

Application of Option Price Model in Mining Industry Merge & Acquisition

by

Chris Xiao

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Approved: Dr. Michael Zhang  
Supervisor  
Department of Finance, Computing  
and Information Systems, and  
Management Science

Approved: Dr. Jenny Chen  
External Examiner  
Rowe School of Business  
Dalhousie University

Approved: Dr. Hai Wang  
Supervisory Committee Member  
Department of Finance, Computing  
and Information Systems, and  
Management Science

Approved: Dr. Adel Merabet  
Supervisory Committee Member  
Division of Engineering

Approved: Dr. Robert Dawson  
Graduate Studies Representative

Date: April 16, 2014

## Abstract

### Case Study: The Application of Option Price Model in Mining Firm M&A

Chu (Chris) Xiao

April 16, 2014

The traditional discounted cash flow valuation (DCF) has many limitations. In order to compensate for some of those limitations, real option valuations (ROV) have been widely accepted and applied. The popularity of ROV is partly related to its ability to analyze flexibility and uncertainties within various industries. We focused on the mining industry, explored the conditions that enable ROV to outperform DCF, and proposed that under certain conditions, ROV may more accurately reflect the market value of a mining firm. We reviewed the current developments of DCF and ROV models and apply both methods to a real Mergers and Acquisitions (M&A) case - Barrick Gold, a very representative mining firm. By comparing DCF and ROV, we discussed the benefits of ROV in mining industry and the premium of the acquirer's offer price. In addition, pertinent concepts were identified and explored to enhance the understanding of business issues arisen in M&A.

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## Chapter 1 Introduction

While there are many methods available to estimate the value of a mining firm, each method has its strengths and shortcomings. In this thesis, we will focus on the comparison between traditional Discounted Cash Flow (DCF) and the Real Option Value (ROV) method, and applied these two methods in a real Mergers and acquisition case – the acquisition of two mining firms. We show ROV is an enhanced approach to addressing valuation idiosyncrasies within the mining industry, we purported that ROV is a valuable tool in ongoing valuations within the mining industry.

### 1.1 Motivation, Relevance, and Contribution

Emerging markets within the mining industry has sparked strong demand and an increase in mergers and acquisitions activity; this creates great interest in determining the value of a target firm. The bidding price is an important indicator of the valuation of target firm by acquirer. However, the determination of bidding price is a challenge since there are many models to determine the market value. In addition, the premium determination complicates the mergers and acquisitions (M&As) decisions. In this study, we will focus on 1) how to determine the target's value by using the two most common models, explore the conditions that enable ROV to outperform DCF; 2) We also discuss the factors that affect price premium during M&A.

In the financial world of today, M&As take an increasingly important role in creating both financial and operating synergy (Fluck and Lynch 1999). Operating synergy allows firms to expand their operating capacity, more efficient or more competitive in the market; it normally falls into three categories:

1. Economies of scale
2. Competition and higher market share
3. Functional strengths

Financial synergy generally can either allow firms to increase their cash flow or to reduce the cost of capital. It provides:

1. Combined cash flow
2. Increased debt capacity
3. Tax benefits

On April 2, 2011, US coal mining firm Walter Energy acquired all outstanding shares of Western coal. The day before the announcement was made to the public, Walter Energy paid C\$11.5 per share at a 56% premium on the top of market value of Western Coal's closing price. The cost of the acquisition was 3.3 billion which was the largest mining merger and acquisition of 2011. Executives within the firm believed that this growth strategy would increase the production by 60%. Joe Leonard, then interim Chief Executive Officer of Walter Energy, said "the combined production capacity and geographic footprint leaves us extremely well positioned to benefit from favorable sector dynamics driven by increased steel production in markets such as China, India and Brazil." The president of Western Coal also believed the offer was fair and expected the future upside by 14% of the combined company.

In this example, the CEO of Walter Energy suggested the main purpose of the deal was to create operating synergy, because the production capacity is expected to be better utilized through multiple geographic areas after the merger. Some other strategic M&As are aiming to create better financial performance for shareholders, either to generate a bigger amount of revenue, or reduce significant cost. This type of mergers is to create financial synergy. We also noticed the bidding price is comprised the value of the firm (market share price) and the premium that the acquirer wished to pay on top of its market value.

Despite extensive research and development (R&D), the determinants of bidding price remain unclear (Edmister and Walking 1985, Wansley 1989, Fowler and Schmidt 2006) mainly due to uncertainties and assumptions. What is acknowledged is that the bidding price is comprised of valuation and premium. In this study, we discussed one element of M&A – corporate valuation, and applied to the mining industry using a case study

approach. This analysis is relevant given that existing studies are centered on valuating an individual mineral project or property/reserve. Thus, we considered the mining firm as whole by considering both its physical assets (reserve, capacity, etc) and the managerial flexibility which can more effectively adapt investment decisions, including timing and scale, to real time market conditions as opposed to preset assumptions and goals. The interest in mining industry is related to potential economic and financial impact of the industry. The Toronto Stock Exchange (TSX) that suggested 58% of the world's public mining companies (over 1400 in total) have listed on TSX and TSX venture exchange. The mining industry is a key contributor to the economic growth of Canada. After the global recession, despite the high market volatility, the total value of deals reached 162 billion more than 2600 M&A deals in which Canadian buyers were involved in 30%, and the gold companies were most targeted.

M&As are often motivated by the potential for added value. In this thesis, we focused on how to perform a more accurate fiscal assessment within the context of M&A and explored a firm's uncertainties, risks, and flexibilities. Corporate finance theories and models have been developed and used in corporate valuations over the years. In current practices, the most common and fundamental methods are: Income based valuation (Discounted Cash Flow Model (DCF), Real Option Valuation (ROV)), Market based method (comparable method), and Cost based method (appraised value).

Approach	Definition	Method
Income based valuation	Determine the value of a business based on its ability to generate desired economic benefit	Discounted Cash flow Method
		Real option valuation
		Earnings multiple
Market based valuation	Establish the business value in comparison to other similar businesses	Comparable method
Cost based valuation	Determine the business value based on the fair market value of its assets less its liabilities	Appraised value

Table 1: Common Valuation Methods

Discounted Cash Flow Model (DCF) is the most traditional and fundamental method by discounting all the projected future cash flow to the present; however, it does have limitations within valuations of multi-step investment opportunities. (Myers (1984); Luehrman (1995)). Option based valuation theories and methods are becoming increasingly popular due to the flexible nature. This method provides an option instead of an obligation for corporate investment decision makers. Market based method (comparables method) assumes the average value of the comparable firms is the fair market value. By using this method, the firm is compared with other similar firms in terms of industry, size, revenue, etc. Cost based method (appraised value) appraises a firm by its cost which would occur if it were replaced by another asset at the present time.

## 1.2 General Discussion of Mining Industry



Before we start to discuss the valuation methods which are applied in mining industry, it is important to identify some characteristics of the mining industry that are important considerations when evaluating a mining firm:

- Mining is a finite business that exploits largely non-renewable natural resources; each reserve contains a limited amount of ore. The lifespan of a mine typically occurs in four stages: 1. Exploration stage, the gold deposit is initially discovered. 2. Development stage, this normally lasts for many years, the company performs research and feasibility study on the deposit. 3. Production stage, the company can successfully and consistently produce gold from the mine. 4. Closing stage, after years of mining, both the production and quality of the gold decline. The company may eventually choose to close it down permanently.
- Mining firms are associated high risks, such as geological risks on exploration properties, and legal/political risks. Governments impose royalty to the gold miners whose competitiveness will be to a great extent impacted by the rate. Also it's a must for gold miners to be in line with the local governmental laws and regulations on the pollution. With the increasing awareness of environment protection, it is expected to see more strict regulations.
- Mining companies have high fixed cost due to the necessary and costly exploration and development stages. In these two stages, a great amount of capital needs to be invested with an unforeseen outcome. In addition, new mining technology, responsibilities to occupational health and safety, building a favorable public persona, and adhering to environmental and governmental standards are associated costs that result in higher costs.

In Chapter 2, we provide a detailed review of ROV and discuss the applicability of ROV to Mining industries. By comparing DCF with ROV and analyzing the unique characteristics of the mining industry, we will determine:

- The method which can more accurately reflects the real value of a firm in terms of future uncertainties and flexibilities
- Though an extensive literature review, establish effective valuation approaches for investment decision making

- Explore contributing factors to the acquirer's offer premium, given that most firms pay a significant amount of premium when they acquire another firm.

### 1.3 Structure & Outline

The remainder of this thesis will be arranged as following:

Chapter 2, we will discuss two basic income based valuation models based on the literatures: Discounted Cash Flow (DCF) model and Real Option Pricing (ROV) model including their theories, advantages and limitations.

Chapter 3, an overview of mining industry and an analysis on our candidate firm - Barrick Gold Corporation will be provided. The analysis comprises the introduction of the firm, the accounting/finance performance before the date they announce to acquire Equinox and other relevant information.

Chapter 4, we will apply option pricing model Margrabe's exchange option model and DCF to appraise one candidate firm- Barrick Gold Corporation, and extract its hidden managerial information.

Chapter 5, we will analyze other the effects such as competition, information sharing and bargaining power on premiums in M&A activities in mining industry. This study will prove the value appraised by real option is closer to the "real" value of the firm. The difference between the appraisal and the deal price – premium will be discussed and analyzed.

Chapter 6, we will conclude the entire thesis and point out the future researches.

## Chapter 2 Literature review

Mergers and acquisition (M&A) is a proven corporate strategy has been evaluated and applied since the inception of corporations. In the modern financial world, M&A takes an increasingly important role. In this literature review, we will focus on valuation methods in M&A. Corporate finance theories and methods have been developed and used in corporate valuations that include the discounted cash flow, market based or relative valuation, asset oriented, replacement cost and real options (DePamphilis, 2009). Our study will be focusing on discounted cash flow model and option pricing model. The latter approach has been applied in valuating R&D projects, investment opportunities and other areas for more than 20 years. This literature review is structured into two sections:

- 2.1 provides a comprehensive background to mergers and acquisitions
- 2.2 explores valuation methods including
  - Discounted Cash Flow including its theories, applications and limitations.
  - Real Option including its theories, applications and limitations.

### 2.1 M&A Background

Mergers and Acquisition is one type of corporate actions which involves buying or selling to combine two entities together. In the figure below, the trend of M&A activities is observed based on the series of time.

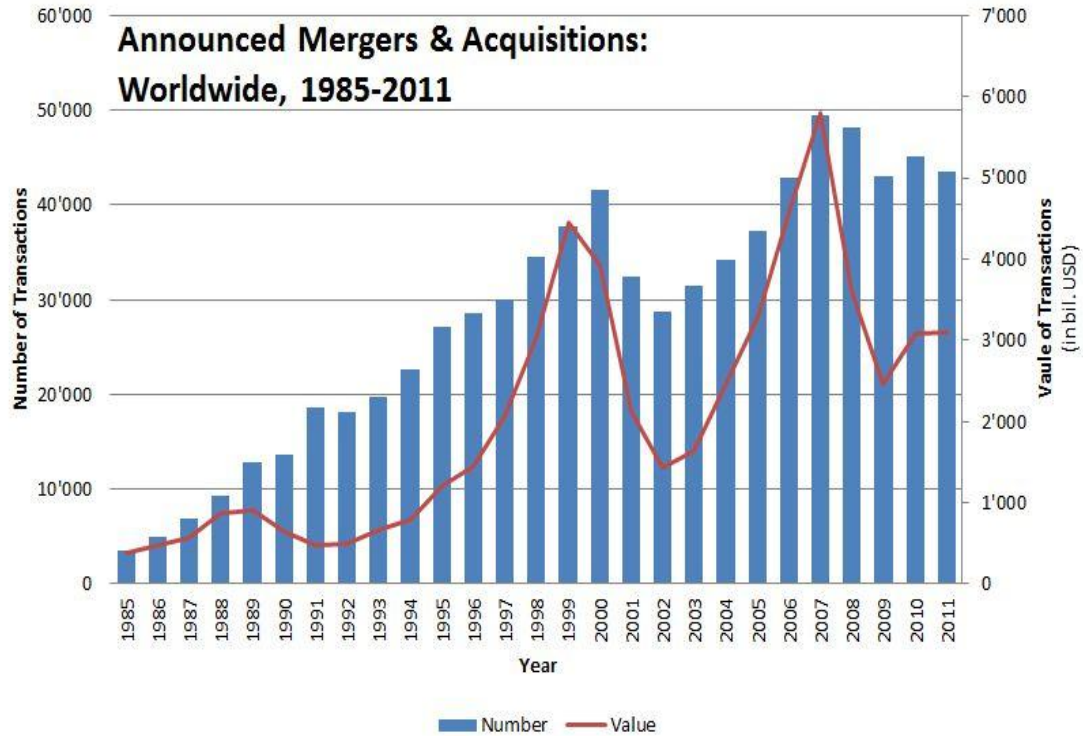


Figure 1 M&A trend, Source: <http://www.ima-institute.org>

This graph shows several trends, including a large upswing in the 1980s and again another upswing after the internet crash in the early 2000s. These trends may exist for several reasons including: regulation impact, level of interest rates/inflation, and economic confidence. In the graph below, business confidence in the United States plummeted in the late 1970s for many of these reasons.

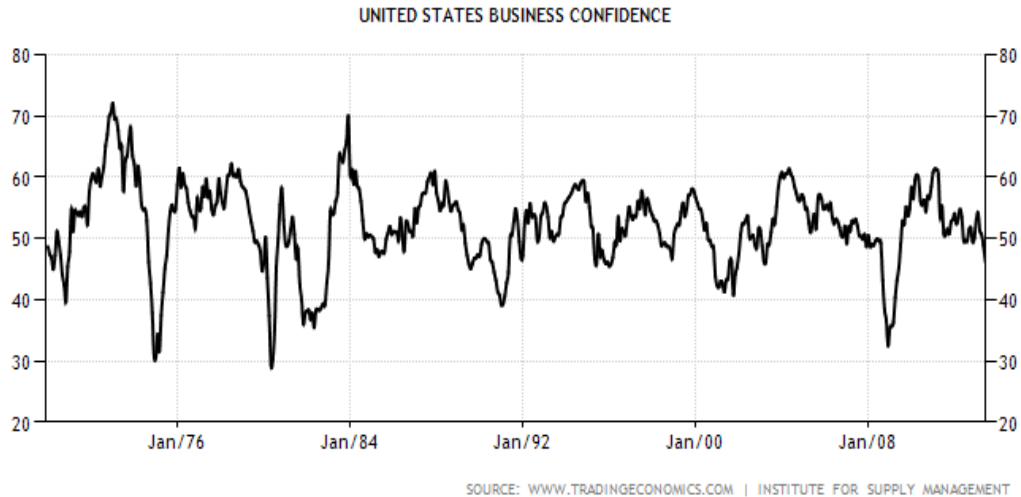


Figure 2 US business confidence, Source: [www.tradingeconomics.com](http://www.tradingeconomics.com)

In the early 1980s governments were much more regulatory and restrictive. Also, inflation was high, and the economic environment was not conducive for large scale transactions. The 1980s saw the rise of President Ronald Reagan and “Reaganomics”, an economic policy put forth by the president that was based on lower marginal tax rates and deregulation in many industries (conditions that heavily favor economic activity). Inflation also began to slow in the 1980s and, as a result, these factors seem to give a reason as to why mergers and acquisitions would increase in this time. As shown below, Interest rates also fell dramatically during this period which would likely make borrowing easier, increasing the likelihood of mergers, including leveraged buyouts (which were incredibly popular during this time period as evidenced by the rise of Michael Milken and Drexel-Burnham).

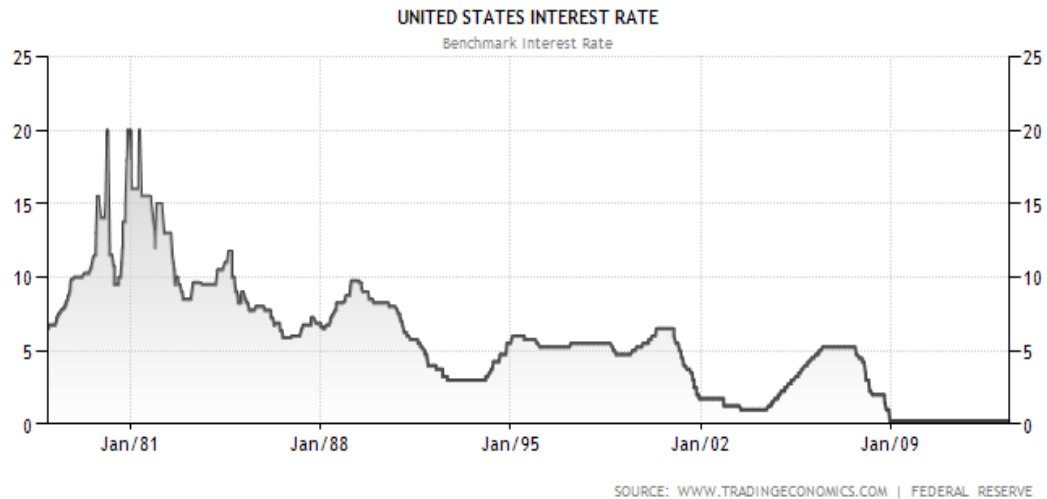


Figure 3 US interest rate, Source: [www.tradingeconomics.com](http://www.tradingeconomics.com)

The rise during the 1990s was largely based on the internet boom. The era is famous for small start-up companies building up their companies and then either selling off to technology giants or cashing in via an IPO. The bubble burst in the early 2000s caused activity to slow down significantly.

The rise in the 2000s can be attributed to a spike in economic confidence largely driven by the housing boom. Interest rates were still at modest levels so borrowing was still plentiful which allowed deals to continue to occur. The crash in 2008 caused this activity to slow significantly. A spike after this time could be attributed to large, stable companies purchasing undervalued companies that had depressed share prices due to the market crash. However; over time, the potential for merger burnout may increase if only a limited number of worthy companies remain for purchase.

The motivations for companies engaging acquisitions and mergers have been widely investigated. In the early works, M&A is believed the primary objective to control assets (Freidheim, 1998). The purpose of firms pursuing M&A are including increasing economy of scale, entering a new market, acquiring a critical resource or a new technology (Blonigen & Taylor, 2003). Empirical studies suggest synergies are creating shareholder's wealth (DeLong 2003), DePamphilis concludes in his book the M&A

create financial synergy and operating synergy (DePamphilis, 2009). Thus, valuating the target firm is integral to M&A and further supports the relevance of this thesis.

## 2.2 CORPORATE VALUATIONS

Corporate valuations have been extensively studied in past decades. The accumulated research has theoretical and practical implications that will impact on daily operational activities of companies. In this chapter, we will review the relevant theories and methodologies which are applied in this thesis.

### 2.2.1 Discounted Cash Flow

Discounted cash flow (DCF) model reflects the present value of all estimated future cash flow within predetermined budgetary periods and possible continuing value. These cash flows include: operational expenses, sales income, and dividends. The future cash flow are discounted by the discount factor incorporating adjusted risk factor. DCF can be written as below:

$$DPV = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \dots + \frac{CF_n}{(1+r)^n}$$

Where:

DPV, discounted present value

$CF_i$ , the expected cash flow in period  $i$

$r$ , constant discount rate

The discounted cash flow (DCF) model has evolved over last 60 years and is essentially used to estimate the company's value in terms of time value. Time value is assumed as a passage of time goes by, there should be a given amount of interest or inflation incurred.

John Williams, in 1930, first articulated the theory of DCF in his book “The Theory of Investment Value”. Gordon (1959) added the divided element to the DCF model. The major assumption of this model was the concept of a constant growth rate. Gordon’s assumptions were later challenged by several researchers given that no investment grows at a constant rate. Geykdajy (1981) provided empirical work on the cost of equity on a sample of 55 domestic and 55 multinational companies from the top 500 fortune list. Rappaport (1988, 1998), Stewart (1991), Hackel and Livnat (1992) and Fama and French (1988, 2001) extended and developed the model to estimate the value of a firm (Arumuga, 2007). Baker & Powell (1999) believe the dividend policy affects firm value from examining 198 US firms on the NYSE, however, also they later pointed out most companies prefer not to pay dividends.

In corporate valuation, discounted cash flow model is also called the Net Present Value (NPV) model which is the present value of future cash inflows of an investment or project minus the present and any associated future cash outflow. The NPV is widely used to appraise a project or investment. If the NPV arrives greater than or equal to zero, then theoretically the project or investment should be implemented; if the NPV is less than zero, the project should be discarded. Armitage (2007) incorporated financing related determinants of value including taxes, transactions costs, disclosure, information asymmetry, and agency problems into the discounted cash flow model. The author concluded that individual factor can effect project future cash flows, cost of capital, and upfront adjustment to the present value. Most researchers and practitioners have realized the presence of flexibilities and uncertainties associated with main variables of NPV analysis, such as discount rate, and discount period. Thus, a tool to analyze uncertainties must be utilized. A literature review by Carmichael and Balatbat (2008) examined probabilistic discounted cash flow analysis of capital projects from 1960s to 2008. They listed the main assumptions on probability distribution, independence, and correlation. According to their study introducing the notion of feasibility, namely probability of an investment, the results of various approaches can be aligned.

### Discounted Rate



Capital asset pricing model (CAPM) is widely utilized to calculate the required rate of return; it models a linear relationship between the expected return and the systematic risk of a portfolio.

Capital asset pricing model (CAPM) was introduced by Sharpe (1964), it's widely accepted to calculate the required rate of return; it models a linear relationship between the expected return and the systematic risk of a portfolio.

CAPM assumptions include:

- All the investors are risk averse
- Risk free investments exist, such as government bonds
- The return on assets is normally distributed, 4) the market is perfect and information symmetrical. CAPM can be written as below:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

$E(R_i)$  is the expected return on the risky asset

$R_f$  is the risk-free rate

$\beta_i$  is the sensitivity of risk premium to expected riskless assets

Fama and French(2004) argued the theory of CAPM model is powerful tool, but it has limited practical application. However, the CAPM model would be difficult to prove using empirics, because different investors may have different risk premium in their mind. Daniel, Hirshleifer and Subrahmanyam (2001) noted that expected return are linearly related to both risk and mispricing measure and is due to the biased shareholders' expectation in the stock market. Their findings include the  $\beta$  can still be used to predict future return even though investors' misvaluation could occur because of the joint effect of risk and mispricing in the model. Their model challenged CAPM based financial behaviour. French and Laura (2005) incorporated uncertainty into an explicit DCF model by recognizing that the uncertain input variables and their pertaining probability

distribution to analyze the real estates. The CAPM model is primarily used in stock exchange valuation in a regulated market.

Weighted Average Cost of Capital (WACC) is valuating the capital structure calculating the minimal rate of return an investment should earn to pay all its creditors.

$$WACC = \frac{\sum_{i=1}^N r_i \cdot MV_i}{\sum_{i=1}^N MV_i}$$

Where:

- $r_i$  is the required rate of return of security  $i$
- $MV_i$  is the market value of security  $i$

Petry (1975) conducted a study using 284 firms from an array of industries including: wealth management, industrial, retail, utility, and transportation. His main findings were:

- Firms tend to maintain a particular capital structure
- Each industry has its own optimal structure
- The management should have 5-6 years capital budgeting period.

Miller (2009) argued that the cash flow discounted WACC is inadequate to cover the payback when considering all the individual source of financing separately. Miller (2009) argued the net cash flow discounted by WACC is insufficient to provide the cash flows to the individual sources of financing when they are considered separately. Miller's claims sparked boisterous debate among scholars and in the response to his paper, Stephen et al (2012) argued that WACC was redundant if interest is not tax deductible, and required rate of return on unlevered equity was more reliable.

### 2.2.2 Application of DCF

DCF is the most popular method to valueate a project, an investment or a whole company in many industries because of its simplicity. In the mining industry, DCF is used to

estimate the differing metals, complexities, and life span, of various reserves. Also, DCF is useful valuating mining infrastructural projects. The usefulness and versatility of DCF has been documented by several authors as outlined below.

Kaplan and Ruback (1995) used discounted cash flow technique to examine 124 management buyouts. Their study suggested that DCF is able to provide a reliable estimation of market value of the examined firms. Their sample included companies in a variety of industries. Because risk premia are positively and significantly related to the industry beta, they used CAPM based approach to calculate the discount rate. In our thesis, we used a similar technique known as the Adjusted Present Value Technique, which is an extension of DCF, to value cash flows.

French and Laura (2005) incorporated uncertainty into an explicit DCF model by recognizing that the uncertain input variables and their use of probability distribution to analyze the real estates. Ikromov and Yavas (2012) conducted an experimental study in the real estate industry by using discounted cash flow method. They argued the assets with more volatile cash flow, the value will be lower.

### 2.2.3 Limitations of DCF

Myers (1984) pointed out the gap between financial theories and strategy management which is further distorted by differences in languages and cultures. Discounted Cash Flow analysis may be misused in managerial practice, and even if it's properly applied, the business strategy still may fail.

Paddock et al (1988) conducted a case study on offshore petroleum leases and discovered that DCF has five major weaknesses in valuating mining industry:

1. the choice of time of DCF is not transparent
2. the different assessments of future cash distribution may lead to divergent valuations
3. DCF is very sensitive to the discount rate chosen.
4. DCF especially Monte Carlo application is complex and costly

5. The geological assessments and cost distribution may also cause large discrepancies

Trigeorgis (1993) argued DCF is not able to respond to unexpected market developments. Since the actual market is full of change and uncertainty, the strategic NPV should equal static NPV (expected cash flow) plus the value of managerial options.

### 2.3 Real Options

Option is a financial instrument which provides the owner a fixed price to trade an underlying common stock at a future date. The fixed price is called strike price, the future date is called expiration date. A European option requires the owner to exercise the option on the expiration date only. An American option gives the right for the owner to exercise the option any time before or on the given date. A call option is to give the right to buy the stock; on the other hand, a put option is to give the right to sell the shares. By introducing financial option methodology to analyze project investment, we call this approach Real Option Valuation (ROV). ROV is widely applied to different industries, because decision makers realize the importance of strategic considerations and used to value investments. Dixit and Pindyck (1994) stated that investments have three characters 1) somewhat irreversible, 2) uncertain over the future reward from the investment, and 3) some leeway about the timing of the investment. The real option theories provide a convenient way of analyzing a broad range of investment timing and option. Kautt (2003) believed the available forecasting tool cannot help the probability of certain outcomes, especially with the advent of the stochastic process. Real option model provides a framework for decision makers for making more informed decisions. Real option has developed both theoretically and practically over past decades, it challenges the traditional valuation techniques, and is generally believed a more cutting edge decision making tool.

Trigeorgis (1993) categorized the common real option into option to defer, time to build option, option to expand, option to abandon, option to switch, growth option and interacting options. Quigg (1993) is the first to document an empirical testing of real option pricing model. She suggested that the option premium is the difference between

the intrinsic value and the option model value, divided by the option model value. She used a continuous time model to test 2700 land transactions, and she found the market price reflected a premium of option to delay. Based on Trigeorgis's option category, Slater, Reddy and Zwirlein (1998) applied a complementary technique which combined discounted cash flow and real option to dynamically value the investment opportunity and the strategy making process. They found traditional DCF complementing real option analysis can provide more realistic and border view of investment decisions. Morellec and Schürhoff (2010) developed a model to test the value of option under asymmetric information. They argued if the firm has positive private information which will signal the outside investors, then the value of option to delay will be significantly decreasing, that means a big portion of the value of an option is to reflect to uncertainties. In our study, we also show that real option approach enhances DCF to incorporate future flexibilities and risks.

### 2.3.1 Black – Scholes model (BSM)

The theoretical models of the option pricing model have greatly developed since Merton and Scholes received the Nobel Prize in Economics in 1997. The Black–Scholes model is the most prominent option pricing model and built upon the existing work of Black and Merton model. Merton (1973) showed the value of a call option is an increasing function of rate of interest and time to maturity. The Black - Scholes model is a mathematical model used as a financial pricing instrument (Black & Scholes 1973). They show a positive function between the variance of the risky asset and the price of the option and is described in the following formula:

$$C(S, t) = N(d_1) S - N(d_2) K e^{-r(T-t)}$$

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T - t)}{\sigma\sqrt{T - t}}$$

$$d_2 = \frac{\ln\left(\frac{S}{K}\right) + \left(r - \frac{\sigma^2}{2}\right)(T - t)}{\sigma\sqrt{T - t}} = d_1 - \sigma\sqrt{T - t}.$$

Where:

- S, be the price of the underlying asset
- C(S,t) the price of a European call option .
- K, the strike price
- r, risk free interest
- $\sigma$ , the volatility of the stock's returns;
- T-t, expiration time in years;

### 2.3.2 Margrabe's Exchange Option

Margrabe (1978) developed the European-type option to exchange one asset for correlated another. This option is based on Black-Scholes model, the assumptions of his theory is very similar to Black-Scholes as well. The following formula is Margrabe's Exchange Option:

$$C(T) = S_1 N(d_1) - S_2 N(d_2)$$

$$d_1 = \frac{(\ln(S_1/S_2) + 0.5 \sigma^2 T)}{\sigma \sqrt{T}}$$

$$d_2 = d_1 - \sigma \sqrt{T}$$

Where:

- $S_1$  = the asset that is exchanged for another, Barrick Gold
- $S_2$  = the acquired asset, Equinox

- $T$  = Time to exchange

The main differences between Margrabe's exchange model and Black-Scholes model include:

- 1) Margrabe's formula takes the volatilities of both assets into the calculation.
- 2) As a special case of BSM, the interest on the asset two is zero, because asset two's return over the period is equal to the compensation for the investment.
- 3) In BSM, the exercise price is known, but the exercise is unable to spot in an exchange option.

Stulz (1982) provided and proved the European call option on minimum of two assets by borrowing Margrabe's result if the exercise price is equal to zero, and he argues the maximum of the option price will be reached if the correlation of the two assets is equal to one. McDonald and Siegel (1985) develop Margrabe's exchange option to model the option to shut down. They assume the future prices and costs follow an infinite stochastic process, and they also extend the existing model by introducing dividends. Carr (1988) developed Margrabe's model to a general American style option which is more suitable for realistic situations. Morellec and Zhdanov (2005) bases on Margrabe's develops a framework which is determined by both timing and competition of imperfect information in an M&A.

### 2.3.3 Application of Real Option

The real option valuation has increasingly become popular; it widely applied in the areas such as R&D, real estate, and natural resources

#### R&D

Kellogg, Charnes and Demirer (1999) studied the application of real option in a biotechnology firm. They divided an entire project into several stages, and argued that based on the information given in different stages, more specific assumptions should be

utilized. The valuation methods used in their study include decision tree, Influence-Diagram and Binomial-Lattice

Villani (2008) used the exchange option model with game theory to value the R&D development cost using limited information. His model captured the value of uncertainty, but the model can be improved by using American exchange option model to decide the optimal time to invest.

### Real Estate

Lucius (2001) conducted a study on the application of real option theory in real estate development. He believed that real option is able to offer a more flexible decision making process. Again, although Lucius' work further supported the theoretical validity of real option theory, the practical application of the theory requires further research.

Chiang et al (2006) used Quigg's (1993) option model to study on the land auctions and property transactions in Hong Kong. Their empirical study provided evidence that the option based pricing model had a more accurate valuation on the lands/properties, and the option premiums are positively related to the volatilities which are consistent with Quigg's study.

### Natural Resources

Kemma (1993) conducted three case studies within the Shell group that included: a timing option in the offshore industry, a growth option in the manufacturing industry, and an abandonment option in the refinery industry. The study was aimed to use option pricing theory in budgeting decisions. She argues the option theory is able to quantify the flexibility. Davis (1996) argued the option premium can only explain approximately half of the observed gap between DCF value and market value, and adds nearly three percent to a mineral asset's gross worth.

Slade (2001) valued managerial flexibility using a real option in mining industry. He compared two models stationary model (Mean Reverting process) and nonstationary



model (Geometric Brownian motion process) by the presence and absence of managerial flexibility.

Sebehela (2010) valued a gold firm by using option pricing theory and determined that the target firm was undervalued by the acquirer. The rationale of using this particular valuation process explained the reason the offer is rejected in a context of M&A.

#### 2.3.4 Limitation of Real Option

Lander and Pinches (1998) discussed three issues when implementing real option models:

1. The types of models currently used are not well known or understood by corporate managers and practitioners
2. The required modeling assumptions are often violated in a practical real option application
3. The necessary additional assumptions required for mathematical tractability limit the scope of applicability

Bowman and Moskowitz (2001) highlighted some limitations of using the real option. They believed that the usefulness of a real options approach to quantitative decision making depends on the extent to which the characteristics of the investment proposal being evaluated match the assumptions of the option valuation model being used. The authors also suggested that the effective use of a quantitative model to value a potential strategic investment is limited by the need to calculate the model's inputs. Within this thesis, we suggest that real option models have much more complicated mathematic process and yet another reason that many firms may still prefer DCF.

#### 2.4 Premiums

In this section we review literature on how to decide price premium in M&A. Laamanen (2007) defined premium as an overpayment that consumes the expected synergies over the performance that would need to be achieved in order even to sustain an acquired

firm's market value. A very important issue in the study of mergers and acquisitions is what factors contribute to the size of the premiums. Haunschild (1994) studied 453 acquisitions and developed her hypotheses and suggested that decision makers will confer with interlock partners and professional firms to decide on the premium. Investment banks have the same premium model across the firms they know and different models for the firms they don't have relationship with. Laamanen (2007) argued that the sizes of premium vary by industry and that higher premia are paid in acquiring technology intensive firms. Sudarsanam and Sorwar (2010) used Black-Scholes option pricing model to explain the takeover premium. They found that longer offer periods and hostile offers require higher valued puts from the bidder because of increased complexity and uncertainty. They also suggested that the premium is highly correlated with the relative riskiness of bidders and targets. Alexandridis et al (2012) argued that there's a negative relation between the offer premium and the target size, which means the acquirers are likely to pay less to buy big firms. Given the importance of considering premium within the context of valuation three main characteristics of premium including; competition, information sharing and bargaining power, are defined below.

#### 2.4.1 Competition

The value of competition has been extract from the development of negotiation process. In the early studies, there were only two players in a negotiation (Rubinstein (1982)), now it's been extended to multiple players. Flanagan and Shaughnessy (2001) studied relationship between multiple bidders and premiums paid. The authors used 285 tender offers for manufacturing firms from 1986 to 1995, a direct relationship between multiple bidders and the tender offer premiums was indicated. The authors proposed that tender offer premiums are higher when multiple bidders are present. Rhodes-Kropf and Viswanathan (2004) argued that the more competing firms provide more information and increase the accuracy of the target. However, there is a limit that the acquirers can learn from the competing bids. Intuitively, the market dynamic has a significant impact on the valuation of a firm. Spiedel and Tookes (2011) are the pioneers who developed the first testable model between market competition and firm valuation under a setting of dynamic

oligopoly. This empirical study strongly suggested that the model-implied calculation, which explicitly incorporates competition, can enrich the valuation analyses. In the modern microeconomic theory, the competition is distinguished between perfect competition and imperfect competition.

#### 2.4.2 Information Sharing

Perfect competition assumes players own the perfect information, vice versa. Most of the studies of value of information sharing are done in the setting of auctions which is very similar as mergers and acquisitions. Langohr and Eckbo (1989) conducted an empirical study to compare corporate takeovers in France before and after 1970. This comparison was made because in 1970 disclosure rules were introduced. They found a significant increase in the average premium over the target share price from 34% to 73% following the disclosure regulation. Hong and Shum (2003) developed a framework of English auction. In the multiple levels model, players gain more information during the course of the auction. The private information becomes common knowledge. They showed on every new stage, the new private information significantly increases the probability of winning bid. Banal-Estanol (2007) analyzed the effects of private information on horizontal mergers. Firms always have more incentives to merge, when the private information about the uncertainty is obtained. Potentially, the party with more information is likely to take advantage of the counter party who is lack of information.

#### 2.4.3 Bargaining Power

Extensive research has been done in the area of negotiation and bargaining power. One of the most influential models is Rubinstein bargaining model (Rubinstein, 1982). The model assumes two players make alternative offers through an infinite time horizon. The assumptions of this model include: 1) complete information, 2) unlimited offers and 3) delays are costly. There is very little literature focusing on how the buyer and the target firm divide the total gain from a merger (Ahern, 2011), firms having more scarce assets are predicted to capture a larger share of total gain. Ahern (2011) used market to book

ratio to define a firms' bargaining power. There is even more limited evidence exploring how bargaining power will effect on a bidder's premium under M&As. Walking and Edmister (1985) examined 158 cash tender offers, they found there's a negative function between the bid premium and the bargaining power of the bidder.

In the next chapter, we will discuss mining industry and candidate firms.

## Chapter 3 Analysis of Candidate Firms and M&A Challenges

### 3.1 Overview of mining M&A

2011 was an economically turbulent year. Global uncertainty and volatility were sparked by the increasing demand of commodities from both developed nations and emerging markets, the mining sector demonstrated strong growth plans to seize opportunities. The annual report from Ernst & Young indicated total M&A deals in mining industry value were up 43% from the prior year to \$162.4b, volumes were down 10%

Although evidence does indicate moderate growth within the mining industry, there are risks to the industry that continually and consistently challenge miners. Ernst & Young (2011), suggest specific challenges to the mining industry include:

- 1 Resource Nationalism
- 2 Skills shortage
- 3 Infrastructure access
- 4 Cost Inflation
- 5 Capital Project Execution
- 6 Maintaining a Social License to Operate
- 7 Price and Currency Volatility
- 8 Capital Management and Access
- 9 Sharing the Benefits
- 10 Fraud and Corruption

Valuation is a core element in the process of mergers and acquisitions. The mining industry relies on finite resources; thus, valuation should be more dynamic than the traditional approaches. Once the deposit becomes depleted, it will not be able to generate any future cash flows. Due to the particular business risks of mining industry as per Ernst & Young, they add more complexities into the mining business valuation.

### 3.2 Mining M&A in Canada

Canada is extremely rich in natural resources, such as oil, forestry, as well as metals. The mining industry is a main contributor to Canada's economy and employs over 300,000 people. Investors have recognized the value in Canada's rich resources. Based on the report from Price Waterhouse Cooper (2011), 25% global mining acquisitions took place in Canada making Canada the most targeted country by volume. Strategic investors around the world seek to fund Canadian junior mining firms; therefore, the capital significantly rose in TSX. And also Canadian buyers together with Australian and American dominated the global mining M&A. The stable investment environment along with the abundant natural resources established Canada as the global mining center. The largest deal in 2011 was AuRico Gold Inc., the Canadian miner that bought Northgate Minerals Corp. for \$1.5 billion. AuRico seeks to expand geographically to maximize its growth opportunities.

As the worldwide competition for valued assets intensifies, continued consolidations in mining industry are expected. A number of key trends driving the M&As in mining include:

- Rising cost pressures, even with the strong commodity performance, the rising cost has a huge impact on the margins. More M&As driven by achieving the economics of scale are expected
- Scarcity of new resources, with the increasing trend of resource nationalism, is causing exploration of new hallenging. This motivates mining firms to merge or acquire another firm to gain quality assets; and M&As is a cheaper route to production than starting a project from scratch.
- Financing difficulty, the global financial crisis has changed the mentality of investors'. Especially, the junior mining firms have increasing difficulties to finance their business through equity market. This inevitably means they have to seek other strategic options – mergers and acquisitions

### 3.3 Barrick Gold

We chose Barrick Gold as our case study because it is the largest gold mining company in the world and it is a Canadian firm based in Toronto. Since Barrick is the leader in this industry, it is very representative, and used as operational or financial benchmarks by other mining firms. By investigating numerous aspects in M&A for this particular case, we can gain understanding of many important business issues in 1) determining the firm value by applying the proper valuation model; 2) understanding the factors which have impacts on the bidding premium. In this section, we will extensively study the gold mining company – Barrick Gold, and its acquisition of Equinox which was settled in 2011. First of all, we conduct a SWOT (Strength, Weakness, Opportunity and Threat) to analyze both financial and operational performance and to position the company in the industry illustrated in table 2.

<b>Barrick Gold SWOT analysis</b>	
<b>Strength</b>	<b>Weakness</b>
<b>Strong financial position</b>	Decreasing production and profit
<b>Diversified and significant reserve</b>	Rising liability
<b>Opportunity</b>	<b>Threats</b>
<b>Strong demand for gold</b>	Skill shortage
<b>Strategic acquisition</b>	Pure-play gold company

Table 2: Barrick Gold SWOT analysis

#### 3.3.1 Strengths

Barrick Gold, founded in 1983, is now the industry leader with the largest gold production, gold reserve, and market capitalization. It operates globally and has projects across the world. Barrick has a strong market position and financial position. The increase in the cost of gold in 2010 facilitated an improved strong balance sheet at Barrick Gold at the end of 2010. The revenue had a growth rate of 35% and the adjusted earnings per share reached 3.32 which was 66% more than the prior year. During the recovery period in 2011, Barrick Gold recorded its most profitable year ever; the adjusted net earnings rose 33%, combining with the Company's positive forecasting of the gold price, and translating to a return on equity of 22%. Adjusted operating cash flow rose 8%.

Barrick is the only gold mining company that has an "A" rating balance sheet. The sufficient cash flow allows the company to have the capacity to finance its new developments such as mergers whenever opportunities emerge. A strong market status reflects the company's strengthening market position with an efficient cost structure.

Figure 4 shows financial trends



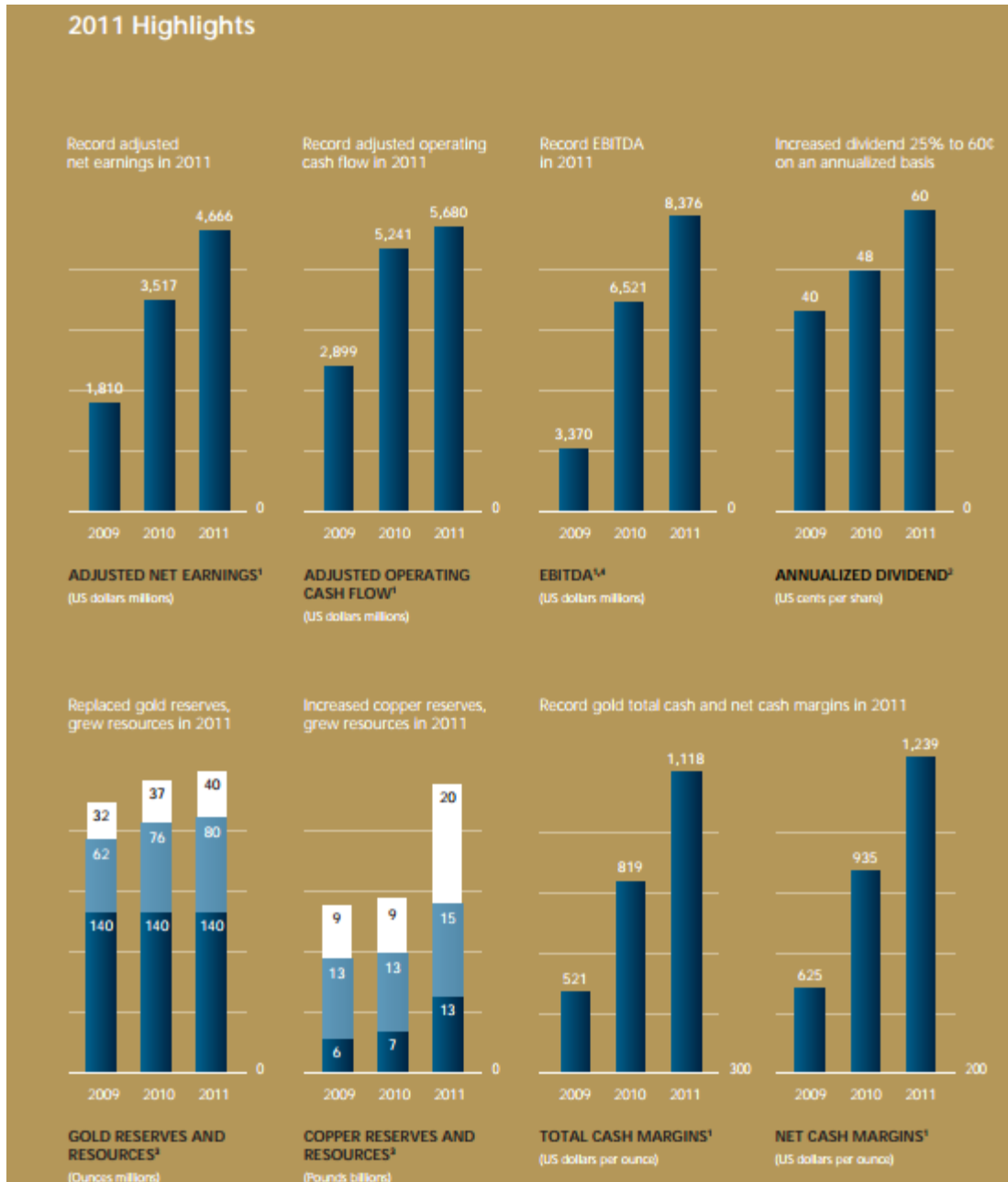


Figure 4 Barrick Gold key financial data. Source: Barrick.com annual report 2011

### Diversified and Significant Reserve

Barrick targets on increasing reserves and resources; it has the largest gold reserves and a geographically diverse portfolio. It operates 27 mines around the world. At end of Dec 12, 2001, Barrick had 140.2 million ounces of gold which were proven and probable. On

the other hand, the company tirelessly focuses on cost-effective strategies. The Cortez mine in Nevada, which is owned by Barrick Gold, produced gold at \$245 per ounce. This was one of the largest low cost gold mines in the world. Due to its strong balance sheet and adequate free cash, Barrick was able to invest in some high return projects, such as Pueblo Viejo mine. Those projects are targeted to the highest quality production and low cash cost.

### 3.3.2 Weaknesses

#### Decreasing production and profit

Like other gold companies, many of Barrick's older mines, such as Eskay Creek and Goldstrike Open Pit, are nearing exhaustion and as operating costs increase, production is diminishes. Due to the lower-grade ore processed; ultimately, Barrick's revenue will be negatively affected. Barrick needs continuous exploring new reserves which are associated with huge cost and high possibility of failure.

#### Rising liability

A key component deterring the risk of a company is its debt; the total liability (including current and non-current) has reached 23,330 million.

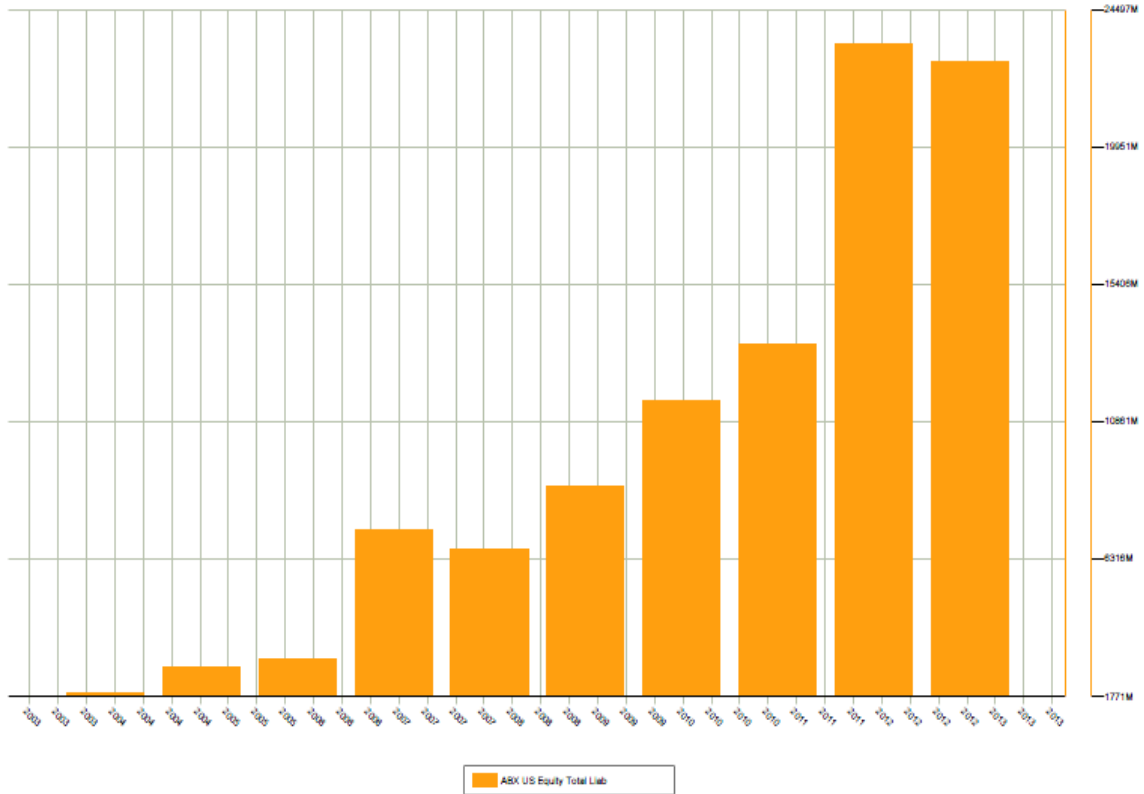


Figure 5 Barrick Gold lawsuits. Source: Barrick.com

There are a number of pending lawsuits against Barrick. Those claims include violation of environmental laws, local labour laws, and bribery of government officials. All those contingent liability involves a significant amount of loss in near future.

### 3.3.3 Opportunities

#### Strong demand for gold

Gold as a precious metal is often used as an inflation hedge against the currency. As the inflation increases, so does the demand for gold. The gold miners have been taking advantage of the increasing gold price. According to Bloomberg Gold spot historical diagram (figure 6) below, the gold price almost doubled from 2009 to 2011.



Figure 6 Gold spot historical diagram. Source: Bloomberg terminal

Due to the strong price gain on gold during the financial crisis, we saw a strong earning on its income statement. Price Waterhouse Cooper projected in 2012, that 80% of gold executives expect the price of gold to continue to climb in the current economic year.

### Strategic Acquisition

Precious metal producers lower the production cost and sell as much future metal as possible when the prices of precious metal are in stagnation. However, they will often lose future opportunities when the prices are rise dramatically. The base metal provides a natural hedge which may attract more gold sales, therefore, Barrick, as the largest gold producer, adds base metals into its portfolio. Mergers and acquisition help strengthen the competitive and edge of Barrick Gold and is reflected in its vision that states: to be the world's best gold company by finding, acquiring, developing and producing quality reserves in a safe, profitable and socially responsible manner. The African copper belt has been producing significant amount of copper each year. Most of the copper in trade came from copper belt before Chile became the dominant copper exporter. Equinox Minerals Ltd. has its key assets in the copper belt – Lumwana, a subsidiary of Equinox, holds 4.5 billion pounds of copper reserve. The increasing expense of deposit discovery has caused

large mining firms strategy by acquiring junior mining firms. However, growth by acquisition is considered riskier than does grow internally.

### 3.3.4 Threats

#### Skill shortage

According to Top 10 *Barriers to Canadian Competitiveness* published by Canadian Chamber 2013, the biggest challenge in mining sector is the labour skills shortage. Ernst & Young (2011) also identified that issues surrounding sustainable development of mining firms, especially Barrick Gold which is the largest gold miner in the world, still exist. The fast changing technology needs transforming the traditional works to highly educated and skilled professionals, such as geologists, metallurgists and information technology scientist.

#### Pure-play gold company

Even though Barrick's global diversified reserve relieved the certain systematic risks such as the political risks, natural disaster, and some of undiversifiable risk, such as supply chain interruptions, and currency fluctuations. Barrick gold is highly reliant on gold production. The volatility of gold price will heavily impact on the stability of earnings. However, most risk neutral investors would not welcome Barrick Gold having a significant portion in its portfolio. Balanced portfolio of gold and other metal assets is to hedge the risk of pure play gold miners.

### 3.4 Bidding wars

As the competition of acquiring quality assets in the mining industry persists, firms may need to pay a significant amount of premium to succeed in acquisition. Figure 7 is our observation prior to the acquisition of Equinox by Barrick:

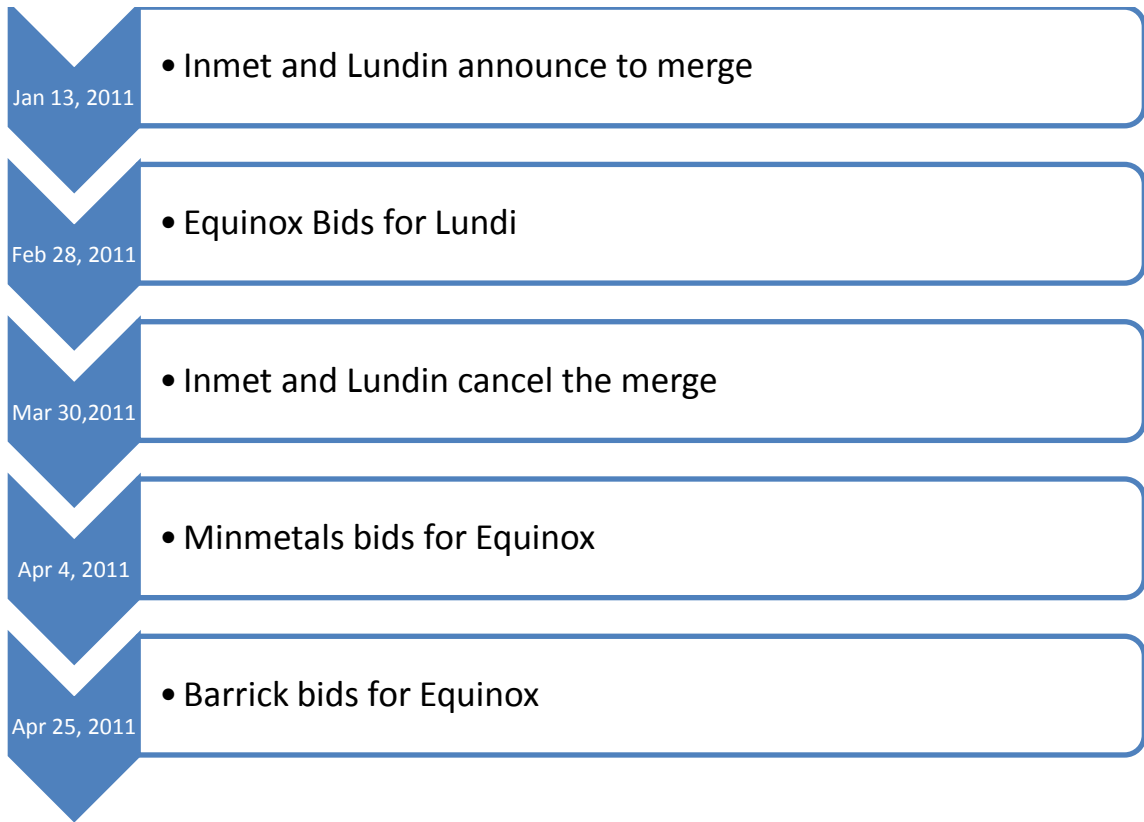


Figure 7 Relevant Mergers and Acquisitions

	<b>Lundin Mining Corp</b>	<b>Inmet Mining Corp</b>	<b>Equinox Minerals Limited</b>
<b>Market capitalization ( in billions)</b>	3.7	4.1	4.4
<b>Annual copper production 2011 (in kt)</b>	108	94	145
<b>Other products</b>	Zinc, Lead	Zinc	N/A
<b>Geographic focus</b>	Europe, Africa	Europe	Africa
<b>Key growth projects</b>	Tenke Fungurume	Cobre Panama	Lumwana, Jabal Sayid

Table 3: comparison of three mining firms: Lundin, Inmet and Equinox

On January 13, 2011, Canadian miners Lundin Mining Corp and Inmet Mining Corp agreed to merge and create a new company, to be named Symterra Corp. Based on the agreement, the two companies will exchange shares. Each Inmet shareholder received 3.49 shares of Symterra, and each Lundin shareholder received 0.33 shares of Symterra. The total value of the transaction is approximately C\$9 billion. According to Inmet's official publication, the merger targeted 1) low cost and long life mines, 2) generation of robust cash flow, financing for future growth, and 3) diversification of metal productions by adding zinc and other base metals in the existing portfolio (see table 3 for brief description for the three firms).

On February 28, 2011, Equinox Minerals Limited (TSX and ASX: EQN) announced an offer to acquire all outstanding shares of Lundin for approximately C\$4.8 billion in given in a combination of cash and shares. Each Lundin shareholder could choose to receive Lundin share of either C\$8.10 in cash or 1.2903 Equinox shares plus \$0.01 per share. According to Equinox President and Chief Executive Officer, Craig Williams, "the combined company will deliver significant value to its shareholders through its superior leverage to near-term strength in copper prices and strong growth profile". However, the deal was conditional, dependent on if Lundin dropped the deal with Inmet. On March 30, 2011, Lundin and Inmet mutually agreed to terminate their merging deal. Equinox was part of the reason of the breakup; most analysts believed the main reason was that the government of Panama forced the company to drop its plans to build a coal-fueled power station for its Cobre Panama project. Both companies stipulated that Lundin was to still pay Inmet \$120 million breakup fee if Lundin accepted Equinox's offer. However, Lundin later rejected Equinox's offer, because Lundin believed rival unsolicited takeover bid of 4.8 billion was too low.

On April 4, 2011, Minmetals Resources Limited made an unsolicited offer of about C\$6.3 billion in cash for Equinox which was the largest unsolicited takeover attempt by a Chinese mining firm. Minmetals's offer reflected a 23% premium to the prior day's

closing price. The purpose of the offer was to try to gain control of Africa's largest copper mine. According to Andrew Michelmore, Chief Executive Officer of Minmetals, the deal perfectly fit into the key areas they wanted to grow: "extending our mine life, expanding our portfolio of regions, and leveraging on our management and technical expertise to extract value". This deal was subject to Equinox dropping its offer for Lundin.

On April 25, 2011, Barrick Gold (NYSE: ABX) (TSX: ABX) announced its acquisition of Equinox Minerals Limited. The friendly takeover offer was all-cash deal at C\$8.15 per share for all the outstanding shares of Equinox. The offer was a 30% premium based on the prior closing price of Equinox on the Toronto Stock Exchange. It was 17% more than the average share price of Equinox over the past 20 days of trading, and also 16% more than the proposal from another mining company Minmetals Resources. Barrick utilized its sufficient cash to fund the acquisition. The acquisition was in line with Barrick's long term development strategy which was to increase gold and copper reserves. One day after Barrick's offer, Minmetals withdrew its offer by claiming that entering a bidding war would not be beneficial for its shareholders.

Equinox is an international mining company with its primary operation being the Lumwana copper mine in Zambia. The company's other development activities include the Lumwana uranium project, base metal exploration in Zambia, sulphide nickel in Australia and the iron oxide copper gold in Peru. The income by origin (Lumwana, Zambia only) for the period ending by 2009 and 2010 are showing below (in Mln USD),



For the period ending	12/31/2010	%	12/31/2009	%
<b>Revenue by Origin (Total)</b>	912.99	100	454.37	100
<b>Africa</b>	912.99		454.37	
<b>Zambia</b>	912.99		454.37	
<b>Lumwana Mine - Copper</b>	942.43	103.22	468.48	103.11
<b>Royalties Tax</b>	-29.43		-14.11	
<b>Net Income</b>	269.11	100	-183.06	
<b>Africa</b>	314.12		-172.06	
<b>Zambia</b>	314.12		-172.06	
<b>Lumwana Project</b>	312.73	101.54	-173.55	100.86
<b>Exploration</b>	1.39	0.45	1.48	-0.86

Table 4 Equinox income by origins 2009-2010

Table 5 shows the total revenue of two companies before the merger, the data was obtained through Bloomberg terminal.

Table 5 Revenues

Revenue	2010	2011	
Product Line	Equinox	Barrick	Combined
<b>Gold Mining</b>		12,131.72	12,131.72
<b>Copper Mining</b>	940.48	1,695.65	2,636.14
<b>Exploration &amp; Production</b>		175.11	175.11
<b>Other Metals</b>		156.31	156.31

The historical prices of Barrick Gold and Equinox were obtained from Bloomberg. The daily closing prices since January 2011 were used. In total there are 327 trading days (total sample size 327). We measure the volatilities of the two securities in a relation to the market – S&P500 index which has been widely accepted as the benchmarks for the

overall US stock market. The regression analysis and summary table are presented as below in Table 6.

Table 6 Variables

<b>Range:</b>		<b>01/01/2010 to 4/24/2011</b>	
<b>Relative index</b>	S&P500 index		
	Barrick Gold	Equinox Mineral	
<b>Sample size</b>		327	327
<b>Volatility <math>\sigma</math></b>		0.919	2.305
<b>Intercept</b>		0.946	0.109
<b>Correlation <math>\rho</math></b>		0.409	0.524
<b><math>\rho^2</math> change the font</b>		0.167	0.274
<b>Std Dev of Error</b>		1.638	2.994
<b>Std Dev of <math>\sigma</math></b>		0.114	0.208
<b>t-test</b>		8.083	11.087

This table/regression shows individual characteristics of Barrick Gold and Equinox, as well as the predictive power of the two companies in relation to a broad market index (the S&P 500). The above results suggest that the Equinox regression has more statistically significant results (as indicated by a higher t-score). This further validates the results of the regression. Equinox has shown to possess a higher coefficient of determination ( $\rho^2$ ) which indicated that the change in its price explains more of the change in the S&P 500 movement than does Barrick Gold (a coefficient of determination of 0.274 basically tells us that the price change for Equinox Mineral explains 27.4% of a 100% price change for the S&P 500). Equinox also appeared to have a higher dispersion of returns as shown by its higher standard deviation. This allows for the possibility of outliers (extreme gains/losses) in the data set. However, because of the higher predictive power, this table

indicates that Equinox is more closely correlated and is also a better predictor of future S&P 500 movements than Barrick Gold.

The regression analysis between Barrick and Equinox is showed in Table 7:

Table 7 regression analysis

<b>Range: 01/01/2010 to 4/24/2011</b>	
<b>Sample size</b>	327
<b>Volatility <math>\sigma</math></b>	0.232
<b>Intercept</b>	0.211
<b>Correlation <math>\rho</math></b>	0.118
<b><math>\rho^2</math></b>	0.014
<b>Std Dev of Error</b>	3.49
<b>Std Dev of <math>\sigma</math></b>	0.108
<b>t-test</b>	2.151

We used the same set of data to do regression analysis of Barrick Gold and Equinox. From the table above, we can conclude that the result is statistically significant. However, it's hard to identify any correlation between these two firms. The merger between two totally unrelated firms is called conglomerate M&A which aims to realize capital investment diversification and lower firm-specific risks.

As we mentioned in previous section, the main difference between DCF and Real Option is the ignorance of the value of managerial flexibilities in DCF; thus DCF generally underestimates the value of a merging firm. The flexibility of the managerial decision can derive a significant amount of benefit for an M&A. Under the uncertainties, the management can delay a deal, call off (not exercise the option), or partially exercise implement a project (partially exercise its options). When an acquirer decided to bid on another company, and the target accepts the offer; this option can be treated as an

“exchange” option. Based on our case, we assume acquirer Barrick Gold’s options illustrating as below

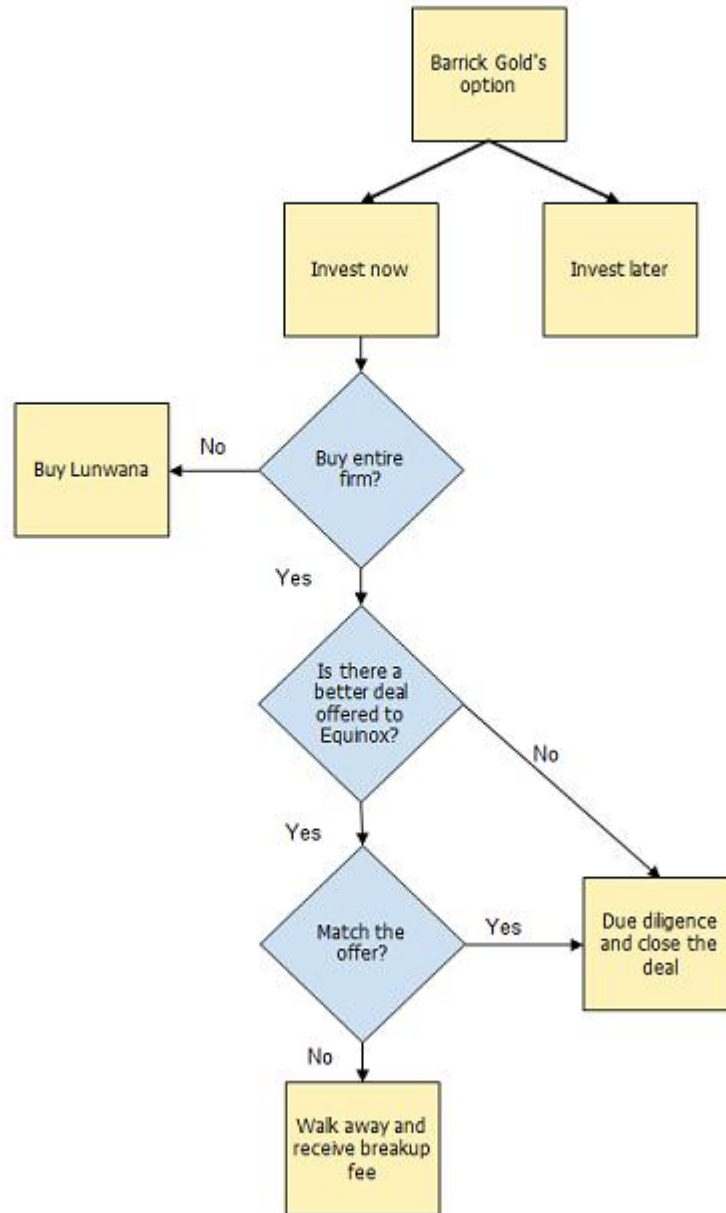


Figure 8 Barrick Gold’s options

Invest now or later

Several scholars suggested that more mergers and acquisitions occur during periods of economic upturn. . We postulated that Barrick Gold chose to acquire Equinox when it did for several reasons: 1) Barrick has excessive cash on hand; 2) Equinox has strategically significant copper reserve on African copper belt of which many other firms wish to obtain, such as Minmetals; 3) The macro economy is recovering from the great recession, so are commodities, 4) Many miners tends to hedge future expected higher production cost through mergers and acquisitions.

Buy entire firm or partial asset

Obviously, the most attractive asset for Barrick is Lumwana project. The total production in 2010 was 323.4 million pounds which is 68% higher comparing with 2009. Recall table 4 which gave us the financial income from every project. Lumwana had a net income of US\$312.73 million which contributed more than 100% of the total income. Table 8 shows the assets value of each project Equinox owned from year 2005 to 2010.

Table 8

Currency: USD						
Units: MLN						
Field	FY 2010	FY 2009	FY 2008	FY 2007	FY 2006	FY 2005
Assets	3,242.29	1,457.67	1,471.13	828.00	357.17	158.90
Africa	1,598.65	1,359.75	1,445.90	810.00	345.52	46.84
Zambia	1,598.65	1,359.75	1,445.90	810.00	345.52	46.84
<b>Lumwana Project</b>	1,531.84	1,358.85	1,444.69	809.45	345.26	46.74
<b>Exploration</b>	66.81	0.90	1.21	0.56	0.26	0.10
Saudi Arabia	1,381.93					
<b>Jabal Sayid</b>	1,381.93					

Discounted cash flow model could be used to appraise the Lumwana project. However, Barrick emphasized the potential of Lumwana, and only Barrick sees how much extra value this property will bring.

Barrick had an opportunity to acquire the entire company as well as outlined in the following section. However, risks associated with the merger included: 1) Valuation risk, the estimated production may be higher, or the forecasted cost may be lower than the real numbers. Indeed, according to Barrick's reporting from 2012, the real production in year 2012 was near the lower end of their estimation; and the operating cost rose significant as well, the total markup shrunk comparing with their original guidance. 2) Investment risk, the multiple may be affected by increasing base metal exposure. Gold investors are still primarily focusing on gold exposure; they are looking for high production at a minimal cost. 3) Financing risk, due to its strong financial position and sufficient cash in hand, Barrick maintained "A-" from Standard and Poor's (S&P's) and Baa1 from Moody's.

After the acquisition, the debt/EBITDA ratio, capital expenditure etc may affect its credit rating. In 2012 July, S&P's lowered Barrick Gold's credit rating to BBB+.

Match other offers or walk away

Barrick's offer also included a right to match any higher offers. If Barrick decided to walk away and Equinox accepted a higher offer, Barrick Gold would have received a termination fee of 250 million Canadian dollars from Equinox. Breakup fee is an agreement that requires compensating the acquirer if the seller backs out of a deal.

Officer (2003)'s empirical study demonstrated that merger deals with target termination fees involve significantly higher premiums and success rates than deals without such clauses.

In the next chapter, we will calculate the firm value of equinox by using both real option model and DCF model. Our rationale was to compare the two results against the real deal price. We chose the approach that resulted in a value closest to that of the actual price.

Margrabe (1978) model was used to determine the real option value which may have existed when Barrick Gold acquired Equinox Minerals.  $T_0$  denotes the date when Barrick Gold Corp announced to the public its acquisition intentions.  $T_1$  indicates when Barrick Gold completed the deal.  $T$  (the period between  $T_0$  and  $T_1$ ) indicates the European option expiration time. In reality, this deal started on April 25, 2011, and closed on July 19, 2011. In order to simplify the calculation, we let the  $T = 0.25$  year. The growth option gives Barrick Gold ( $S_1$ ) a right, but not the obligation to buy Equinox Minerals ( $S_2$ ) at a specific time. Other inputs for this model are listed in a previous regression analysis.

## Chapter 4 Application of M&A Models and Results

### 4.1 Margrabe's Exchange Option Model

Margrabe shared many of Black-Scholes's assumptions; they are both under frictionless market, and the assets prices follow a geometric Brownian motion with constant volatility  $\sigma$ . Margrabe (1978) also assumes the price of a riskless discount bond grow exponentially at the riskless interest rate  $r$ . The rate of return of each asset

$$dS_i = \mu_i S_i dt + \sigma_i S_i dW_i$$

$$i=1, 2$$

$dW_i$  is a Wiener process; therefore,  $dS_i$  is an "Ito process".

The payoff  $C(T)$  is  $\max(0, S_1(T) - S_2(T))$

At time  $T$ . The value of the option must satisfy

$$0 \leq C(T) \leq \max(0, S_1(T) - S_2(T))$$

$$\text{Thus, } S_2(T) = \max(0, S_1(T) - C(T))$$

The formula is given as:

$$C(T) = e^{-r_1 T} S_1 N(d_1) - e^{-r_2 T} S_2 N(d_2)$$

Where

$$d_1 = (\ln(S_1/S_2) + 0.5\sigma^2 T) / \sigma \sqrt{T}$$

$$d_2 = d_1 - \sigma \sqrt{T}$$

$S_1$  = the asset that is exchanged for another, Barrick Gold

$S_2$  = the acquired asset, Equinox



T = Time to exchange

$$\sigma^2 = \sigma_1^2 + \sigma_2^2 - 2\rho \sigma_1 \sigma_2$$

$\sigma$ , combined volatility of asset 1 and asset 2

$\sigma_1$ , volatility of asset 1, Barrick Gold

$\sigma_2$ , volatility of asset 2, Equinox

We assume  $r_1 = r_2 =$  risk free rate

$\rho$ , correlation between asset 1, Barrick Gold and asset 2 Equinox

N(d) is the cumulative standard normal density function

The results calculated using Margrabe's formula are list in Table 9:

Table 9 calculation

	<b>Barrick</b>	<b>Equinox</b>
<b>S</b>	53.07	7.5100
<b><math>\sigma</math></b>	0.9460	1.8700
<b>T</b>	0.2500	0.2500
<b>r</b>	0.0172	0.0172
<b>D</b>	2.46007455	1.463288805
<b>N(d)</b>	0.993054592	0.928305815

The maximum payoff of Barrick is  $C(T) = 45.53361$ . This suggested that Barrick should pay \$7.5364 to Equinox. Before Barrick Gold announced its intention to acquire Equinox, Minmetals Resources Ltd bid \$6.3 billion which was significantly lower than the minimal required payoff for Equinox; therefore, the offer was rejected by Equinox. However, we can see there's still a gap between the price we calculated and the price Barrick paid. We will discuss the gap in later chapter.

## 4.2 Sensitivity analysis

For a better understanding of Margrabe's exchange option model, we conducted a sensitivity analysis. The results aim to provide the changes of the option value (Barrick wishes to pay to acquire Equinox) in terms of the uncertainty of some key parameters in this model. The following five parameters are commonly tested risk sensitivities; they are named using first-order Greeks.

Parameter	Symbol	Measures	Equation
<b>Delta</b>	$\Delta$	Change in underlying price	$\Delta = \delta V / \delta S$
<b>Vega</b>	$v$	Change in volatility	$V = \delta V / \delta \sigma$
<b>Theta</b>	$\theta$	Change in time to expiration	$\theta = \delta V / \delta T$
<b>Rho</b>	$\rho$	Change in interest rate	$\rho = \delta V / \delta r$
<b>Lambda/omega</b>	$\lambda / \Omega$	Percentage change in underlying price	$\Delta = (\delta V / \delta S) \times (S / V)$

Table 10: Greeks

We used this sensitivity analysis to test the robustness of the application of Margrabe's option model in the presence of uncertainties. In each test, we assume only one variable change, the other inputs were constant.

Firstly, Delta  $\Delta$  measured the sensitivity of the call option to the underlying prices. We increased/decreased the S1 and S2 prices at an increment of 5%. We observed the option value changes as below:

Table 11 price sensitivity

S1/S2	4.5060	4.8815	5.6325	6.0080	6.3835	6.7590	7.1345	7.5100	7.8855	8.2610	8.6365	9.0120	9.3875	9.7630
31.8420	27.3202	26.9752	26.2988	25.9675	25.6408	25.3189	25.0017	24.6893	24.3817	24.0788	23.7807	23.4872	23.1983	22.9141
34.4955	29.9459	29.5968	28.9107	28.5739	28.2413	27.9130	27.5891	27.2696	26.9544	26.6437	26.3373	26.0354	25.7377	25.4444
39.8025	35.2063	34.8511	34.1502	33.8049	33.4630	33.1248	32.7902	32.4593	32.1322	31.8089	31.4893	31.1736	30.8617	30.5536
42.4560	37.8397	37.4821	36.7756	36.4269	36.0814	35.7393	35.4004	35.0651	34.7331	34.4047	34.0798	33.7585	33.4408	33.1266
45.1095	40.4746	40.1150	39.4037	39.0521	38.7036	38.3580	38.0155	37.6762	37.3401	37.0073	36.6777	36.3515	36.0286	35.7091
47.7630	43.1107	42.7494	42.0340	41.6800	41.3287	40.9803	40.6346	40.2919	39.9521	39.6154	39.2817	38.9512	38.6237	38.2995
50.4165	45.7478	45.3851	44.6660	44.3100	43.9564	43.6054	43.2569	42.9112	42.5682	42.2281	41.8908	41.5564	41.2250	40.8965
53.0700	48.3857	48.0217	47.2996	46.9417	46.5861	46.2328	45.8820	45.5336	45.1878	44.8447	44.5042	44.1664	43.8313	43.4990
55.7235	51.0242	50.6591	49.9344	49.5749	49.2175	48.8623	48.5093	48.1586	47.8103	47.4644	47.1211	46.7803	46.4420	46.1064
58.3770	53.6632	53.2973	52.5702	52.2093	51.8503	51.4934	51.1385	50.7857	50.4352	50.0870	49.7411	49.3975	49.0564	48.7178
61.0305	56.3027	55.9359	55.2068	54.8447	54.4844	54.1259	53.7693	53.4147	53.0622	52.7118	52.3637	52.0177	51.6740	51.3326
63.6840	58.9425	58.5750	57.8442	57.4810	57.1194	56.7595	56.4015	56.0453	55.6910	55.3387	54.9885	54.6403	54.2943	53.9505
66.3375	61.5827	61.2146	60.4821	60.1179	59.7553	59.3942	59.0348	58.6772	58.3213	57.9673	57.6152	57.2651	56.9170	56.5710
68.9910	64.2231	63.8544	63.1206	62.7555	62.3919	62.0298	61.6692	61.3102	60.9529	60.5974	60.2437	59.8918	59.5418	59.1937

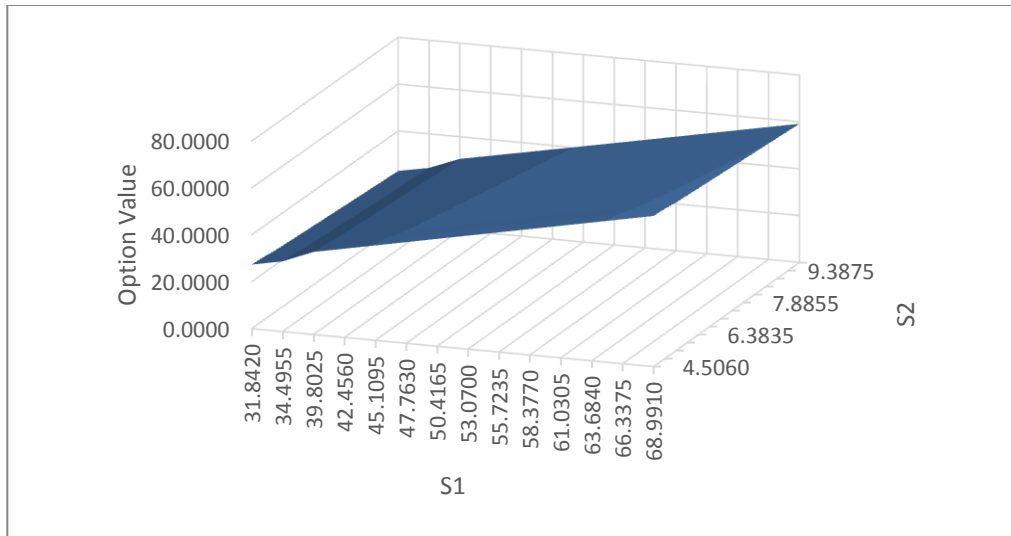


Figure 9 sensitivity of the call option to the underlying prices

As the increase of S1, S2 remained constant, the value of option rose; thus, the expected total payoff between S1 and S1 increases. However, S2 had a negative impact on the option price. As S2 increased, the total payoff was expected to fall. Thus, Barrick needed to pay more to acquire Equinox. We also find the option value is much more sensitive to the change of S1 than that of S2.

Secondly, Theta  $\theta$  measured the sensitivity of the call option to the passage of time. The acquisition duration is highly uncertain in the real world. The T from the announcement date to the completion date often varied from months to years. We study T from one month to one year in this case.

Table 12 Time sensitivity

Time (In year)	0.083	0.167	0.250	0.333	0.417	0.500	0.583	0.667	0.750	0.833	0.917	1.000
Payoff	45.561	45.601	45.730	45.932	46.180	46.452	46.734	47.018	47.298	47.572	47.836	48.090
Bid price	7.509	7.469	7.340	7.138	6.890	6.618	6.336	6.052	5.772	5.498	5.234	4.980

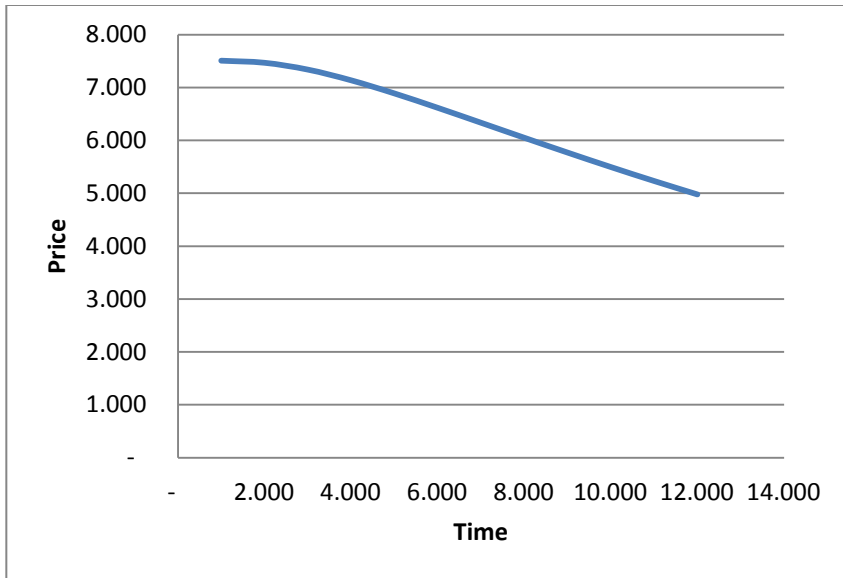


Figure 10 sensitivity of the call option to the time

Intuitively, as the time increased, the maximum payoff from Barrick  $C(T)$  would go up, and the price Barrick is willing to pay will go down. This is consistent with the option time decay curve:  $\theta = \delta V / \delta T$ , the lower time value, the greater degree of certainty of the option's expiry value. This test also implies that the longer duration of an acquisition, it's more costly for the buyer: option value = Time value + intrinsic value. However, we are only considering European option here, which is in a closed form. American option value may increase as the expiration time increases, because it can be exercised any point before it expires. A longer period also has the potential to attract more buyers. Most sellers usually act to complete a transaction fast. Most of the M&A deals last from six to nine months.

Thirdly, Vega, measured sensitivity to volatility. As volatility increased and the seller's price increased, the buyer would benefit from the price increase. However, if the price went down drastically, the buyer would withdraw its offer, or the maximum loss would be the penalty (or breakup fee) if there's one. Since Margrabe's model assumes the underlying assets follow correlated Brownian Motions, we assume there is  $P=365$  trading days a year. In order to be consistent with the acquisition duration which is measured in one year, the volatilities need to be annualized as well, and the formula is given as below:

$\sigma$ annual —

Table 13 volatility sensitivity

$\sigma$ (standard deviation)	Annualized volatility	Option price
1	19.10497317	45.5601026
1.5	28.65745976	45.58019538
2	38.20994635	45.7331509
2.5	47.76243294	46.1069119
3	57.31491952	46.67556392
3.5	66.86740611	47.36651382
4	76.4198927	48.10911999
4.5	85.97237929	48.84904985
5	95.52486587	49.54906168
5.5	105.0773525	50.18615013
6	114.629839	50.74824676
6.5	124.1823256	51.23130347
7	133.7348122	51.63689313

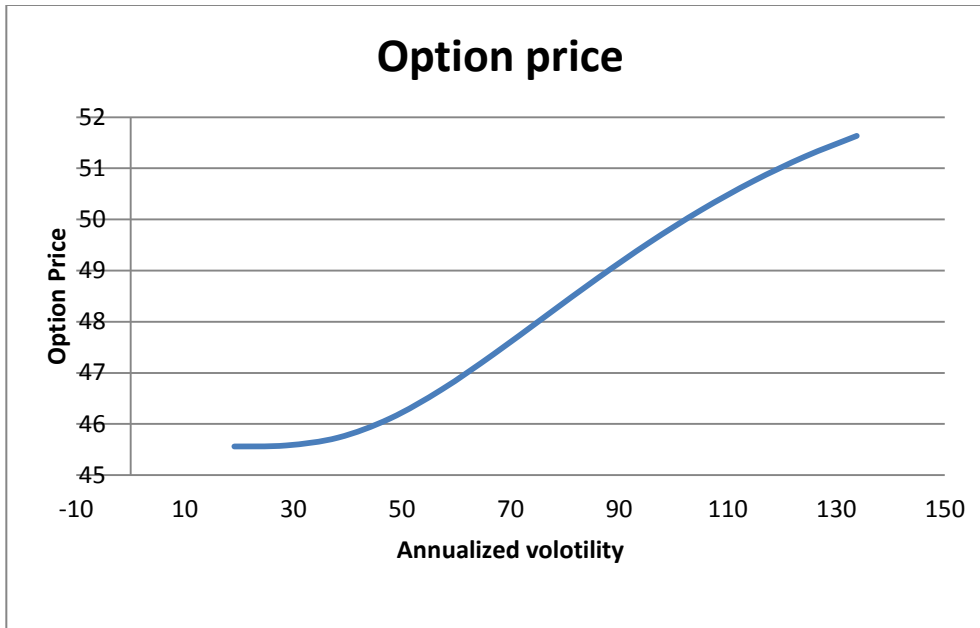


Figure 11 sensitivity of the call option to volatility

The chart above, as the model suggests, proved the option value would increase indefinitely by increasing the volatility,  $V = \delta V / \delta \sigma$ . We discovered that by increasing the volatility from 19.1 to 133.73 which is near 86%, the option price changes merely 12%. Comparing with the time T, we discovered the option price is less sensitive to the combined volatility which is against the first-order Greeks. We argued that because there were two options in the transaction; the seller's put option value offset the buyer's call option. However, we didn't do any additional tests to see if the independent volatility of each asset or the correlation between the two contributes more change of the option price.

Fourthly, Rho, measured sensitivity to a risk free interest rate. It was commonly thought that changes in interest rates had insignificant impact on the option prices. However, the change in interest rate will first lead a strong effect on the stock market, which means a drift the price of underlying assets. According to first-order Greeks, the underlying price, Delta, had the most significant impact on the option price; therefore, it's the least used measurement in the first-order Greeks. Again, we make the interest rate change at an incremental of 5%, we observe the option value as below, table 14

Table 14 interest sensitivity

Risk free rate	0.0129	0.0138	0.0146	0.0155	0.0163	0.0172	0.0181	0.0189	0.0198	0.0206	0.0215
Option value	45.5826	45.5728	45.5630	45.5532	45.5434	45.5336	45.5238	45.5140	45.5043	45.4945	45.4847
Bid price	7.4874	7.4972	7.5070	7.5168	7.5266	7.5364	7.5462	7.5560	7.5657	7.5755	7.5853

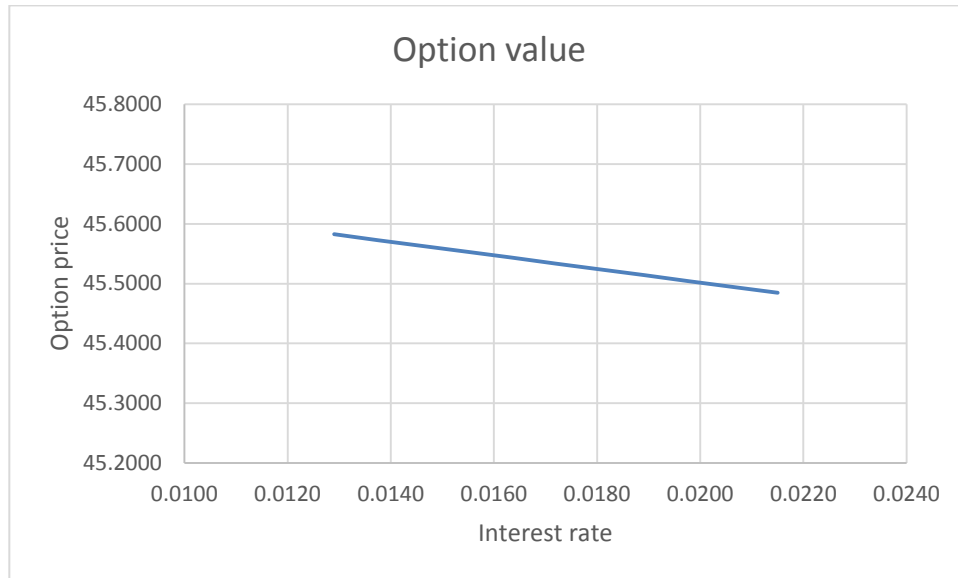


Figure 12 sensitivity of the call option to risk free rate

The change in option value in terms of interest rate was very little. In one asset option pricing model the underlying asset grew at the rate of risk free. The option price is discounted from future growth; therefore, the interest rate and option price have a positive relationship. However, with Margrabe’s model, we had two exchanging assets. The underlying asset 1 has a much higher price than asset 2, therefore the call option price of assets 2 is having a negative relation to the interest rate, but the impact was insignificant.

### 4.3 DCF Model

We used NPV (Net Present Value) analysis to determine the value of the target firm. We assumed the M&A would benefit Barrick Gold for five years. Discounting the future free cash flows by the WACC (Weighted Average Cost of Capital) revealed the net present cash value. If the NPV is positive, the positive amount would be the maximum amount



Barrick Gold would pay for Equinox. If the NPV is negative, then the deal would be never reached. All data were collected from the company website and Bloomberg terminal.

Table 15 Barrick Gold cash flow (2001-2007)

Millions USD	Historical Year Ended				
	2007	2008	2009	2010	2011
<b>Total Revenue</b>	<b>\$ 6,332.00</b>	<b>\$ 7,913.00</b>	<b>\$ 8,136.00</b>	<b>\$ 10,924.00</b>	<b>\$ 14,312.00</b>
COGS	3128	3955	3948	4201	6316
Gross Profit	3204	3958	4188	6723	7996
Operating Expense	1855	2816	6189	2124	1317
SG&A	865	1859	5116	912	-102
EBITDA	2339	2099	-928	5811	8098
D & A	990	957	1073	1212	1419
EBIT	1349	1142	-2001	4599	6679
Taxes	341	590	648	1370	2287
Capital Expense	1035	1807	2351	3323	4973
Working Capital	1200	1477	655	670	889
<b>Free Cash Flow to Firm</b>	<b>\$ (86.00)</b>	<b>\$ (575.00)</b>	<b>\$ (3,105.00)</b>	<b>\$ 1,103.00</b>	<b>\$ 619.00</b>

Based on the historical data, we can calculate the average rates from 2007-2011 shown in the following table 16.

Table 16 Historical Cash Flow in Percentage

	2007	2008	2009	2010	2011	Average
Total Revenue	12.3%	25.0%	2.8%	34.3%	31.0%	21.1%
- COGS	49.4%	50.0%	48.5%	38.5%	44.1%	46.1%
Gross Profit	50.6%	50.0%	51.5%	61.5%	55.9%	53.9%
- Operating Exp	29.3%	35.6%	76.1%	19.4%	9.2%	33.9%
- SG&A (Op Ex)	13.7%	23.5%	62.9%	8.3%	-0.7%	21.5%
EBITDA	36.9%	26.5%	-11.4%	53.2%	56.6%	32.4%
EBIT	21.3%	14.4%	-24.6%	42.1%	46.7%	20.0%
- CapEx	16.3%	22.8%	28.9%	30.4%	34.7%	26.6%
Working Capital	19.0%	18.7%	8.1%	6.1%	6.2%	6.2%
- WC Investment	16.6%	3.5%	-10.1%	0.1%	1.5%	1.1%

In table 17 below the forecasted cash flow for the 2012-2016 is displayed. Since the debt ratio changed over the periods, we believed Free Cash Flow to Firm (FCFF) may be a better choice than Free Cash Flow to Equity (FCFE). FCFF is used to determine all the cash available after all taxed and reinvestment. The model assumes that there's neither interest expense, nor tax shield from the interest expenses.

$$\text{FCFF} = \text{EBIT} (1 - \text{tax rate}) - \text{Capital Expense} - \Delta \text{working capital}$$

Positive FCFF implied that there was sufficient cash to cover the debt, or to pay dividends to the shareholders. FCFF helps to estimate the value of a firm as a whole. The discounted rate for FCFF is typically WACC (weighted average cost of capital).

According to the Cost of Capital by Sector by New York University, they collect 73 firms in Metals & Mining sector as of 2011, the average cost of capital is 9.31%, and tax rate is 11.04. We used the past five years' financial data of Barrick Gold to project the next five years cash flow. The growth rate and the expense rate are estimated as the average of past five years. Therefore we use the rates calculated above, the industry wide average cost of capital is 9.31%, and tax rate 11.04 to estimate the net present value.

Table 17 project cash flow for the year 2012-2016

	Projected Year Ending				
	2012	2013	2014	2015	2016
<b>Total Revenue</b>	<b>\$ 17,329.47</b>	<b>\$ 20,983.13</b>	<b>\$ 25,407.10</b>	<b>\$ 30,763.81</b>	<b>\$ 37,249.90</b>
COGS	7988.66	9672.95	11712.34	14181.71	17171.71
Gross Profit	9340.81	11310.18	13694.76	16582.10	20078.19
Operating Expense	5878.07	7117.37	8617.96	10434.93	12634.98
SG&A	3731.75	4128.39	4526.39	4908.71	5251.04
EBITDA	5609.06	7181.79	9168.37	11673.39	14827.15
D & A	2146.32	2988.98	4091.57	5526.22	7383.94
EBIT	3462.74	4192.81	5076.80	6147.17	7443.21
Taxes	382.29	462.89	560.48	678.65	821.73
Capital Expense	4618.09	5591.75	6770.69	8198.18	9926.65
Working Capital	1076.43	1303.38	1578.18	1910.92	2313.80
<b>Free Cash Flow to Firm</b>	<b>\$ 421.25</b>	<b>\$ 900.21</b>	<b>\$ 1,562.41</b>	<b>\$ 2,463.82</b>	<b>\$ 3,675.88</b>
<b>Present Value of Free Cash Flows</b>	<b>\$ 385.37</b>	<b>\$ 753.40</b>	<b>\$ 1,196.23</b>	<b>\$ 1,725.72</b>	<b>\$ 2,355.39</b>
<b>NPV</b>	<b>\$ 6,416.10</b>				

The NPV (as seen in table 12) is approximately 6.4 billion in US Dollar which is a deep discount compared to the real deal price of 7.8 billion (US Dollar). Our result is consistent with previous literature that suggested DCF is likely to undervalue a firm/project. The traditional NPV analysis of a set of future forecasted cash flow cannot capture the full value of the acquisition, because much of the value is generated from other hidden options.

In industry practice, determining the discount rate can be very challenging. In order to reflect the risks associating with the firm/project, managers normally use risk adjusted discount rate:

Risk-adjusted discount rate = risk-free rate of return + risk premium.

The risk premium is subjectively determined to compensate for extra risks. As we mentioned earlier, mining industry has several risks, therefore decision makers normally apply heavily on the discount rate. In our calculation, we didn't apply risk factor at all; all the future cash flows are just discounted by WACC.

In this section, the sensitivity of NPV was tested as it applied to the change of discounted rate. From the diagram we can see a higher discount rate reduces the present value; the change of NPV is about one third change of the discount rate. Table 18

Table 18 Discount rate sensitivity

Discount rate change		-30.00%	-20.00%	-10.00%	0.00%	10.00%	20.00%	30.00%
Discount rate		0.065	0.074	0.084	0.093	0.102	0.112	0.121
NPV		\$7,076.49	\$6,846.44	\$6,626.48	\$6,416.10	\$6,214.77	\$6,022.02	\$5,837.40
NPV change		10.29%	6.71%	3.28%	0.00%	-3.14%	-6.14%	-9.02%

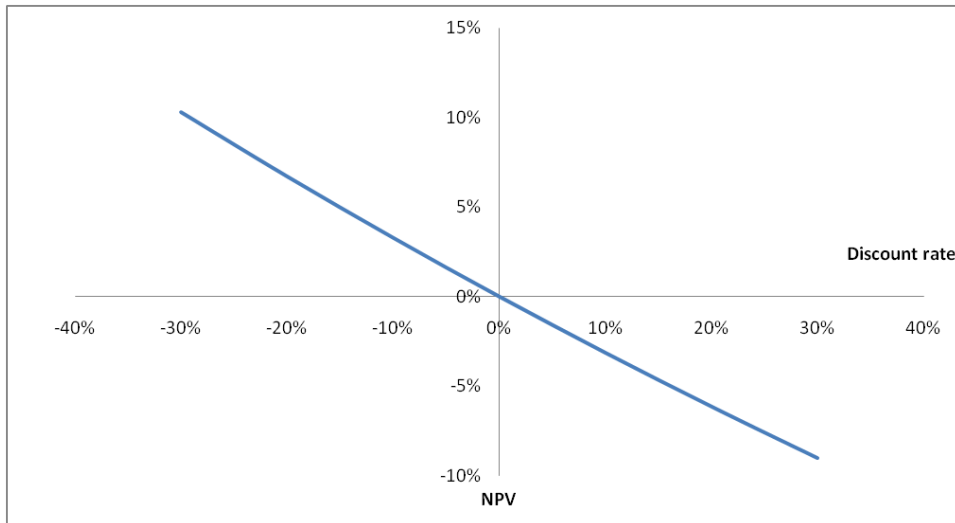
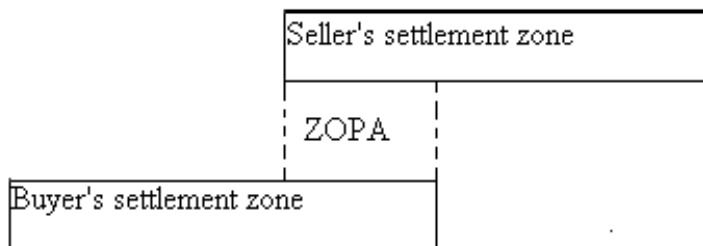


Figure 13 discount rate and NPV

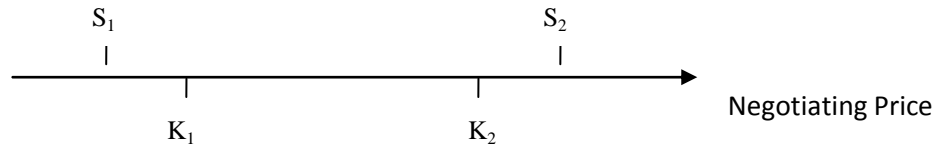
#### 4.4 Zone of Possible Agreement

When two parties are involved in a negotiation, the Zone of Possible Agreement (ZOPA) exists. The traditional ZOPA is illustrated as below. ZOPA is crucial to the successful outcome of a negotiation. Each party has a “bottom line”, ZOPA is an overlapping of two “bottom lines”. It takes time for both parties to communicate and assess the situation to determine the ZOPA in a bilateral negotiation; anywhere outside the ZOPA is not feasible.



Moon et. al (2009) examined a two way negotiation process and outcome. The authors illustrated that two options involved in the negotiation process include a call option for the buyer, and put option for the seller. They revisited the traditional ZOPA. They defined the negotiating prices without an option are S1 and S2, with an option are K1 and

$K_2$ , the values of  $K_1$  and  $K_2$  are fractions of  $S_1$  and  $S_2$ . The negotiation range ( $K_1-K_2$ ) will be narrower when the negotiation prices are calculated with option.



In this thesis, we only considered the buyer's option. Therefore, in reference to the figure above, we only consider the lower bound of the negotiating prices,  $K_1=7.3$  (with option) and  $S_1=6.4$  (without option). The gap between  $S_1$  and  $K_1$  is explained by the option add-on value. The different results from the option are caused by the timing flexibility. Moon et al (2009)'s research shows "the options of waiting to sell and to buy (1) narrow the traditional zone of possible agreement and (2) lower the probability of negotiation agreement".

#### 4.5 Extension - Blackberry Case

When we are finishing up this thesis, there is news regarding to the Blackberry. On September 23, 2013, Fairfax financial holding announced its attention to acquire Smartphone maker blackberry LTD. Currently Fairfax owns roughly 10% of blackberry shares, and it could pay US\$9 a share in cash for the remaining 90%. The total amount of the deal is 4.7 billion USD. Fairfax has no obligation to finalize the offer, and is contingent on condition of its ability to secure financing which could include private equity or pension funds. This transaction is subject to a six-week due diligence. During this period time, Fairfax can withdraw its offer at any moment without penalty. Blackberry can seek other better offers as well, but if it accepts another offer, blackberry must pay Fairfax a termination fee of 150 million.

Blackberry used to be a dominant player in smart phone market. Because of the rising competition of apple, android and windows phones, blackberry gradually lost its leading

position. The table below highlights some financial data of blackberry for period 2009 to 2013 from Bloomberg

	2013	2012	2011	2010	2009
<b>For the period ending</b>	3/2/2013	3/3/2012	2/26/2011	2/27/2010	2/28/2009
<b>Market Capitalization</b>	6949.03	7211.51	34520.30	39397.72	22727.43
<b>cash &amp; equivalents</b>	2654.00	1744.00	2121.00	1911.47	1518.21
<b>Enterprise Value</b>	4295.03	5437.51	32399.30	37486.27	21209.22
<b>Revenue</b>	11073.00	18423.00	19907.00	14953.22	11065.19
<b>EBITDA</b>	1018.00	3375.00	5563.00	4017.29	3047.99

Table 19: Blackberry key data

In recent years, Blackberry encounters many challenges that include the diminishing market share. Blackberry accounted for just 2.8% of smartphone sales in the first half of 2013 worldwide. Comparing with 11% in 2011, the market share dropped 5%.

Blackberry just reported a loss of US\$965 million and revenue of 1.6 billion which is 50% lower than consensus expectation and reached the lowest since mid-2007. Gross margin declined sequentially from 40.1% to 33.9%. The company posted an operating loss instead of consensus for a profit. Also it's writing down of \$960 million of unsold Z10 inventory for the fiscal second quarter according to a statement from Blackberry.

Blackberry is in a process of consolidating its product portfolio; it's narrowing down the target market to professional and corporate users by cutting down from six to four devices. The company is also discontinuing its focus on developing new software and tables. The main motivation of the strategy is to cut costs. However, according to a recent survey by Gartner In, they predicted most businesses will move towards "bring-your-own-device" policies. In addition, Blackberry also announced its workforce cutting plan in September. 4500 jobs, which will affect 40 per cent of its global staff, will be eliminated by end of May 2014

The biggest challenge that Blackberry is facing is intensive competition. As the number of competitors within the industry increases, such as Apple, Samsung and Microsoft, Blackberry must struggle to maintain a competitive edge within the market. As the development of innovative technology becomes stagnant, blackberry faces the struggle of maintaining a competitive advantage over fellow competitors that often provide similar and comparable technologies. Further, the threat of third party infringement on technology from competitors is a factor that blackberry must be conscious of. This not only threatens Blackberry's proprietorship, which is costly in the long term, but may be costly in the short term as litigation can have a negative material effect on financial health.

One area in which Blackberry may have more flexibility to successfully compete in is service and prices. Increased competitors will result in increased pressure on blackberry to decrease prices and increase service quality. Blackberry will feel pressure to offer services that other competitors do not, in an effort to appeal to the target market. In turn, blackberry's main objective is to remain profitable, and therefore is very dependent on cost efficient, reliable suppliers. Proper suppliers are essential to maintaining a cost efficient business. There are many risks involved in supplier selection. Blackberry relies on their supplier to provide quality, cost efficient product on a timely basis. If the supplier fails to meet requirements, Blackberry product and service will suffer.

Fairfax is the biggest shareholder of blackberry, they have keen interest to see blackberry potentially turning around. Mr. Prem Watsa, the founder of Fairfax, became the "Canadian Warren Buffett" by some successful buying and selling commercial enterprises. He believes blackberry is underestimated by the "emotional" market; it will survive for a long time and be successful again if it has a "sound capital structure".

#### 4.5.1 Valuation

The cash price of \$9 represents a 3.2% premium to the closing price of previous day. However, the 20 day average price was \$10.31. According to Blackberry's most recent financial reporting, it has \$3.1 billion cash, the capital structure is equity only which has a 13.5% cost of capital. The company had \$630 million cash from operations. The following cash flow table was retrieved from Bloomberg, the current value of Blackberry

is worth approximately \$13.5 billion based on our DCF model. However, the current value doesn't reflect any potential growth that Blackberry may have in the future, because most analysts believe the Blackberry will have negative growth in next periods.

Field	FQ2 2014	FY 2013	FY 2012	FY 2011	FY 2010	FY 2009	FY 2008	FY 2007	FY 2006
	most recent	original	restated	original	original	original	original	original	restated
<b>Cash From Operating Activities</b>									
Net Income	-942	-646	1164	3411	2457.144	1892.616	1293.867	631.572	374.656
Depreciation & Amortization	2072	1918	1523	927	615.621	327.896	177.366	126.355	85.873
Other Non-Cash Adjustments	139	546	435	167	122.818	0.447	-25.268	120.324	80.212
Changes in Non-Cash Capital	1015	485	-210	-496	-160.709	-769.114	130.794	-142.582	-390.65
Cash From Operations	2284	2303	2912	4009	3034.874	1451.845	1576.759	735.669	150.091
<b>Cash From Investing Activities</b>									
Disposal of Fixed Assets	0	0	0	0	0	0	0	0	0
Capital Expenditures	-451	-413	-902	-1039	-1009.42	-833.521	-351.914	-254.041	-178.732
Increase in Investments	-514	-296	-355	-784	-862.977	-507.082	-757.656	-100.08	-103.179
Decrease in Investments	418	227	376	893	473.476	431.713	260.393	86.583	61.495
Other Investing Activities	-1953	-1758	-2143	-768	-71.21	-914.633	-304.76	-97.039	287.74
Cash From Investing Activities	-2500	-2240	-3024	-1698	-1470.13	-1823.523	-1153.937	-364.577	67.324
<b>Cash from Financing Activities</b>									
Dividends Paid	0	0	0	0	0	0	0	0	0
Change in Short-Term Borrowings	0	0	0	0	0	0	0	0	0
Increase in Long-Term Borrowings	0	0	0	0	0	0	0	0	0
Decrease in Long-term Borrowings	0	0	0	0	-6.099	-14.305	-0.302	-0.262	-0.229
Increase in Capital Stocks	0	0	9	67	30.246	27.024	62.889	44.534	23.269
Decrease in Capital Stocks	-43	-25	-156	-2153	-869.471	0	0	-203.933	-391.212
Other Financing Activities	-24	-16	-5	15	-4.108	10.107	21.845	6.173	-0.057
Cash from Financing Activities	-67	-41	-152	-2071	-849.432	22.826	84.432	-153.488	-368.229
Net Changes in Cash	-283	22	-264	240	715.315	-348.852	507.254	217.604	-150.814
<b>Reference Items</b>									
EBITDA	229	1018	3375	5563	4017.291	3049.992	1913.82	935.228	705.484
Trailing 12M EBITDA Margin	2.28	9.1935	18.3195	27.9449	26.8657	27.5639	31.8471	30.7934	34.1499
Cash paid for taxes		0	0	1053	1081.72	946.237	216.095	32.101	2.449
Cash Paid for Interest		0	0	0	0	0.502	0.518	0.494	0.483
Net Cash Paid for Acquisitions	-31	60	226	494	143.375	48.425	6.2	116.19	3.795
Free Cash Flow	1833	1890	2010	2970	2025.458	618.324	1224.845	481.628	-28.641
Free Cash Flow to Firm		1890	2010	2970	2025.458	618.6633	1225.215	481.9912	-28.2652
Free Cash Flow to Equity	1833	1890	2010	2970	2019.359	604.019	1224.543	481.366	-28.87
Free Cash Flow per Basic Share	3.5	3.6058	3.8351	5.5412	3.5881	1.0943	2.1881	2.5984	-0.1516

Table 20 Cash projection, source: Bloomberg

Makor capital used fair market value to estimate Blackberry. Their valuation is made up three parts: cash, which is from Blackberry's most recent financial statement; patents, by looking at the market price after adjusting for transaction cost and risk differential; and the value of the business. They assigned patent for 2.5 billion, cash 2 billion and business,



in a very conservative way, for 1.5 billion. The enterprise is in total 6 billion or 11.4 per share.

The historical prices of Blackberry and Fairfax were obtained from Bloomberg. The daily closing prices since January 2013 to September 22, 2013 (the day before the announcement were used). Since Fairfax is not listed in US, we used TSX as the benchmark. The regression analysis and summary table are presented as below

Table 21 Regression analysis

<b>Range: 09/22/2012 to 09/22/2013</b>		
<b>Relative index</b>	TSX CN Equity	
	Blackberry	Fairfax
<b>Volatility <math>\sigma</math></b>	1.124	0.043
<b>Intercept</b>	-0.207	0.184
<b>Correlation <math>\rho</math></b>	0.331	0.154
<b>Std Dev of Error</b>	3.499	5.593
<b>t-test</b>	10.75	1.674

Table 22 Margrabe's option variables

	<b>Blackberry</b>	<b>Fairfax</b>
<b>S</b>	8.73	415.86
<b><math>\sigma</math></b>	1.124	0.043
<b>T</b>	0.115*	0.115
<b>r</b>	0.0172	0.0172
<b>D</b>	72.39218	72.33879

T, we assume six weeks. After the six-week due diligence, Fairfax needs to make a firm offer or walk away.

Based on Margrabe's option model, we calculated that the lowest price that Blackberry would accept is \$8.39 per share. The results from the option model is still closer to the bidding price that Fairfax would like to pay.

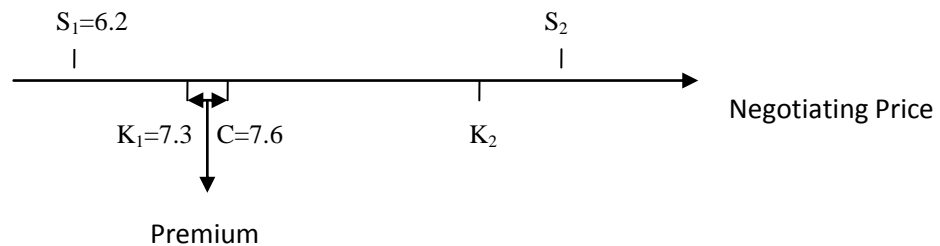
From our valuation, we can see the bidding price actually has a deep discount which is not common seen in the mergers and acquisitions. The reasons are generally 1) Losing competency in the market, less innovation and appealing products; 2) weakening balance sheet, disappointing quarterly earnings.

According to most of analysts from investment banks, it's unlikely that other bidders will step in. For Blackberry shareholders, Fairfax's deal may be still a wishful thinking. As we mentioned before, this deal is not a firm offer, Fairfax may walk away anytime. This offer may be just an "excuse" to perform a due diligence. It's likely that Fairfax will further lower its offering price after the due diligence.

## Chapter 5 Factors in determining bidding premium

After the mergers of Equinox, according to Barrick Q3 financial reporting, Barrick's total net earnings increased to 1.67 billion from 942 million. Barrick expanded production of copper mainly because of acquiring of Lumwana which produced 323 million pounds of copper. The third quarter total sale of copper rose from 90 million pounds to 146 million pounds. The total production cost decreased from \$2.2 to \$1.37.

During the Merger, Morgan Stanley and RBC Capital Markets acted as financial advisors to Barrick Gold, we do not have the knowledge which method they used in the valuation. As we mentioned in the last chapter, by using option pricing model, the negotiation range will be more accurately defined. The current valuation methodologies are still unable to provide a figure that a buyer is willing to pay and seller is willing to accept.



According to Dionne, Gaye and Bergeres (2010) research, most of acquirers pay for a significant amount of premium to the target companies. The average premium is 34.62% with a standard deviation is 30.46%. They analyzed the independent determinations in four categories: target (runup effect, market-to-book, sales growth, company size), acquirer (cash flow, corporate governance, and strategy), transaction (transaction type, hostility, competition, information asymmetry) and other instrumental variable such as regulations/policies. In this chapter, we will mainly discuss three factors – competition, information asymmetry and bargaining power.

## 5.1 Competition

Either Margrabe's model or NPV analysis does not incorporate the game-theoretic competition in an M&A. In our case study, there are two firms involved in bidding for Equinox. The bidding process is significantly impacting on the bidding price in a merger. Yu and Xu (2011) focused on the process and formed the M&A pricing formula by using classic Rubinstein's offer-counteroffer bargaining model. However, their formulation only introduces two players (the acquirer and the target) in the game. Another important element is missing – the competition between two buyers. Intuitively, the effect of competition is not negligible in the bidding war. Consider a simple competition game, when two equal entities engage in a single bidding contest, competitive pressure forces the bidder to pay a premium which may equal to the total potential synergy. Aktas et al (2010) proved that competition allows target shareholders to receive a reasonable premium.

According to Smit (2001), the competing firm will affect each other's behavior, especially when the bids are in a sequence. Based on our case study, we mimic a real option game model: two players A (Minmetals) and B (Barrick) take sequential bid on Equinox. Minmetals bid at  $t=0$ , and Barrick bid at  $t=1$ . It's very alike Smit et al (2006)'s model. They believe the player B will observe the bid and the result and can discover more information about the target firm. Therefore, the bid from player A signals the updated value of target firm which is strictly equal or higher than the implied bid. They formed the bidding game by using Margrabe's exchange option and argue player A's bidding price is exchanged for more information of the target value to player B. therefore, we borrow their result,

At  $t=1$ , player A Minmetals's option to bid on the target  $V_A(1)$

At  $t=2$ , target firm Equinox's expected payoff  $V_B(2)$

$$C(I) = E_Q(\max(V_B(2) - V_A(1), 0) | V_A(1))$$

Where

$E_Q$  is the assumption of risk neutral

$V_i(t)$  is the player  $i$ 's current expected value of the target at time  $t$ , in this case,  $i = A$  or  $B$ ,  
 $t = 0, 1$  or  $3$

$V_i^*$  is implied value of target from player  $i$

$V_B(2) - V_A(1)$  can also be understood as the entry barriers that  $A$  setup at time 1 for playing  $B$  to bid at time 2, and we predict that  $C(I)$  is highly positively linear with the intensity of the bidding competition.

In reality, many of the competitions occur simultaneously instead of in sequence. In recent years, there is a growing number of papers related to the real option game models and conceptually describe complete/incomplete information, zero-sum/winner-take-all, simultaneous/sequential, etc. These models are a better fit in the context of real competing market and have potential for future research.

## 5.2 Asymmetrical information

After the information that the government of Panama may force Inmet to drop its plans to build a coal-fired power station for its Cobre Panama project; Lundy abandoned the deal by claiming they cannot reach a position that they thought would satisfy both sets of shareholders. Before Barrick bid on Equinox, Barrick conducted intensive feasibility studies on both Equinox's projects to obtain as much information as possible. The research on how information asymmetry affects the bidding price/premium remains limited.

Eckbo et al (1990) examined the relationship between the acquiring offer, information and the synergy. Their model is given as below:

Bidder makes an offer  $(Z, C)$ .  $C$  is the cash payment;  $Z$  is shares that the target firm will be holding after the M&A

Target's expected payoff from accepting an offer is

$$C+Z (t_i + \Omega (Z, C)-C)$$

$t_i$ , target's value at time  $i$

$\Omega (Z, C)$ , the estimation of target value of buyer, assuming the target acknowledges this value by given  $(Z, C)$

If  $C+Z (t_i + \Omega (Z, C)-C) \geq t_i$ , target accepts the offer, otherwise, the target will reject the offer.

Since this model is viewed as an extensive game under incomplete information, therefore we can predict:

$$\text{Information asymmetry } I \in [0, C+Z (t_i + \Omega (Z, C)-C) - t_i]$$

This model has been formulated with an assumption of two-way information asymmetries between the buyer and the seller. It theoretically proved the existence of the value of information. In another part of the model, it provided the optimal equilibrium of cash and stock mix as the payment in the mergers and acquisitions' transactions.

Stegemoller et al (2008) argued that the acquirers pay significant higher premium to exchange private firms which are difficult value due to the information asymmetry, Dionne et al (2010) tested 1026 acquisitions in the United States between 1990 and 2007, They found information asymmetry has an impact on the premium. Blockholder of the target's share pay an around 70% lower premium compared with other buyers.

### 5.3 Bargaining power

In the process of negotiation, the bargaining power is the ability to influence the behaviors of other players; it plays a significant role in determining the contract price. If a buyer has more bargaining power than a seller, the deal price is expected to be negotiated lower. A player who has more bargaining power is expected to be distributed bigger

portion of payoff as well. According to generalized Nash equilibrium in the game theory, two players  $X_1$  and  $X_2$ , assuming player 1's bargaining power is  $\pi$ , then player 2's bargaining power would be  $1 - \pi$ , the general total payoff is given as

$$K = X_1 \pi + X_2(1 - \pi)$$

In our case,  $K = C(T)$

Robinson and Rhodes-Kropf (2004) examined the relationship between Market to Book ratio and relative bargaining power in a merger and acquisition; they proposed that firms market to book ratios before a merger are affected not by the value they bring to the future merger, but by their relative bargaining power. The following table shows the market to book ratios of Barrick and Equinox from 2007 to 2010. We get the total assets, total liabilities and total market value from Bloomberg.

<b>Barrick Gold</b>						
Year	2010	2009	2008	2007	2006	
Total Assets	34,637.00	27,075.00	24,161.00	21,951.00	21,510.00	
Total Liabilities	13,420.00	11,528.00	8,702.00	6,613.00	7,255.00	
Total Market Value	62,064.38	46,371.39	37,863.67	40,100.01	29,859.62	
Market to Book Ratio	2.93	2.98	2.45	2.61	2.09	
<b>Equinox</b>						
Total Assets	3,242.30	1,457.67	1,471.13	828.00	357.17	
Total Liabilities	1,267.07	777.10	760.92	409.66	68.94	
Total Market Value	5,951.03	3,257.68	1,289.16	3,380.44	657.17	
Market to Book Ratio	3.01	4.79	1.82	8.08	2.28	

Table 23: market to book ratio

As the market to book ratio is defined as:

Market to Book ratio = Total market value/total book value = total market value / (total assets-total liability)

we calculated the market to book ratio according to the data, the 2006-2010 yearly market to book ratios of Equinox are higher than Barrick Gold, except year 2008 which is largely

related to the inauguration of Lumwana project. Therefore, Equinox had more bargaining power in the negotiation process, and were distributed a larger portion of total payoff.

Now we give the following regression model:

$$\text{Premium} = \beta_0 + \beta_1 \text{informaion} + \beta_2 \text{bargaining power} + \beta_3 \text{competition} + \mu$$

Where

Premium is as a percentage of the offer price

Information is assumed between two parties.  $\alpha$  and  $1 - \alpha$

Bargaining power is defined as market to book ratio

Competition is a dummy variable, 1, if there are competitions; 0, if there is no competition

We used Xlstat to run a sample of 100 tests. We assigned the value for information from 0 to 1, incremental of 0.1. Bargaining power, market to book ratio, is assigned from 1 to 5, competition is assigned either 0 or 1. We randomly assign the combination of these three numbers for each observation. One limitation of our test was that there were no correlations among information sharing, bargaining power and competition.

Summary statistics from regression

Variable	Observations	Minimum	Maximum	Mean	Std. deviation
Information sharing	120	0.000	1.000	0.471	0.308
Bargaining power	120	1.000	5.000	3.043	1.169
competition	120	0.000	1.000	0.475	0.501



Correlations between variables and factors:

	F1
Information sharing	0.469
Bargaining power	0.991
competition	-0.081

Factor pattern coefficients:

	F1
Information sharing	0.318
Bargaining power	0.563
competition	-0.035

## Chapter 6 Conclusion

This thesis reviewed literature on discounted cash flow method and real option model and applied both models to value Barrick Gold which acquired Equinox in 2011. In Section 1, we conducted a case study to help examine and analyze the acquirer, its motivations to bid on the Equinox, and the bidding game that involved other mining companies (maybe mention the names). A comparison of the results explained why Equinox should accept Barrick's offer, but reject Minmetals. This is the first paper that used Margrabe's exchange option model in addition to the traditional NPV analysis. The result is consistent with previous literature and explained the gap of the results between the two methods. The real option method bridges the traditional corporate finance practices and the strategic decisions. Even though we only applied the real option model to one case, through our analysis on this particular case and the extensive literature review, we confidently conclude that the real option approach better incorporates managerial flexibility and strategic planning. We demonstrated this to be particularly true in cases where the industry has more uncertainties and associated higher risks, the outcomes are closer to the company's real value.

In chapter 2, we discussed three major reasons why buyers will generally pay a premium price in a merger. Those reasons included: competition, information sharing, and bargaining power. In recent years, there is a growing body of literature related to real option game models. For example, models such as complete/incomplete information, zero-sum/winner-take-all, or simultaneous/sequential are based on Discounted Cash Flow and/or Real Option and Game theory. In addition, considerations for: 1) uncertainties of the future, 2) timing and managerial flexibilities, 3) interaction with other players in the market, are nuances that warrant further research. Further research in these areas may result in better predictability of the contracting price in the context of a real competing market.

However, there are some limitations in our thesis. First, due to time constraint, we were able to only conduct one main case study. In future studies, we will be able to conduct

an empirical study on more recent M&A deals, apply the option pricing model, then compare the results against with the real deal price. Second, we considered only the buyer's option; thus we only provided the lower point of the ZOPA. Third, the option pricing model we considered is based on continuous-time stochastic process. In reality, due to weekends, holidays and other special events, trading is more like a jump diffusion process which has a significant impact on the measurement of the volatilities

In conclusion, this thesis conducted sufficient literature review on current developments of DCF and ROV models including the theories and applications. The literature review provided a solid foundation for the entire thesis. By introducing the two models in the case study, the major contribution of this thesis is that we discussed the benefits of ROV in mining industry which handles better in flexibilities and uncertainties. In addition to the case analysis; we discussed some business issues arisen in M&A such as information sharing, bargaining power and competition which are very important factors in determining the premium.

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