administrators, the company would continue their mining business as usual in an attempt to trade out of the huge $2.6 billion debt (Hooper, 2001; Pasminco, 2001; Whyte, 2001). In the company's 2001 Annual Report, Pasminco claimed to incur a loss of AUD2,418.3 million after tax compared to a profit of AUD23.4 million in 2000 (Brown and Ma, 2006; Pasminco, 2001). The big tumble was regarded as a result of falling zinc prices coupled with bad judgment (strategies) on its hedging of foreign currencies,

[9] Refer to Hooper (2001), Pasminco (2001), and Whyte (2001) for more information.

which led to drastically falling share prices as well as crippling debts that at one time reached a maximum of $2.8 billion.

Authors like Whyte (2001) later referred to the Australian lead and zinc producer as the highest profile casualty of currency hedging, and this statement comes as no surprise. Indeed, it has been disclosed that Pasminco had a currency hedge book valued at negative AUD867 million that was sitting on top of a AUD77.1 million losses resulting from the company's bad-timing in selling forward silver and silver swap contracts (Pasminco, 2001; Whyte, 2001). This research unveiled that at the financial year-end in June 2000, the currency hedge book included AUD3.5 billion in sold currency put options with strike prices averaging near US64.4 cents, and AUD3.3 billion in bought call options with strike prices averaging near US68.1 cent, (Whyte, 2001). According to Whyte (2001), the hedging strategies were supposed to protect revenue if the exchange rate rose above US68.1 cents. This protection came at a cost of forgoing any revenue windfall if the exchange rate fell below US64.4 cents. Unfortunately, as historical data from the Reserve Bank of Australia (RBA) later unveiled, the Australian dollar fell to a low of US48.3 cents on 3rd April 2001 (RBA, 2005). By then, one can only imagine the total currency losses experienced by Pasminco (Whyte, 2001). In reality, at the end of 2000, Pasminco had already reported foreign exchange losses of negative AUD42 million. Hence, it is no wonder that a few months later when the AUD bottomed out, the losses in the options market not only swallowed the whole operating profit of AUD88 million, but, presented Pasminco with an interim net loss of AUD37.3 million (Whyte, 2001; RBA, 2005). These losses in the financial markets unquestionably played a significant part in the ill-fated

Pasminco's road to voluntary administration. After the collapse of Pasminco, numerous researches were conducted surrounding the financial operations of this company. Authors, such as Brown and Ma (2006), suggested that the use of quantitative models for risk measurement could have assisted the management of Pasminco to better calculate and quantify the real risk of insolvency that the company faced, in turns, made better judgment with regards to their currency hedge strategy. However, the findings of their research can only be a valuable lessons and reference for other companies.

Having examined the hedging strategy adopted by Pasminco, it seems that the company's hedge committee (those who designed and approved the hedging strategies for Pasminco) must have been very confident in their own ability to predict the movement of the Australian dollar. In fact, they executed such an aggressive strategy despite the obvious embedded risk. Amongst all those risks, the imbalance between the amount hedged and those needed to be hedged was almost impossible to go unnoticed. It is based on such obvious risk embedded in the strategy that we began questioning the true intention of Pasminco's utilization of financial derivatives. The company certainly declared in their Annual Report that Pasminco was not involved in speculative derivative usage. However, we remained unconvinced and the following explains why.

In a very simplified sense, we see that the basic function of hedging is like sitting on the seesaw. When companies create a hedge account, the first and foremost intention is to use any revenue gained from this hedge account to offset and make up for the losses encountered in their daily operational revenue. In other words, when the company's revenue is estimated to suffer due to a rising Australian dollar, the correct move will be to open a hedge position predicting the Australian dollar to appreciate, which in options market's terms, is to either buy a call option or sell a put option. In doing so, should the prediction of a rising Australian dollar come true, the company will be able to offset the operational loss using the hedge gain (vice versa if the prediction is not realized). It is vital to note that in order for the seesaw effect mentioned earlier to work, the amount opened on the options positions ought to equal the expected earning intended to be hedged. Otherwise, in the case of Pasminco where the hedge (AUD3.3 billion in bought call options and AUD3.5 billion in sold options, using an average exchange rate in June 2000 of US60 cents the sum is equal to nearly US$4 billion) exceeded the intended earning (nearly US$2.3 billion as estimated in the year ending 30 June 2000), the seesaw will become imbalanced and it takes no genius to figure out what happens next to a combination of an imbalanced seesaw and poorly built (financial) foundation – the person sitting on top of the seesaw falls, which in this case means the company faces losses.

Having said the above, we also acknowledge, unquestionably, that the so-called "cap and floor strategy" adopted by Pasminco would have been a brilliant strategy, not only as hedging mechanism, but also as an opportunity for the company to earn an extra windfall from the derivative market, if their prediction on the Australian dollar movement had been correct. Sadly, as history unfolded, their prediction went horribly wrong. Indeed, the excessive hedge ratio most certainly exposed Pasminco to even more volatility in the currency market, creating a vicious cycle for the company's already unfit financial wellbeing, and undeniably distorted the basic function of hedging as insurance for corporate earnings. Moreover, it is possible that the use of the cap and floor strategy was mainly due to the strategy's ability to: (1) reduce the cost (the amount of premium required to open the options positions) by paying the premium for their bought call options by using the premium paid to them in their sold put options; and (2) double the hedge gain should Pasminco's Australian prediction came true. The possibility of this being their motivation for using the cap and floor strategy is disturbing. Indeed, a person's hunger for cost reduction and greed for speculative gain in the financial market can never justify putting the well-being of a multinational company on the line. It is based on the above analysis that we maintain our suspicion as to the true intention of Pasminco's so-called currency hedge strategy during that period.

It is an unfortunate reality that bad currency hedge books were not problems unique to Pasminco. In fact, research unveiled that bad currency hedge books were also the main motivation on that kindled merger talks between another two Australian mining companies, Delta Gold and Goldfields (Whyte, 2001). For the purpose of this thesis, Delta Gold will be referred as DG from here onwards. It is reported that at the end of March 2001 (before the Australian dollar reached a low of USD48.3cents in April 2001), DG reported a currency hedge book with mark-to-market value AUD-111 million (Whyte, 2001; RBA, 2005). The figure was coupled with AUD-121 million recorded for the gold miner's wrongly judged gold hedge (Whyte, 2001; RBA, 2005). These losses resulted from the company's wrongly designed hedge strategies and cost DG dearly. Indeed, with reported revenue of AUD416 million in the year ending June 2001, DG only recorded earnings of fifty two million Australian Dollars (AUD52million). The year-2001 losses were regrettably even worse than the previous year, in which DG lost AUD115 million on revenue of AUD327 million (Whyte, 2001).

Goldfields is a gold producer in which the South African house Harmony Gold hold a 23% interest. Compared to DG, Goldfields had done slightly better in the financial markets. Goldfields reported an AUD87 million liability from a currency hedge, compared to DG's AUD111 million liability from their currency hedge (Whyte, 2001). Goldfields also reported a better result in their gold hedge. In fact, the company reported positive mark-to-market gold hedges when DG reported a AUD121 million loss in their gold hedges (Whyte, 2001). Goldfields managed to report an increased profit of AUD26 million in year 2001 despite its losses in the currency hedges. It is almost devastating that these two gold producers had reported a combined whopping AUD198 million loss in their currency hedges. The sum is obviously much less than the incurred on the Pasminco Group's hedge book. Nevertheless, AUD198 million is still a substantial loss in the financial market, especially if it is caused by bad strategic calls by their risk management committee.

In addition to the above mentioned international Australian mining companies, Newcrest Mining joined the group as another victim of the falling AUD in April 2001. However, unlike Pasminco or Delta Gold, Newcrest Mining survived. In fact, Newcrest Mining is still trading without having to go through voluntary administration or merger talks. According to Whyte (2001), Newcrest Mining reported total losses of AUD694 million for the year ending June 2001, which was more than the combined losses of both DG and Goldfields. The total loss included a mark-to-market currency hedge book value of AUD436 million, and a further AUD173 million and AUD85 million as recorded for the company's failed gold and copper hedges (Whyte, 2001). Having gone through the company's five-year financial summary, we believe that Newcrest Mining was more resistant toward this huge deduction to their book's balance, mainly because the company's financial structure was otherwise healthy, especially compared to the Pasminco Group as recorded in Pasminco's annual reports[10] (Newcrest Mining, 2005; Pasminco, 2001; Pasminco, 2002). Indeed, the annual report showed that Newcrest's return on capital employed remained positive during 2001-2005, and their total assets and liabilities normally have a 2:1 proportion (Newcrest Mining, 2005). Hence, despite their enormous hedge loss that was a few times larger than that of Delta Gold (DG), Newcrest Mining was not only able to avoid any merger talks like occurred between DG and Goldfields, but also to re-bound declaring a profit after tax of AUD92 million in 2003 following a meager earning of AUD38 million in 2001, and a low negative earning of AUD53 million in 2002 (Newcrest Mining, 2005).

So far in this section we have unveiled some of those most talked-about cases of failed currency hedging strategies in Australia. It is indisputable that these Australian mining companies have had quite a bumpy ride on the road of currency hedging with their combined hedging loses in 2001 estimated at a total of AUD15.01 billion, and this amount only accounts for their "not-so-successful" currency hedges and does not include other hedge losses encountered in the commodity markets. The failures of the disastrous hedging attempts discussed above were mainly due to: (1) bad judgment on the

[10] Pasminco's Annual Report 2001 and 2002.

movement of the Australian dollar before it hit US48.3 cents in April 2001; and (2) the irresponsible and aggressive hedging tactics of the hedgers. We classify them as classic failed hedging attempts are caused by lack of a clear understanding of the surrounding economic fundamentals. We believe the cases discussed here did not involve questionable hedging intentions like we witnessed with Enron before the energy company collapsed in 2001. We refer to Enron's hedging intention as "questionable", mainly because we see the function of hedging as insurance for companies exposed to risks. We share this view with Nguyen and Faff (2002), Alster (2003), Anac and Gozen (2003), De Roon et al. (2003), Dinwoodie and Morris (2003), and other authors in the financial field. We believe that hedging should be used to assist companies in minimizing their earning exposure and stabilizing their income level. We oppose the use of hedging as a technique to conceal any additional debt faced by the company. In fact, hedging is most definitely not a tool to be applied by ethical management in keeping true economic losses off their company's financial statements. We now address how Enron's management had utilized the financial markets in ways which led to the questioning of their true intention.

We mentioned earlier in this chapter that hedging is sometimes taken as a form of value-adding exercise for a company. However, we think that Enron's management had perhaps taken this idea a bit too far. Indeed, the management seemingly believed that keeping the true economic losses of the company's investments off Enron's financial statements, would buy them time to settle those debts or at least figure out another strategy to keep them under the carpet (Wilson and Campbell, 2003). Unfortunately for them, this is not what hedging is about, and most certainly not what ethical corporate governance is about. With every action there are consequences. In fact, with such an unethical management style, the collapse of Enron was unfortunate but almost inevitable. For the purpose of this thesis, we will not go into more detail regarding Enron's hedging scheme, mainly because Enron's hedging strategies were aimed at the stock market (by hedging its own stock using options) (Wilson and Campbell, 2003). With the focus of this thesis is set on hedging the currency market, one ought to understand the varying arena between Enron's hedging scheme and the intended focus of this thesis. For more information on Enron's hedging scheme, refer to Wilson and Campbell (2003).

The Pasminco Group, Delta Gold, Goldfields, NewCrest Mining and Enron are sadly not the only companies reported to have suffered in the financial markets. In January 1985, Lufthansa, the German airline, entered a contract with Boeing to purchase 20 aircrafts for USD500 million (Homaifar, 2004, p.11, p.238). At that time, the US was experiencing high real interest rates, triggered by the tight monetary policy of Volker (the chairman of the Federal Reserve at that time). Faced with such a volatile economy, Lufthansa feared this would increase their cost of the aircraft in Deutsche marks. Hence, the German airline purchased US dollars using a forward contract. However, as history revealed, the value of the US dollar fell sharply, notably after the September 1985 Plaza Agreement in New York. This agreement was signed the Group of Five Central Banks, which include the US, Japan, Germany, France and the United Kingdom. The purpose of this agreement was to put downward pressure on the value of the US dollar by selling reserves of the US dollar to buy other foreign currencies. Lufthansa's initial fear suddenly became a costly reality. Indeed, as the US dollar devalued against the Deutsche mark, the forward contracts instead of reducing the cost of purchase increased it by USD140 million to USD160 million (Homaifar, 2004, p.11, p.238). There are many lessons to be learned from the Lufthansa case. We believe the most significant message is that hedging using the financial market is not always the only or best solution for companies trying to minimize their currency risks. In fact, as witnessed in this case, the company would have unquestionably been much better off adopting the so-called "do nothing" hedging approach. In the "do nothing" approach, Lufthansa could have simply waited and purchased the currency on the spot market, and benefited from the September 1985 Plaza Agreement in New York.

So far, we have discussed a number of cases in which the misuse of hedging exposed users to even more risk, as opposed to reducing the risk exposure.

It is regrettable that the above mentioned cases, both Australian and overseas multinational corporations (MNCs), are just the tip of the iceberg of companies' failed battles in the foreign exchange market. In Table A1, we list some of those multinational corporations that also encountered foreign exchange losses during the 1990s. See Hull (2006, p.11) for more examples of companies experiencing losses in derivative markets.

Table A1: Foreign Exchange Losses

Company (Home Country)	Transaction-inducing Loss	Date	Approximate Loss	Description
Kashima Oil (Japan)	Futures	1993	USD1.5 billion	Speculative losses stemming from loss of internal control
Bank Negara (Malaysia)	Foreign exchange futures	1993	USD2.1 billion	Speculative loss in foreign currency futures
Allied Lyons (U.K.)	Foreign exchange options	1991	USD219 million	Speculative loss from unauthorized option hedging
Showa Shell (Japan)	Foreign exchange futures	1993	USD1.54 billion	Affiliate of Shell conceals FX loss for years

Source: Hull, (2006, p. 11).

In this section, we have identified some of the consequence which imprudent hedging practices can bring to companies. Nonetheless, it is noted that the real extent of hedging damage is often only made evident through its interaction with other facets of the company's financial structure. In fact, the damage caused by hedging can either be intensified or off-set by this interaction, which mostly explains why Newcrest Mining survived the US48.3 cent per Australian dollar ordeal in year 2001, whereas Pasminco remains under voluntary administration, and Delta Gold and Goldfields entered into merger talks (Whyte, 2001).

Lessons learned from the above empirical cases of failed currency hedging have convinced us to firmly align ourselves to the group of authors[11] that criticize the wrongful use of hedging strategies. There has been evidence that indicates hedging using financial tools (such as forward, futures, options, money market, and leveraged spot) is not always the best solution. In fact, under certain circumstances companies are better off adopting the "do nothing" strategy (e.g. Lufthansa in 1985). However, having said that, it is vital that when companies do hedge, they use hedging as tool of managing currency risk but not as a speculative tool for additional revenue, and most definitely not as a tactic for unethical management to cover up company losses. In this section, we have presented several cases in which the basic function of hedging has been distorted.

It is unfortunate that the cases we present are likely to be just the tip of the iceberg. There are still many unexposed cases in which bad hedging strategies have practiced. Batten et al. (1993) claimed that amongst those many firms involved in hedging using financial tools, some contracts are done without any proper management control (p.571). A proper management control could be setting an internal foreign exchange dealing limit on contract taking. Due to such lack of control, irresponsible hedgers sometimes trade more contracts than they should, in turn, exposing the company to even more risk. Batten et al. believed that these risk-bearing (instead of risk-minimizing) practices are normally not disclosed to shareholders. Nonetheless, with the

[11] Including Dawson and Rodney (1994), Kawaller (2001), Nguyen and Faff (2002), Alster (2003), Anac and Gozen (2003), De Roon et al (2003), Dinwoodie and Morris (2003), Lalancette et al. (2004), and O'Leary (2004).

introduction of derivative guidelines, such as the FAS 133[12], government authorities are stepping up the pressure on companies to disclose their activities in the financial markets, in turn, allowing shareholders to make better decisions with regard to their investments.

In order to not become just another casualty of the currency hedge, it is absolutely critical that corporate treasurers constantly review and evaluate the effectiveness of the company's hedging strategies, as with any other corporate strategies. Adjustment actions should be immediately implemented as soon as circumstances change. Continuous monitoring of hedging strategies is to become mandatory under the new accounting guidelines that apply specifically to derivative transactions. These new guidelines include the FAS 133 for the United States of America and the Listing Rule 4.10.17 as outlined by the ASX. Under these guidelines, all listed entities should include assessment and reporting of hedge effectiveness (gains and losses using financial tools) in their annual reports (ASX, 2003).

[12] The FAS 133, otherwise known as Statement No. 133, establishes the accounting and reporting standard for derivative instruments and hedging activities. This Statement applies to all entities in the United States and is effective for all fiscal quarters of fiscal years beginning after June 14, 1999. For more information on this Statement, please refer to the Financial Accounting Standards Board at URL: http://www.fasb.org/st/summary/stsum133.shtml.

Appendix A4 Benefits of Hedging

In the above section, we have presented some cases which showed the negative side of hedging. We showed that companies had failed or been forced into voluntary administration after adopting some imprudent hedging practices. However, having said that, one should not undermine the potential benefits which proper hedging can bring to companies. Indeed, companies that hedge properly using financial instruments can expect reduction on their currency risk exposure, and in turn, improvement on profit/revenue estimations. The literature clearly asserts that unmanaged currency fluctuations are an on-going threat for companies, regardless of whether these companies are multinational companies acting as importer/exporter, or head-quarters with foreign subsidiaries[13].

So, should a company hedge using financial instruments to manage their currency risks? If the answer is yes, then how and by how much should the company hedge their currency risks? The contradictions between those that suffered losses from hedging attempts and those companies that suffered losses by their unhedged currency accounts has triggered constant debate with regard to the adoption of hedging using financial instruments (such as forward, futures, options, swap, money market and leveraged spot). Hence, having presented the negative stories of hedging failure, we now proceed to show the other side of hedging – the positive benefits of hedging, as documented by previous literature.

[13] Dawson and Rodney (1994), Kawaller (2001), Nguyen and Faff (2002), Alster (2003), Anac and Gozen (2003), De Roon et al. (2003), Dinwoodie and Morris (2003), Lalancette et al. (2004), and O'Leary (2004) are some of those authors that shared this view.

We believe that the benefits of hedging are best appreciated by a company that has been on the wrong side of a sudden currency fluctuation. Indeed, it is typically after those harsh lessons that companies change their attitudes towards currency risk management, and begin responding to the foreign exchange market with conservative yet comprehensive hedging strategies (Alster, 2003). Amongst those companies that have learned the benefits of hedging the hard way, J.D. Edwards & Co. is one documented in past literature. According to Alster (2003), the Denver-based enterprise software firm lost more than USD6 million in 1996-1998 due to an unmanaged (unhedged) currency account. Since then, the company changed their currency management policy to hedging 100% with over USD1 billion of transactions a year in their attempts to avoid becoming just another victim in the ever fluctuating foreign exchange market. Like other companies which utilize hedging as a tool for minimizing the effects of currency movements, J.D. Edwards asserts that the company is not involved in speculative activities, instead, the company's hedging policy is aimed at ensuring stable earnings (Alster, 2003).

The most commonly documented benefit of hedging is that it is an effective tool for companies to manage any price risk expected during the course of business[14]. More specifically, Anac and Gozen (2003) and Alster (2003) claim that for multinational companies that source components, assemble parts, test and market products in various countries, a currency hedge can guard against the currency movements that can swallow the company's earnings. In fact, a

[14] This idea is shared amongst authors such as Dawson and Rodney (1994), Kawaller (2001), Nguyen and Faff (2002), Alster (2003), Anac and Gozen (2003), De Roon et al. (2003), Dinwoodie and Morris (2003), Callinan (2004), Lalancette et al. (2004), and O'Leary (2004).

currency hedge can assure the company has a predictable cash flow which is needed to run the business and allows the company to maintain more stable products/services pricing. Nguyen and Faff (2002, 2003a, 2003b) supported the aforementioned view. In fact, these authors claimed that Australian companies with higher debt ratio and dividend payable are more likely than others to be involved in currency hedging, mostly because of the added need for a stable and predictable income (Nguyen and Faff, 2002, 2003a, 2003b).

In the previous section, we presented some imprudent hedging strategies that can lead companies into trouble. However, carefully executed hedging strategies can indisputably act as insurance for companies to guard their earnings when currency goes against their favor. This statement has been supported by various authors in the financial field[15]. Thus far, we have mentioned countless times that a currency hedge can protect an international company from adverse currency movements. So, what happens if the currency is expected to go in their favor and because of hedging, the company is restricted from gaining the extra windfall? This scenario is realistic and the result can be disastrous as happened to Lufthansa in 1985. It is most certainly true that companies can benefit by earning extra cash flow when a currency change goes in their favor. Based on the "seesaw effect", companies that hedge are protected from losses due to adverse currency movements and restricted from any gain due to favorable currency movements. Therefore, a logical recommendation would be for companies to consider using a currency

[15] Including authors such as Dawson and Rodney (1994), Kawaller (2001), Nguyen and Faff (2002), Alster (2003), Anac and Gozen (2003), De Roon et al. (2003), Dinwoodie and Morris (2003), Lalancette et al. (2004), and O'Leary (2004).

hedge with financial instruments only if they expect the currency to go against them. Otherwise, companies should choose the “do nothing” strategy. However, having said that, faced with the ever changing business environment, the volatile international money market, tax responsibility and shareholders’ interest, responsible corporate hedgers normally (and logically) choose to forego the chance of earning a few extra dollars at the risk of losing the entire company’s legitimate earnings. We believe that to some extent, the decision of to hedge or not to hedge also depends on the hedger’s tolerance toward risks.

So far, we have presented our view of whether or not a corporation should adopt currency hedges as means of dealing with adverse currency movements. The reality seems like any unhedged currency account is just as risky as a 100% hedged account. Indeed, unless the hedger can be absolutely precise when judging the direction of currency movements, the company could well end up just like Lufthansa in 1985. We know that the international money market is anything but predictable. Therefore, companies are mostly being confronted with equal chances of avoiding losses caused by adverse currency movements with or without hedging. Authors such as Murray (2004) and Alster (2003) suggested that companies should only hedge 50% while leaving the other 50% subject to currency movements. These authors claimed that a hedge of 50% will buy the company some time to react to any changes in the money market should things go against them; meanwhile the other unhedged 50% will allow the company to gain should the currency move in their favor (Murray, 2004; Alster, 2003). This is a way in which companies can gain protection from their hedging tactics while keeping the window of opportunity open for themselves. Murray (2004) and Alster (2003) claimed that the fifty-fifty hedging policy is widely supported by hedgers, including Kawaller who is the president of Kawaller Consulting in New York City. This is mainly because it puts companies in a neutral opportunity cost position.

Having said that, we assert the hedge ratio should change as the circumstances change in the money market or in the company's operating environment. In fact, during different phases of the business and economic cycles, a company ought to be responsive and modify their generic hedge strategies or make necessary adjustment to their existing hedge ratio, so to prevent executing out-dated hedging strategies. As we discussed in the previous section, improper hedging strategies can bring disastrous consequences to companies. Dinwoodie and Morris (2003) suggested that the management's tolerance toward risks is also a significant contributing factor when deciding hedge ratio. This tolerance for risk normally affects the way we make our decisions under uncertainty. In fact, management with higher risk aversion is most likely to take additional actions when dealing with their exposure to any risk. Hence, it is no surprise that these authors suggested that risk aversion is the fundamental motivation for corporate hedging. In fact, if a company's treasurer is a highly risk averse individual, then the company will mostly have higher hedge ratios, as prudent hedging using financial instruments can allow these treasurers to manage currency risk that is sometimes beyond their control (Dinwoodie and Morris, 2003). Having said that, it is important to note that in this thesis, we see hedgers as risk neutral individuals as they tend to choose their hedging strategies based on the expected value (return) of any given strategy. Therefore, instead of claiming the company's hedge ratio would increase according to the treasurer's (assuming treasurer is the corporate hedger) risk aversion, we would suggest that the company's hedge ratio would increase according to the expected value of each given hedge ratio.

Appendix A5 International Financial Markets

In this section we describe the international monetary system (IMS) which has been changing over time. A discussion of these changes is relevant to determining the policy and other mechanisms that are used to evaluate the Australian dollar.

The world is currently witnessing globalization which involves movements in goods, services and factors of production across national boundaries. As this globalization occurs a very large number of transactions are conducted which required some order in the currency market. A chaotic currency market would be disastrous for both globalization and world order.

The international monetary system has undergone enormous change as a consequence of changing economic conditions and world trade. In the period 1879-1913, international currency markets were governed by the Gold Standard. The history of using gold as a medium of exchange can be dated as far back as to the Pharaohs in Egypt (about 3000 B.C.). In fact, the Greeks and Romans used gold coins and passed on this tradition through the mercantile era to the nineteenth century. The increase of trade during the late nineteenth century led to a need for a more formalized system for settling international trade balances. The "rules of the game" were then developed, in which one country set a par value for its currency (paper or coin) in terms of gold. As an example, the US declared the dollar to be convertible to gold at a rate of \$20.67 per ounce of gold, and the British pound was pegged at £4.2474 per ounce of gold. Therefore, the dollar/pound exchange rate was: \$4.8665/£. With such simple “rules”, the gold standard gained acceptance as an international monetary system in Western Europe in the 1870s. The US officially adopted the system nine years later. During the gold standard era, was important for governments to maintain adequate reserves of gold to back their currency’s value. The system implicitly limited the rate at which any individual country could change its money supply, mainly because any growth in the amount of money was limited to the rate at which the government could acquire additional gold. The gold standard worked adequately until the outbreak of World War I interrupted trade flows and the free movement of gold. This caused the main trading nations to suspend operation of the gold standard (Moffett et al., 2006, p.38).

During World War I and the early 1920s, currencies were allowed to fluctuate over fairly wide ranges in terms of gold and each other. In theory, a country’s imports and exports caused moderate change in their exchange rate. Unfortunately, growing numbers of international speculators threw the flexible exchange rates into disequilibrium. These speculators sold the weak currencies short, causing them to fall further in value than warranted by real economic factors. The reverse happened with strong currencies. Fluctuations in currency value could not be offset by the relatively illiquid forward exchange market except at very high cost. As a result, the volume of world trade did not grow in the 1920s in proportion to world gross national product but instead declined to a very low level with the advent of the Great Depression in the 1930s. In 1934, the US dollar was devalued to $35 per ounce of gold from $20.67 per ounce prior to World War I. In response to the devaluation, the US government adopted a modified gold standard, in which the US treasury traded gold only with foreign central banks but not private citizens. From 1934 to the end of World War II, exchange rates were theoretically determined by each currency's value in terms of gold. However, with the chaos created by World War II and its aftermath, most main trading currencies lost their convertibility into other currencies, with the US being the only exceptional currency that continued to be convertible (Moffett et al., 2006, p.38).

Throughout these evolutionary phases, one ought to note the significance of the establishment of the International Monetary Fund (IMF) after Bretton Woods. In 1944, as World War II drew to a close, the Allied Powers met at Bretton Woods, New Hampshire, to create a new post war international monetary system (Moffett et al., 2006, p.38). With the establishment of the Bretton Woods Agreements, the world was faced with a US dollar-based international monetary system and two new institutions, International Monetary Fund (IMF) and the World Bank. The main purpose of the IMF is to aid countries with balance of payments and exchange rate problems, whereas, the World Bank (also known as the International Bank for Reconstruction and Development) helped fund post war reconstruction and since then has supported general economic development.

Between 1945 and 1973, as the world was faced with widely different national policies, rates of inflations and various unexpected external shocks, the Bretton Woods Agreements began to fail. The collapse was mainly due to: (1) the lack of adjustment mechanisms in the Bretton Woods Agreement; (2) the international liquidity problems associated with inadequate gold production; and (3) the failure to maintain gold parity by not allowing the official gold price to increase (Eng et al., 1998, p.32). The following Table A2 showed the changing eras of the international monetary system.

Table A2: History of the International Monetary System

History of the IMS	
The Gold Standard	1876-1913
The Inter-War Years and World War II	1914-1944
Bretton Woods and the International Monetary Fund	1944
Fixed Exchange Rates	1945-1973
Floating System	1973-Present

Source: Author.

Appendix A6 Data from the 2005 Australian Bureau of Statistics Survey

Table A3: Foreign Currency Exposure by Sector as at 31 March 2005

Instrument	*Banks* $b	*RBA* $b	*Other financial corporations* $b	*CBAs & general government* $b	*Other resident sectors* $b	*Total all sectors* $b
Foreign equity assets	33.0	0.2	160.4	—	150.1	343.7
Foreign currency denominated debt assets	96.8	43.7	48.7	0.3	24.1	213.7
Foreign currency denominated debt liabilities	282.4	0.1	95.4	3.6	84.0	465.5
equals						
Net foreign currency balance sheet position	**–152.5**	**43.8**	**113.7**	**–3.3**	**90.2**	**91.9**
Expected foreign currency denominated receipts from trade	—	—	—	0.1	92.6	92.7
Expected foreign currency denominated payments for trade	—	—	—	2.6	86.2	88.8
equals						
Expected net foreign currency exposure (before hedging)	**–152.5**	**43.8**	**113.7**	**–5.8**	**96.6**	**95.8**
Principal value of foreign currency derivative contracts in a bought position	1 450.9	8.1	205.3	3.9	137.9	1 806.2
Foreign currency bought in exchange for Australian dollars	887.0	0.7	205.3	3.9	137.9	1 234.8
Foreign currency bought in exchange for other foreign currencies	563.9	7.5	. .	. .	. .	571.4
Principal value of foreign currency derivative contracts in a sold position	1 297.6	29.6	220.6	0.6	136.0	1 684.4
Foreign currency sold in exchange for Australian dollars	733.7	22.1	220.6	0.6	136.0	1 113.0
Foreign currency sold in exchange for other foreign currencies	563.9	7.5	. .	. .	. .	571.4
equals						
Net foreign currency exposure (after hedging)	**0.8**	**22.4**	**98.5**	**–2.5**	**98.5**	**217.6**

. . not applicable
— nil or rounded to zero (including null cells)

(a) For sign conventions see paragraph 13 of the Explanatory Notes.

Source: ABS (2005).

Table A4: Types of Derivative Contracts

Product type	Banks $b	RBA $b	Other financial corporations $b	CBAs & general government $b	Other resident sectors $b	Total all sectors $b
Principal value of foreign currency derivative contracts in a bought position	**1 450.9**	**8.1**	**205.3**	**3.9**	**137.9**	**1 806.2**
Foreign currency bought in exchange for Australian dollars	887.0	0.7	205.3	3.9	137.9	1 234.8
Forward foreign exchange	483.2	0.7	150.5	3.6	112.4	750.4
Cross currency interest rate swaps	265.7	—	42.1	0.3	21.5	329.6
Futures	86.9	—	—	—	—	86.9
Currency options	50.8	—	12.1	—	4.0	66.8
Other	0.5	—	0.6	—	—	1.1
Foreign currency bought in exchange for foreign currency	563.9	7.5	. .	. .	. .	571.4
Principal value of foreign currency derivative contracts in a sold position	**1 297.6**	**29.6**	**220.6**	**0.6**	**136.0**	**1 684.4**
Foreign currency sold in exchange for Australian dollars	733.7	22.1	220.6	0.6	136.0	1 113.0
Forward foreign exchange	419.7	22.1	173.7	0.3	130.9	746.8
Cross currency interest rate swaps	179.3	—	21.5	0.3	3.0	204.1
Futures	86.4	—	0.4	—	—	86.8
Currency options	48.2	—	24.9	—	2.1	75.2
Other	0.2	—	0.1	—	—	0.2
Foreign currency sold in exchange for foreign currency	563.9	7.5	. .	. .	. .	571.4

. . not applicable — nil or rounded to zero (including null cells)

Source: ABS (2005).

Table A5: Value of Instrument, by Policy and Level of Hedging as at 31 March 2005

Instrument and Policy	Banks $b	RBA $b	Other financial corporations $b	CBAs & general government $b	Other resident sectors $b	Total all sectors $b
Foreign equity assets						
Value before hedging by policy	33.0	0.2	160.4	—	150.1	343.7
No hedging	19.4	0.2	54.7	—	143.8	218.1
No policy	—	—	—	—	—	—
Hedging constant percentage	10.0	—	64.9	—	5.4	80.2
Level hedged varies with changing conditions	—	—	24.1	—	0.4	24.5
Other policy	3.7	—	16.8	—	0.6	21.0
Value hedged by policy(a)	9.7	—	60.0	—	2.2	72.0
No hedging	—	—	—	—	—	—
No policy	—	—	—	—	—	—
Hedging constant percentage	9.5	—	43.8	—	1.9	55.2
Level hedged varies with changing conditions	—	—	9.9	—	0.3	10.2
Other policy	0.2	—	6.4	—	—	6.6
Debt assets and liabilities						
Value before hedging by policy	379.2	43.8	144.1	4.0	108.1	679.1
No hedging	26.5	—	9.9	0.1	46.2	82.7
No policy	—	—	—	—	—	—
Hedging constant percentage	264.2	—	113.2	3.9	51.8	433.0
Level hedged varies with changing conditions	11.5	—	8.5	—	4.8	24.8
Level hedged varies with time horizons	—	—	—	—	0.6	0.6
Other policy	77.0	43.8	12.5	—	4.7	138.0
Value hedged by policy(a)	343.3	21.5	119.1	3.7	48.3	535.8
No hedging	—	—	—	—	—	—
No policy	—	—	—	—	—	—
Hedging constant percentage	255.9	—	109.8	3.7	42.8	412.2
Level hedged varies with changing conditions	10.7	—	3.4	—	3.7	17.7
Level hedged varies with time horizons	—	—	—	—	0.5	0.5
Other policy	76.8	21.5	5.9	—	1.3	105.4

— nil or rounded to zero (including null cells)

(a) Value hedged is the total value reported, multiplied by the nominated percentage to be hedged.

Source: ABS (2005).

Appendix A7 Mechanisms of Financial Instruments

Appendix A7.1 Forward Contracts

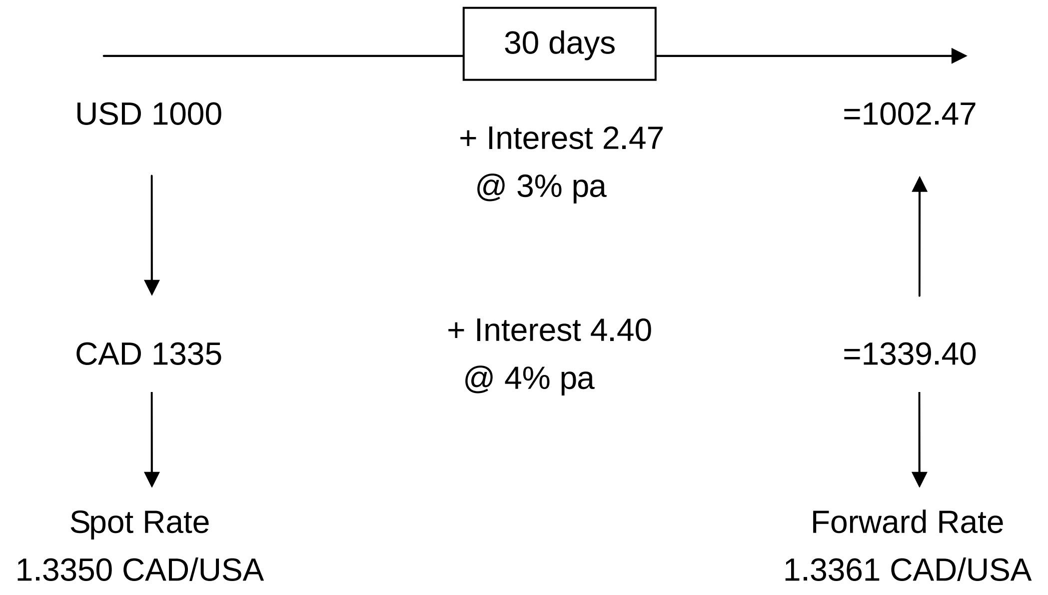
In this section, we continue to discuss the mechanism of calculating forward rates for a currency. Research found that forward rates are a function of the spot rate and the differential in the interest rates of the two currencies. It is important to note that the forward rate is however not to be seen as a projection of where the rates are headed; in fact, it is merely a reflection of the current market conditions and government interest rate policies (Hallwood and MacDonald, 2000, p.250; Hughes and MacDonald, 2002, p.208; Murray, 2004).

This brings the discussion back to the limitation of forward contract mentioned earlier: the lack of flexibility over the duration of the agreement. As Murray (2004) also pointed out, the forward rate is only a reflection of current market circumstances and, after the forward contact is negotiated, the hedger cannot pull their business out of a difficult situation once the market has moved (unfavorably) (Kyte, 2002; Homaifar, 2004, p.8).

A forward contract is 'when two sides agree today to buy/sell the foreign exchange at some future date at a price that is agreed on today. The forward currencies trade at a premium or discount relative to their spot rate', which reflects the interest rate differentials (Hughes and MacDonald, 2002, p. 207). The following is a simplified example of a typical forward transaction. Figure A1 provides further insights regarding the mechanism of a forward contract. See Hull (2006, chap. 5) for more information on the determination of forward prices.

Let us suppose that Company B is an Australian company that imports washing machines from Japan. The company had just concluded a negotiation for the sales of 200 washing machines from Company H, a Japanese white goods manufacturer. The contract is for JPY20,000,000 and is signed in June with payment due six months later in December. Since the account is payable in Japanese yen, Company B (the Australian company) is faced with a currency exposure problem. Company B would be very happy if the Australian dollar appreciated against the Japanese yen. Concerns will rise if the Japanese yen becomes stronger against the Australian dollar. In order to manage their currency risk, the company prepared a hedging strategy to minimize the currency exposure to any adverse currency movements. Company B therefore negotiated a forward contract with a nominated bank. The forward contract was contracted on 1st June 2006 with maturities of six months (180 days). That means, the delivery would take place on the 180th day, nothing earlier or later than the 180th day. If the currency movement was in favor of Company B on the 90th day, the company would still have to wait until the 180th day for delivery.

Figure A1: Calculating the Forward Exchange Rate



A forward contract can be considered as a loan of the foreign currency converted to the home currency at the market (spot) rate, with an agreed time at which the loan will be repaid. The final exchange rate will be determined by the current market exchange rate and the differentials in interest rate between the two countries.

Source: Murray, (2004).

Appendix A7.2 Futures Contracts

A currency futures contract is a commitment to buy or sell the currency at a set price on a specified future date. There is no money exchanged when the contract is signed; however, a collateral or deposit of some form is required to ensure that both parties fulfill their commitments to buy and sell the currency at the set price on the specified future date (Solnik and McLeavey, 2004, p.508; ASX, 2005e; ASX, 2005f). This deposit is normally referred to as the margin. The margin is set by clearinghouses, and can be deposited in the form of cash or interest bearing securities. The Australian Stock Exchange (ASX) also accepts certain ASX traded securities and bank guarantees from their approved banks, as eligible margin.

There are two types of margins for each contract (Solnik and McLeavey, 2004, pp.508-509; ASX, 2005e, 2005f). The first type is the initial margin, which is required when the investor first enters a futures contract. In Australia, the Australian Clearing House Pty Ltd (ACH) sets the initial margin for futures contracts traded according to the volatility of the underlying index. The second type is the maintenance margin, which is the amount to be paid by an investor to cover an unfavorable movement in their futures contract. The maintenance margin varies daily. As all futures contracts are marked-to-market, each day the futures contracts are revalued. If the position has moved to become unfavorable since the previous day's closing price, then the investor will be required to pay the differences; if the position has moved to become favorable, then the trader will receive the differential.

We now proceed to discuss the mechanism of futures markets. If the trader expects the currency to *appreciate* in value, then he/she will want to lock in a price at which they can *buy* the currency at price that is lower than the spot rate on the specified future date. To lock in this price, the trader can take a "long" position of the currency. By taking a "long" position, the trader is locking in on the price at which they can buy that currency on the specified future date. If the trader expects the currency to *depreciate* in value, then he/she will want to lock in a price at which they can *sell* the currency on the specified future date. To lock in this price, the trader can take a "short" position of the currency. By taking a "short" position, the trader has locked in the right to sell the currency at a set price on the specified future date (Moffett et al., 2006, pp.175-176).

We now use a simple example to illustrate the mechanism the futures markets. Let us suppose that James is a hedger working for Company C. He believes that the Australian dollar will appreciate in value against the US dollar by December. He could take a long position on the Australian dollar futures. By taking a long position, James locks in the right to buy AUD100,000 at a set price. If the price of the Australian dollar does appreciate by the maturity date as James had expected, then James has a contract to buy the Australian dollar at a price below the spot rate. Hence, he reduces the potential currency losses for Company C. If James believes that the Australian dollar will depreciate in value against the US dollar by December. Then, he could take a short position on the Australian dollar futures. By taking a short position, James locks in the right to sell AUD100,000 at a set price. If the price of the Australian dollar does depreciate by the maturity date as James had expected, then James has a contract to sell the Australian dollar at a price below the spot rate. So, what happens if James' prediction on the movements of the Australian dollar turns out to be inaccurate? James will undoubtedly make a loss in the financial market. However, Company C will also make extra profit from their operating account due to the favorable currency movements. Therefore, because James is a hedger for Company C, the “seesaw” effect of hedging will come into play where one effect will cancel out another. Note that the fundamental condition for the “seesaw” effect to work is for the hedge account to be of equal size to the business account. Needless to say, if James is not a hedger but a speculator, he will not have a business account that can balance off his losses. Therefore, if his prediction (as a speculator) on the currency movements turns out to be inaccurate, he will have no choice but to bear the loss.

Having gone through the mechanism of futures markets, it is worth noting the importance of market makers. Indeed, currency futures markets are operated by these market makers, who can be either individuals or companies, which ‘compete against one another while trading on their own account and at their own risk’. In overseas futures markets, some key market makers include those on the Chicago International Money Market and the London International Financial Futures Exchange. In Australia, according to the ASX, the Australian market makers include Salomon Smith Barney and Timberhill SG Australia. In order to ensure liquidity in the market as well as allow easier trading for fellow futures contracts traders, these market makers are required to provide quotes in the Mini Index Futures contracts listed on ASX (Hallwood and MacDonald, 2000, p.292; ASX, 2005c).

Appendix A7.3 Options Contracts

We can explain an options contract by analogy with a cricket game ticket. The buyer of the game ticket has the right to attend the game, but is not obligated to attend. If the buyer chooses to attend the cricket game, then the seller of the ticket cannot refuse the buyer from attending the game. If the buyer chooses not to attend the cricket game, then he/she can choose to resell to others who wish to attend the game. Whether or not the buyer chooses to attend the cricket game, he/she cannot lose more than what he/she paid for the ticket. Similarly, the options holder cannot lose more than what he/she paid for the options contract (Moffett et al., 2006, p.178; Solnik and McLeavey, 2004, p.542). Hence, we can say that as an options holder, he/she is faced with limited losses. As common knowledge, after the expiry date, any unused game ticket will become worthless. The same logic applies to the options contracts. If the contract holder chooses not to exercise the right, then the options contract will become worthless after the expiry date.

In terms of quotations, a currency options contract may be quoted in two ways. The first way to quote a currency options contract is by the American terms, in which a currency is quoted in terms of the US dollar per unit of foreign currency (PHLX, 2005a). An example of this type of quotation will be 0.7548 US dollar = 1.0021 Australian dollar. The second way to quote a currency options contract is by the European-terms, in which the dollar is quoted in terms of units of foreign currency per dollar (PHLX, 2005a). An example for the second type of quotation will be 1.0021 Australian dollar = 0.7548 US dollars. These quotation methods are used by the Philadelphia Stock Exchange.

There are two major components when pricing options, namely the intrinsic value and the time value of the options (ASX, 2005h; PHLX, 2005a). Intrinsic value of the options contract is simply the difference between the spot price and the strike price. The spot price is the price of the underlying asset at the close of trading day. The strike price is also known as the exercise price; it is the price that must be paid if the options contract is exercised. For a *put options* contract, if the *spot price is below the option strike price*, then this is known as *in-the-money*; if the *spot price is above the option strike price*, then this is known as *out-of-the-money*; the put options contract is *at-the-money* when the spot price is *the same as* the strike price. For a *call options* contract, if the *spot price is below the option strike price*, then we call it *out-of-the-money*; if the *spot price is above the strike price*, then we call it *in-the-money*; if the *spot price and strike price* are *the same*, then we call it *at-the-money*. These concepts are shown in Table A6.

Table A6: Intrinsic Value of the Options Contracts

	Strike Price < Spot Price	**Strike Price = Spot Price**	**Strike Price > Spot Price**
Call Options	In-the-money	At-the-money	Out-of-the-money
Put Options	Out-of-the-money	At-the-money	In-the-money

Source: ASX (2005h).

There are several factors affecting the time value of an options contract: (1) the price of the underlying asset; (2) the exercise price (also known as the strike price); (3) the expiry date (which is the time remaining before options expiry); (4) volatility of the underlying asset; and (5) interest rate (the risk-free rate of return)[16]. The price of the options contract is valued as a function of these factors. It is worth noting that while these features may change during the life of the options contract. In Australia, such adjustment is often required to be made in accordance with the ASX Market Rules (ASX, 2005h).

We now proceed to explain the abovementioned factors that affect the time value of an options contract. The first factor is the price of the underlying asset. The lower the price of the underlying asset, the lower the premium for a call options contract (the higher for a put options contract). The second factor is the exercise price which is also known as the strike price. It is the price at which the option holder has the right to buy or sell the underlying asset. The third factor is the expiry date of the contract. This refers to the date on which the options will expire. As we explained earlier, options contracts are like a cricket game ticket; therefore, if the contract holder chooses not to exercise the options prior to its expiry day, then he/she will lose the right to exercise the options, as the options contract itself no longer has any value after its expiry date. For an exchange traded options contract, the expiry dates are fixed by the options market. The fourth factor is the volatility of the underlying asset. This refers to the tendency of the underlying asset's price to fluctuate. The volatility of the underlying asset reflects the magnitude of a price change (ASX, 2005g). This is a major factor in determining the options' premium. Indeed, the premium of an options contract increases if the volatility of the underlying asset is high; this is because it is more likely for the options to move in-the-money (ASX, 2005g). The fifth factor is the interest rate differential between nations.

[16] See Brailsford and Heaney (1998, pp.680-681), ASX (2005g, 2005h), NYMEX (2005), PHLX (2005a), and Hull (2006) for further explanation on these elements of options pricing.

More specifically, the Philadelphia Stock Exchange explained that this is the difference in the risk-free rate of interest that can be earned by the two currencies (PHLX, 2005a). The value of a call (put) options contract increases with a higher domestic interest rate. This is because by taking a call currency options contract, the contract holder is forgoing the opportunity to benefit from the interest paid on the currency (ASX, 2005g; PHLX, 2005a).

Appendix A7.4 SWAPs

Before we discuss the mechanism of swaps, we need to address the role played by the International Swaps and Derivatives Association (ISDA) in governing the operation of swaps market. The ISDA have pioneered efforts in identifying and reducing risk associated with using swaps. These risks include the risk of default by participants of privately negotiated derivatives. One of ISDA's agendas has always been to prepare standard documentation for use by participants in the over-the-counter derivatives markets (ISDA, 2002, 2003, 2006). The most recognized standard documentation is the ISDA Master Agreements. In September 1990, the Australian Financial Markets Association (AFMA) published a guide to use the 1987 ISDA Master Agreements under the Australian law. As the 1987 Agreements have been reviewed and reintroduced as the 1992 ISDA Master Agreements, the guide has also been updated to incorporate new developments of derivative products. This guide ensures that the swaps transactions are enforceable under Australian law.

Having gone through a brief background on the governing authority for swaps markets participants, we now proceed to discuss the definition and mechanism of swaps. The ISDA defined a basic swap as 'a transaction in which one party pays periodic amounts of a given currency based on a floating rate and the other party pays periodic amounts of the same currency based on another floating rate, with both rates reset periodically; all calculations are based on a notional amount of the given currency' (ISDA, 2002, p.9). Moreover, a currency swap is defined as 'a transaction in which one party pays fixed periodic amount of one currency and the other party pays fixed periodic amount of another currency. Payments are calculated on a notional amount. Such swaps may involve initial and/or final payments that correspond to the notional amount[17] (ISDA, 2002, p.10). In simpler terms, we can explain swaps as contracts that involve two parties that agree to periodically exchange cash flow.

A swap transaction resembles a back-to-back loan. The main difference between these two transactions is that a back-to-back loan involves two separate loans whereas a swap transaction involves only a single contract. In back-to-back loans, each party lends money to the other party for the same initial amount, but in different currencies and at the respective local market interest rate. A back-to-back loan is recorded in a company's balance sheet. In swaps, the transactions are not recorded in the company's balance sheet as a liability, but as a financial derivatives transaction. Typically, a currency swap requires two different companies to borrow funds in the market and currencies they are most familiar with. For instance, a Japanese company will borrow Japanese yen from its home market; and a US company will borrow US dollars from its home market. Each party in the swaps transaction is known as a "leg" (Solnik and McLeavey, 2004, p.528).

We mentioned that swaps are privately negotiated agreements between two parties. However, to set up a swap, companies typically go through a swap dealer. These swap dealers then act as the middleman, providing swap rate quotes and finding a matching arrangement for the company. In these, as in all

[17] These definitions given by the association has been widely adopted by authors such as Hughes and MacDonald (2002), Kyte (2002), Moffett et al. (2006), Solnik and McLeavey (2004), Homaifar (2004), and Hull (2006).

exchanges, the swap dealers handle both sides of the transactions, so each side of the swap arrangement sees the dealer as their counterparty. The risk of default in swaps transactions can be considered as minimal (if not minimal, still acceptable) since the swaps markets are dominated by major banks worldwide (Hughes and MacDonald, 2002, p.211; Kyte, 2002; Moffett et al, 2006, p.381; Homaifar, 2004, p.203).

A swap transaction in the "inter-bank" market is the simultaneous purchase and sale of a given amount of foreign exchange for two different value dates (Hughes and MacDonald, 2002, p.211; Kyte, 2002). Both purchase and sale are conducted with the same counterparty. A common type of swap is a "spot against forward". The dealer buys a currency in the spot market and simultaneously sells the same amount back to the same bank in the forward market. Since this is executed as a single transaction with counterparty, the dealer incurs no unexpected foreign exchange risk. Swap transactions and outright forwards combined made up 57% of all foreign exchange market activity in April 2001.

Appendix A7.5 Money Markets

We now proceed with the mechanism of hedging using money markets. The money market and forward market are identical because interest rate parity holds. So hedging in the money market is like hedging in the forward market. A money market hedge also includes a contract and a source of funds to fulfill the contract. Those hedgers who use money market hedges borrow in one currency and convert the borrowing into another currency. To illustrate this idea, let us use the following simple example.

Let us suppose that Company D is a Japanese company that imports wines from Australia. The company had just concluded a negotiation for the sales of 2000 bottles of wines from Company M, an Australian winery. The contract is for AUD50,000. The contract is signed in June with payment due six months later in December. Since the account is payable in Australian dollars, Company D (the Japanese company) is faced with a currency exposure problem. Company D would be very happy if the Japanese yen appreciated against the Australian dollar. Concerns will rise if the Japanese yen weakens or the Australian dollar strengthens. In order to manage their currency risk, the company prepared a hedging strategy to minimize the currency exposure due to any adverse currency movements. Company D therefore enters into an opposite position in the money market. In order to implement this money market hedge, Company D can either use excess cash or borrow cash from a bank to buy Australian dollars.

Let us suppose, again, that Company D chooses to borrow Japanese yen in Japan and immediately converts the borrowed Japanese yen into Australian dollars, and repays the Japanese yen loan in six months with the proceeds from their sale. Company D will need to borrow just enough to repay both the principal and interest with the sale proceeds. Let us suppose again that the borrowing interest rate in Japan is set at 2% per annum, or 1% for six months, and the interest rate in Australia is set at 6% per annum, or 3% for six months. We also assume that the spot rate, denoted by $S = \left(\frac{JPY}{AUD}\right)$ is assumed to be equal to 80.76, that is, one Australian dollar exchanges for 80.76 Japanese yen in the spot market. The amount to borrow for repayment in six months can be calculated as:

$$\frac{AUD50{,}000}{1 + r_{Australia}} \times \frac{JPY}{AUD} = \frac{AUD50{,}000}{1 + 0.03} \times 80.76 = JPY3{,}920{,}388.35$$

(see column 1 in Table A7).

Table A7: Hedging in Money Markets with Unfavorable Currency Movements

Hedging Account in Money Market						
JPY				JPY	Profit/Loss from	
3,920,388.35	→	1.00%	→	3,959,592.23	money market	
Borrowing					JPY	AUD
↑				$ 4,920,000.00	$ 960,407.77	$ 9,760.24
	spot currency movement					
80.76	→			98.40		
↑				↑		
AUD				AUD		
$ 48,543.69	←	3.00%	←	$ 50,000.00		
Business Transaction Account						
Source of funding					Profit/Loss from	
JPY					business account	
4,038,000.00						
	spot currency movement					AUD
80.76	→			98.40		$ 41,036.59

Source: Author's calculations.

Therefore, to ensure that the company's AUD50,000 account payable is free from any adverse currency movement that may occur six months later, Company D has to borrow JPY3,920,388.35 from the Japanese Bank and covert the borrowed amount into AUD48,543.69 at the exchange rate of 80.76JPY/AUD.

Company D then invests the amount (AUD48,543.69) in the Australian money market where it earns 6% per annum or 3% for six months. In this case, when the account payable is due in December, the amount of funds available in the hedging account for Company D would include principal plus interest earned from the Australian money market, which is $AUD48{,}543.69 * 1.03 = AUD50{,}000$. When the contract is due in December, Company D will need to transfer this amount of AUD50,000 into Japanese yen at the spot rate to repay the Japanese yen principal of JPY3,920,388.35 plus interest of 2% per annum (1% for six months). Depending on the exchange rate when the transfer happens, Company D will yield profit or loss from their hedging account using the money market. If the Japanese yen is weaker against the Australian dollar in December, say, the exchange rate is 98.40JPY/AUD, then Company D will gain from this hedging exercise. As shown in column 5, 6, and 7 of Table A7, when $\frac{JPY}{AUD} = 98.40$, $AUD50{,}000 \times 98.40 \frac{JPY}{AUD} = JPY4{,}920{,}000$. After deducting the principal and interest payable to the Japanese Bank, which is equals to JPY3,959,592.23, the total profit generated from this hedging exercise is calculated as:

$JPY4{,}920{,}000 - JYP3{,}959{,}592.23 = JPY960{,}407.77$, or

$$\frac{(JPY4{,}920{,}000 - JYP3{,}959{,}592.23)}{98.40} = AUD9{,}760.24 .$$

We mentioned earlier that a money market hedge includes a contract and a source of funds to fulfill the contract. In this case, we make a reasonable assumption that Company D has prepared an amount to pay off the AUD50,000 account payable to their Australian wine supplier. The source of funding is from their business operation (see ‘Business Transaction Account’ in Table A7). Therefore, the amount is in Japanese yen. With the exchange rate of 80.76JPY/AUD, this amount comes to JPY4,038,000 (refer to column 1 of Table A7).

If the Japanese yen is weaker against the Australian dollar in December, say, the exchange rate is 98.40JPY/AUD, Company D will lose from this business account. Instead of $\frac{JPY4{,}038{,}000}{80.76} = AUD50{,}000$, the fund becomes $\frac{JPY4{,}038{,}000}{98.40} = AUD41{,}036.59$. There is a currency movement loss of AUD8,963.41 for Company D’s business transaction account. We illustrated earlier that the hedging account using the money market can yield profit of AUD9,760.24 when the exchange rate changes from 80.76JPY/AUD to 98.40JPY/AUD in December. Therefore, even though Company D has experienced an adverse currency movement, the company is protected from losses, as they can use the profit generated from the money market hedge to balance off the losses experienced in their business transaction account.

Let us also consider the hypothesis in which the Japanese yen has become stronger against the Australian dollar. Let us suppose that the exchange rate changes from 80.76JPY/AUD to 74.23JPY/AUD. This is a favorable currency movement for the business account of Company D. As presented in Table A8, Company D would incur a loss of AUD3,342.21 in their hedging account using the money market, while gaining a profit of AUD4,398.49 in their business transaction account. If this hypothesis realizes, Company D will not be able to take advantage of the favorable currency movement. In fact, due to the seesaw effect, Company D will have to use the profit from the business transaction account to cover the loss from their hedging account.

Table A8: Hedging in Money Markets with Favorable Currency Movements

Hedging Account in Money Market						
JPY				**JPY**	**Profit/Loss from**	
3,920,388.35	→	1.00%	→	**3,959,592.23**	**money market**	
Borrowing					**JPY**	**AUD**
↑				$ 3,711,500.00	-$ 248,092.23	-$ 3,342.21
	spot currency movement					
80.76	→			74.23		
↑				↑		
AUD				**AUD**		
$ 48,543.69	←	3.00%	←	**$ 50,000.00**		
Business Transaction Account						
Source of funding					**Profit/Loss from**	
JPY					**business account**	
4,038,000.00						
	spot currency movement					**AUD**
80.76	→			74.23		$ 54,398.49

Source: Author’s calculations.

Appendix A8 Parity Relationships

In this section, we include a brief discussion on the four parity relationships that form the basis for a simple model of the international monetary environment.

Appendix A8.1 Interest Rate Parity (IRP)

The interest rate differential holds the key to explaining exchange rate movements in the short term. According to the interest rate parity (IRP) theory, a discrepancy between the forward and spot rate of a currency is due to the differentiation between interest rates in two countries. Interest arbitrage creates short-term movement in the flow of money, and the forward rate discount/premium eventually brings the currencies back to equilibrium (Eng et al., 1998, p.101; Kim and Kim, 2006, p.133). For instance, let us suppose that the Australian nominal interest rate is currently set at 5.5% and the US at 4.75%. Under the IRP model, the capital flow will cause an inflow of US dollars into Australia because investors are seeking a higher return on investment (ROI). In order to prevent the occurrence of the so-called covered interest arbitrage (CIA), the difference of forward rate in these two currencies would include the difference in interest rate. Nevertheless, while the IRP theory states that discrepancies between interest rates in the two countries can cause exchange rate movement, it is sometimes very difficult to clearly determinate the causality of such movement in reality[18].

[18] This is a shared view by the Reserve Bank of Australia, as well as by numerous scholars, including Conway and Franulovich (2002), Davis (2004), Mannino and Milani (1992), and Rankin (2004).

Appendix A8.2 Purchasing Power Parity (PPP)

Purchasing power parity (PPP) theory provides a system for the determination of the exchange rate. According to this theory, the exchanged value of a unit of currency should be able to purchase the same quantity of goods/services regardless of where (which country) the transaction takes place (Eng et al., 1998, p.99; Kim and Kim, 2006, p.129). Hence, when there is a differentiation in inflation rate between two countries, the exchange rate will adjust, providing an equilibrium exchange rate that satisfies the PPP[19]. Evidence from studies undertaken by the Reserve Bank of Australia has indicated that, indeed, when the inflation rate in Australia is higher than its trading partners, the Australian dollar tends to depreciate over time. However, as identified by many researchers, such an effect does not take place immediately but with a lag. This lag masks the true reliability of the PPP in explaining the exchange rate trends. Antonopoulos (1999), Henry and Olekalns (2002) and Cheung and Chinn (2001) are just some of those empirical analysis that questioned the validity of the PPP in explaining exchange rate movements.

Appendix A8.3 Fisher Effect

The Fisher effect, named after the economist Irving Fisher, states that while the inflation rate can be used as an indicator for the future direction of a nation's currency, the inflation rate itself could be predicted by comparing the interest rates among the countries (Eng et al., 1998, p.100; Mishkin and Simon, 1995). In Australia, the Reserve Bank of Australia has identified that inflation and the Australian dollar are inversely related to each other. When the inflation

[19] See Sarno and Taylor (2002), Mannino and Milani (1992), Kim and Sheen (2002), Davis (2004), and Conway and Franulovich (2002) for more explanation.

rate is higher than that of its trading partners, the Australian dollar tends to depreciate, stimulating export activities. This preserves global competitiveness by compensated for the high inflation rate. There is no evidence of a short-term Fisher effect as changes in the interest rate affect the system with a lag. However, in the long run, a change in interest rates indicates inflationary expectation (Rankin, 2004; Mishkin and Simon, 1995).

Appendix A8.4 International Fisher Effect (IFE)

The international Fisher effect (IFE) suggests that an interest rate differential between two countries results in a trend for the exchange rates to move in the opposite directions (Eng et al., 1998, p.101; Kim and Kim, 2006, p.132). For instance, when comparing Australia and the United States, a higher interest rate in Australia will result in the long-term appreciation of the US dollar. More importantly, the international Fisher effect also recognises that in the short-term, countries with higher interest rates (in this case, Australia) will experience an appreciation in their currency. A higher interest rate tends to attract foreign capital inflow into the country, resulting in the appreciation of the currency. This short-term effect has also been noted by the Reserve Bank of Australia with evidence referenced to the upward movement of the Australian dollar in 1998 immediately after the announcement of an increase in interest rates (Rankin, 2004). Again, this is a crucial consideration in the short run which differentiates from the international Fisher effect.

Appendix 9 Government Intervention

Appendix 9.1 Direct Intervention (Sterilized and Non-Sterilized)

In a direct intervention, the Reserve Bank of Australia tries to influence the exchange rate by buying or selling the Australian dollar. For instance, if the Reserve Bank of Australia wanted to improve the value of Australian dollar, it would sell foreign exchange and buy Australian dollars, or vice-versa. Intervention itself has implications for the domestic money market because there would be a fall in the banking system money market. If the Reserve Bank of Australia takes no further action, the money market would be short of cash and the interest rate would tend to rise (Kearns and Rigobon, 2002; Rankin, 2004). This is an example of non-sterilized intervention.

In simpler terms, non-sterilized intervention occurs when the central bank affects nominal exchange rates by changing monetary supply and domestic interest rates (Kearns and Rigobon, 2002; Rankin, 2004; Edison et al., 2003). These authors agree that this method is more effective than sterilized intervention.

According to Edison et al. (2003), sterilized intervention is where the central bank 'takes action to offset the effects of a change in official foreign assets on the domestic monetary base, leaving interest rates unchanged' (pg. 3). In sterilized intervention, the Reserve Bank of Australia alters the currency composition of domestic and foreign assets through two channels: (1) 'portfolio balance channel, where a change in the reserve holdings of the central bank induces private agents to revalue their portfolios of domestic and foreign assets; and (2) the signaling channel, where the central bank uses foreign exchange operation to signal forthcoming changes in monetary policy' (Edison et al., 2003, p. 3).

An example of sterilized intervention by the Reserve Bank of Australia happened in 2004. At the start of 2004, we saw the Australian dollar overshooting (by appreciation). The RBA therefore intended to intervene in the foreign currency market, however, it needed to also consider the circumstances in the property market (housing prices), which, according the Australian Financial Review, had fallen by 7.5% in Sydney and 12.9% in Melbourne during the March quarter. The central bank increased the interest rate sequentially, causing a shortage of money. By sequentially increasing the interest rates, the RBA's 'sterilized intervention' devalued the Australian dollar to alignment it with monetary policy, yet minimize the implications of such action (Tyndall, 2004).

In terms of the effectiveness of these direct interventions by central banks, we found there has been a division of opinion within existing literature on government intervention. Having said that, it is important to note that regardless of the mechanism (sterilized or non-sterilized intervention), the action taken by the RBA should be consistent with current monetary policy, as the public money (cash) market related to the interest rate can be sensitive and critical towards changes in the monetary policy (Macfarlane, 1993; Kearns and Rigobon, 2002; Rankin, 2004).

Appendix 9.2 Indirect Intervention

The Reserve Bank of Australia can affect the Australian dollar's value by indirectly influencing any of the factors that determine its exchange rate. For instance, to boost the Australian dollar, the RBA could raise interest rates because higher interest rates tend to attract foreign capital inflow, which raises the demand for the Australian dollar and the subsequent value appreciation. Other factors that influence the value of the Australian dollar include: inflation, size of foreign debt, size of current account deficit or surplus and monetary policy. If government monetary authorities targeted any of these factors, there would be an indirect effect on the value of the Australian dollar[20].

[20] See Blundell-Wignall et al (1993), Karfakis and Kim (1995), Kearns and Rigobon (2002), and Rankin (2004).

Appendix B

For model simulation, we use data of the spot Japanese yen exchange rate against US dollars from 2001 to 2005. We take natural logs of the spot rate on a daily basis (please refer to Table B2 for details of daily spot exchange rate) as shown in the following Table B1 to obtain annual variance, which is a measure of the annual volatility of spot rate.

The daily variance has been converted to annual variance using the formula:

(B1.1) $$\tilde{V} = \frac{V}{t} = \frac{V}{1/250} = V * 250$$

Table B1: The calculation of annual variance

Year	Average	Daily Variance	Annual variance
2001	121.51	0.000763	0.190677
2002	125.14	0.001897	0.474251
2003	115.84	0.001537	0.384203
2004	108.10	0.000637	0.159226
2005	110.15	0.002007	0.501850
01' - 05'	116.14	0.004473	**0.342041**

Source: Author’s calculations.

Since this is just a sample variance, we have calculated an estimation of the population variance (σ^2). This provides a range for the true population variance based on our sample. To apply the formula of population variance (σ^2), we choose the 99.5% of significance level within 5 years of the Japanese yen spot rate for US dollars based on the formula (B1.2) below:

(B1.2) $$\frac{(n-1)\tilde{V}}{X^2_{n-1,\alpha/2}} < \sigma^2 < \frac{(n-1)\tilde{V}}{X^2_{n-1,1-\alpha/2}}$$

We substitute n = 5 and $\tilde{V}$ = 0.342041, along with $X^2_{.005,4}$ = 14.860 and $X^2_{.995,4}$ = 0.207, obtained from Chi Square Table, into the equation (B1.2).

We get:

$$\frac{4(0.342041)^2}{14.860} < \sigma^2 < \frac{4(0.342041)^2}{0.207}, \text{ or}$$

$$0.031492 < \sigma^2 < 2.260716$$

This gives the range to which the population variance lies given the sample data, and a 99.5% confidence interval of α .

Appendix C

As we mentioned in section 3.2 in Chapter 3, if the cost function is linear in *K*, then the *K* optimum will involve a corner solution that is illustrated as below:

However, if cost function is linear in *K*, for example,

(3.2') $$c(\delta KV) = \frac{1}{2}\delta VK$$

The expected net profit denominated in Japanese yen *π* becomes:

(3.7a) $$\Pi = KV[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] - \frac{1}{2}\delta VK$$

The investor will choose *K* in order to maximize *π,* then the first order condition becomes the following situations:

1. $\frac{\partial \Pi}{\partial K} = V[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] - \frac{1}{2}\delta VK \quad > 0$,

when $V[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] > \frac{1}{2}\delta VK$, in this case, the investor would buy as many contracts as he/she can afford, that is, the optimal *K* is infinity.

2. $\frac{\partial \Pi}{\partial K} = V[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] - \frac{1}{2}\delta VK \quad < 0$,

when $V[(r_{us} - r_J) + (1 + r_{US})E(\dot{S})] < \frac{1}{2}\delta VK$, in this case, no contract will be opened, the optimal contract *K* is zero.