Uranium Mining Industry
- A valuation of uranium mining companies
Master Thesis within Business Administration

Title: Uranium mining – An explosive business?

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Subject terms: Uranium, uranium mining, mining, commodity valuation, share valuation, valuation, natural resource valuation, cash flow analysis, relative PV.

Background: Over the last three years uranium prices have soared from US $14 per pound (lb) to the current price of US $120/lb and this rapid incline of the commodity have created a boom within the uranium prospecting and mining industry. There are currently 435 nuclear reactors all over the world and these reactors demand 180 millions of pounds of uranium each year to run at full production. Currently the uranium mining industry only supplies 110 million pounds of the demanded quantity. The remaining 70 million pounds are coming from secondary sources such as decommissioned nuclear warheads and other sources. Market estimations say that the secondary sources will only cover the shortage up until around 2012 then primary sources have to supply almost the whole quantity demanded. These factors imply that some sort of analysis model for uranium mining companies would be needed.

Purpose: The purpose of this report is to valuate three companies within the uranium industry and to establish if the current market value is coherent with the fundamental value of these companies. The authors will propose a valuation model that could be used when valuating companies within the uranium industry.

Method: A qualitative method has been used in order to value three companies within the uranium mining business that are fairly large players on the market. The valuation of these companies is based upon a discounted cash flow analysis, a relative PV valuation and relative valuation. The companies included in the report are corporations that are quoted at Toronto Stock Exchange and they have started mining uranium. Data have been collected through annual reports and the companies Internet pages. Other secondary information such as valuation theories has been collected from academic search engines and books on the subjects.

Conclusions: The current market values of uranium mining companies are not coherent with the actual fundamental values according to the authors. Both fundamental and a comparative approach could be used when valuing these companies and the most important part in the valuation is to try and forecast the commodity price and then to estimate the companies possible mining reserve/extractable resources.
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1 Introduction

This chapter gives an introduction to the thesis. First a general background to the subject, followed by a problem discussion that leads to the problem statement. The problem statement is followed by the purpose of the thesis.

1.1 Background

“I think we are seeing the tip of the iceberg of financial investors entering the physical uranium market”, Mitchell Dong, chief investment officer of Solios Asset Management said in mid September 2006. On top of that, Patricia Mohr, Vice President for Economics at Canada’s Scotiabank, stated that if uranium were traded on a futures exchange prices would have reached US $100 per pound (lb) already (Finch, J. 2006).

Since 2003, the spot price of uranium has soared from US $14/lb to astonishing US $120/lb at May 10, 2007. Over the last 12 months from February 2006 the price has risen more than 100 percent. Preceding the recent spike, the uranium market has been in a drought for twenty years. Prices fell and finally bottomed at US $7.1/lb in 2001. Many investors had virtually given up when the market changed in 2003 (Finch, J. 2006).

During the World Nuclear Association Annual Symposium in September 2002, Dr Moukhtar E. Dzhakishev questioned the pricing system of uranium and accused it of being primitive. Due to sporadic trading and the fact that only a fraction of the volumes are traded on spot markets, the spot price is not the actual price that most power plants pay. In 2001, only four percent of total volumes were traded on the spot market, while the remaining was sold on long-term contracts. Although it is higher now, this inevitably leads to the question how the spot price of uranium can be representative for the whole market (World Nuclear Association, 2006a).

Presently there are 435 operating nuclear reactors in the world with a combined demand of approximately 180 MM lbs (millions of pounds) of uranium. The demand is settled by a primary and a secondary supply. Primary production accounts for 110 MM lbs, while sec-
ondary supply from recycling programs and utility held supplies accounts for the remaining part. The World Nuclear Association (2006b) assumes that secondary supply will only be sufficient until 2012, when a significant shortage will emerge on the market if the mining sector does not expand.

In the last few years an immense increase in the number of companies prospecting and mining uranium have been seen however uranium have been mined and enriched long before the year 2000. Mining and prospecting operations began in for more than 60 years ago. The trade originated in the nuclear weapons procurement programs of the United States and the United Kingdom, and later on also that of France. The first shipments came from Canada, South Africa and Australia. These shipments played an essential role in the development of nuclear weapons and in 1959 the trade peaked at 20 000 metric tones. After this peak demand fell and resulting in a price drop of 60 % until the year of 1966 and it was not until the 1970’s that the commercial market for uranium began to emerge and develop to what it is today several decades later (Neff, 1984).

Since the arms race with nuclear weapons in the 1940’s and 1950’s both in the United States and the former Soviet Union a lot of the uranium used for nuclear fuel used in the 1980’s and in the 1990’s have come from decommissioned nuclear warheads but now that source of uranium is running out and new sources, or rather more sources have to be found in order to meet energy demands. Today production from world uranium mines only supplies roughly about 60 % of the requirement of power utilities (World Nuclear Association, 2006b).

1.2 Problem discussion

Over the last years, shares on stock exchanges mainly in Canada and the US that trade or mine/explore opportunities of uranium production have sky rocketed. There are numerous companies that now are involved in exploring mining opportunities of uranium. Since not only the share prices of companies dealing with uranium have soared but also the price per pound of uranium there are some good opportunities in this market. There are only a handful of the companies that actually mine uranium today or within the next two or three years. The rest of the companies are merely prospecting different areas all over the world for the “grey gold”.

The uranium market is very interesting since over the last years more and more countries have decided to build nuclear power plants to meet future energy demands. The mining market is growing fast, especially with all the new prospecting companies that want to have a slice of the uranium pie. However, there is probably not enough uranium to go around for all these companies so the race is on. Eventually as we see it the market for prospecting and mining uranium have to be consolidated within time.

The uranium prospecting and mining companies all see an opportunity to make money. In just four years time the price/pound of uranium have risen from US $10.60 (Feb. 2003) to a spot price currently at US $120 (May 15, 2007). The price have risen straight as an arrow and does not seem to currently have any roof at all and when seeing these figures one can understand the current “uranium rush”. In the light of all these new companies there are of course investors that have been increasingly interested in earning some money in uranium companies. Now, this is not the whole truth, it is easy to be mislead by these high prices but the truth is, as mentioned before, that only a fraction of the nuclear fuel today is bought on the spot market. The price of uranium sold in western countries today is agreed
upon beforehand, sometimes years in advance. (World Nuclear Association, 2006a; M, Dzhakishev 2002)

Since there is such a high interest for prospecting and mining uranium there is also a demand for some sort of analysis of the market as a whole and for specific companies within the industry for potential investors.

Today no one knows exactly how much uranium there is to mine all over the world and not only that, many countries for instance Sweden have very strict laws against these types of mining operations.

There is a lot of literature within the field of finance dealing with how to valuate companies but there is almost nothing written on the specific subject of the uranium market, at least not academic publications. All the companies that are currently active in mining and enriching uranium make press releases but there is actually not a lot of objective information on the subject.

1.3 Problem statement

• Is the current market value of advanced uranium mining companies representative for their actual fundamental value?

• Which specific valuation aspect, fundamental or comparative, could be used when valuating uranium companies?

• What valuation method is the most suitable for establishing the fair market value of advanced mining projects?

1.4 Purpose

The purpose of this report is to valuate three companies within the uranium industry and to establish if the current market value is coherent with the fundamental value of these companies. The authors will propose a basic valuation model that could be used when valuating companies within the uranium mining industry.

1.5 Delimitations

There are many early stage exploration companies, but these will not be included in the report. The authors will accordingly limit the analysis to mining companies where operations are advanced enough for a cash flow analysis. Since the mining industry is inherently associated with a high degree of expectations of the success or failure of exploration, the authors have chosen to valuate the company’s based on fairly certain mine reserves and recoverable assets.

In order to delimit the valuation to solely uranium mining, the company’s are valuated based on their uranium mining activities rather than incorporating non-core business activities.

1.6 Pre-study & Approach

The authors want to provide an analysis for companies within the uranium industry in order to see if investing in this highly speculative market would be a wise move. The first step
was to collect basic knowledge about the topic. Basic terminology within the mining industry, market research of the uranium market and knowledge of currently producing uranium companies was of interest. The achieved knowledge in the pre-study phase, created a solid base for the authors to advance with more specific studies in the subject. Using databases in the university library constituted the pre-study and its resources were used as a primary tool to find books, articles and supportive information.

By using specific keywords such as uranium market, mining, uranium prospecting, the authors have been able to find accurate information. The data for analysis was gathered from mainly World Nuclear Association and the companies included in the analysis.
1.7 Disposition of the thesis

Chapter 1
Introduction

The first chapter aims to give a clear picture of the background, problem, purpose and the delimitations. It states the reason why this subject is of interest.

Chapter 2
Frame of reference

Chapter two intends to present and describe relevant theories regarding the purpose of the thesis. The purpose of this chapter is to give the reader a clear picture of the chosen theories as well a good understanding.

Chapter 3
Methodology

The third chapter describes the relevance of the methodology, the chosen method, the approach and why the authors have chosen them. Information of the selected sample, in this case the selected uranium mining companies.

Chapter 4
Empirical Result and analysis

In this chapter the findings are presented and analyzed. Tables and figures illustrate the result of the findings.

Chapter 5
Conclusion

In this chapter the authors present the conclusions from the analysis, in order to fulfill the purpose.

Chapter 6
Final discussion

The last chapter of the thesis gives a discussion of the subject, what more or else that could have been done. Criticism and reflections that have emerged during the study.
2 Frame of reference

This chapter intends to give the reader a theoretical framework for reading this thesis. It will describe the valuation methods applied to the results in the empirical results and analysis chapter.

2.1 Uranium deposits

Uranium can be found all over the world but the largest deposits known so far are found in Australia, Kazakhstan and Canada but important to remember is that high-grade deposits have only been found in Canada so far. Figure 2.1 shows the currently known uranium deposits in the world today (Cameco, 2007).

![World uranium deposits](image)

Since uranium mining began in Canada already in the 1930’s and in combination with the high-grade deposits Canada now have the world’s best developed market for uranium companies. A majority of the large uranium mining corporations is quoted at TSX (Cameco, 2007).

2.2 Price elasticity

Elasticity is a measure of responsiveness. The most common elasticity measurement is that of price elasticity of demand. It measures how consumers respond in their buying decisions to a change in price. When the price of a good rises, the quantity demanded falls when consulting basic economic theory. Price elasticity of demand for uranium measures how sensitive the change in price of uranium will change the demand. The elasticity for a good tends to be larger when substitutes for the good are available, when a good’s share of the budget is larger and finally when the buyer have more time to adjust to the change in price. The opposite holds for inelastic demand (Frank & Bernake, 2004).
2.3 Capital Asset Pricing Model - CAPM

The relationship between risk and expected return of an individual asset, the CAPM model is often referred to as a centerpiece of corporate finance. The model is used to provide an estimate of the risk and expected return relationship of an asset. The CAPM forecast the required return and can be used to compare against the actual return of an asset. The investor can then assess whether or not the security provides a sufficient return. (Bodie, Kane & Marcus, 1999)

All investors will hold the market portfolio M. The market portfolio is the maximum mean variance portfolio placed on the efficient frontier. The Capital Market Line will be drawn from the risk free rate through the optimal risky portfolio M. All investors will hold the risky portfolio M, differentiation only through the allocation of the risk free asset.

The risk premium of the market portfolio is related to its variance and the average degree of risk aversion across the population of investors.

The risk premium of an individual asset will be proportionate to the market risk. The beta coefficient represents the individual assets risk premium towards the market. The beta value measures the individual assets movement compared to the general market movement.

\[ \beta_i = \frac{\text{cov}(r_i, r_m)}{\text{var}(r_m)} = \frac{\sigma_{i,m}}{\sigma_m^2} \]

\( \beta_i \) = Systematic risk
\( \sigma_{i,m} \) = Covariance between asset and market portfolio return
\( \sigma_m^2 \) = Variance in market portfolio return

Consequently the risk premium for an individual security is as follows.

\[ r_i = r_f + \beta(r_m - r_f) \]

\( r_i \) = Expected return on asset
\( r_f \) = Risk-free interest rate
\( \beta \) = Systematic risk
\( r_m \) = Expected return on market portfolio

2.4 Relative Valuation

2.4.1 Market Comparable Valuation

In a market comparable valuation the relative ratios of similar projects are applied to the specific project. The ratios are normalized to represent an industry standard valuation. If a project has a recoverable reserve of 1 million pounds of uranium and the comparable ratio infers a valuation of US $120/lb, the project value is US $120 million. The market comparable is expressed as a ratio (McClure, 2003).

\[
\text{Market value} \quad \frac{\text{Comparable parameter}}{}
\]

Ben McClure (2003) has identified the simplicity in relative valuation, and warns investors for being trapped in its simplicity. The concept is quick and easy to use; the value of one
company is decided by its relative valuation to other companies in the same industry. An investor can easily access the key information for comprising ratios for comparison. Since the observations are so casual, one might be mislead by indications of an under- or overvalued stock. When the P/E ratio of two companies within the same industry differ widely, it does not necessarily mean one is incorrectly valued. The forecasted earning of one company can justify a higher P/E ratio, and is by fundamental means the better investment.

When picking companies for relative valuation it is important not to only look for companies within the same industry, but also with the same underlying fundamentals. Unique variables such as growth, risk and cash flow will affect the valuation ratio. Relative valuation must be used together with fundamental analysis such as discounted cash flows to provide the investor with an accurate valuation (McClure, 2003).

2.5 Fundamental valuation

The fundamental valuation technique is based on the information concerned with the mining project. The projected commodity price and discount rate is estimated in order to produce a cash flow model. From the model the estimated free cash flow from a project is discounted back to a present value. The value of a project or firm is the present value of the free cash flow discounted by the weighted average cost of capital (Roberts, 2007; Smith & Smith, 2004)

The relevant cash flow for the project should be included in the PV model. Ross et. Al. (2005) defines relevant cash flow as the change in a firm’s overall cash flow that comes as a direct result of engaging the project. Cash flow that exists regardless of whether or not a project is undertaken cannot be associated with the project valuation.

When valuating a project in a large firm it can be virtually impossible to decide how a project will affect the overall cash flow of the company. The stand-alone principle argues that the project should be treated as a stand-alone entity. Only the incremental cash flows generated as an effect of the project is included in the analysis. By doing so, it is more comprehensive to evaluate the specific effect a project has on the whole firm (Ross et. al., 2005).

2.5.1 Discounted Cash flow analysis

Discounted cash flow (DCF) valuation is based upon a company’s ability to generate cash flow to owners over time. It is based upon long-term growth and the return on the invested capital in relationship to the company's cost of capital (Copeland et. al., 2000).

The DCF model is based on traditional theories in present value calculations which in turn means that all future cash flows is discounted to a current present value and this value is the value of the asset. The demanded rate of return is also taken into account so the value of an asset can only change in two ways; either a higher or lower future cash flows or another demanded rate of return. The present value formula is based on the pretense that the assets in question will generate cash flow in perpetuity (Gärtner & Olbert, 1995).
The formula used in DCF analysis looks as following:

\[
P_0 = \sum_{t=1}^{N} \frac{CF_N}{(1 + WACC)^t} + \frac{CF_{N+1}}{WACC - g} \left( \frac{1}{WACC} - \frac{1}{WACC^{N+1}} \right)
\]

\[P_0\] = Present value of cash flow in perpetuity
\[CF_1\] = Cash Flow period 1
\[WACC\] = Discount factor
\[N\] = Period of time denoted in years
\[g\] = Cash flow growth each year

**Free cash flow**

Miller and Modigliani (1961), reasons that the value of a firm’s equity is equal to the present value of the net cash flows generated by the firm’s assets, including the present value of investments made in the future. By saying that the equity value is merely dependent on the PV of current and future investments, a firm’s dividend and financing decisions will only affect the circumstances under which the returns are handed back to the shareholders, and hence not the actual value of the firm. The free cash flow approach estimates the value of the firm as a whole and derives the equity value by subtracting the market value of non-equity liabilities. The value is estimated by discounting the free cash flows assuming a total equity financing, adding back the present value of tax shields generated by debt financing.

<table>
<thead>
<tr>
<th>Cash flow from operation before tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Depreciation</td>
</tr>
<tr>
<td>= Taxable income</td>
</tr>
<tr>
<td>- Taxes</td>
</tr>
<tr>
<td>= Unleveraged income after tax</td>
</tr>
<tr>
<td>+ Depreciation</td>
</tr>
<tr>
<td>= Cash flow from operation after tax</td>
</tr>
<tr>
<td>+ New investments</td>
</tr>
<tr>
<td>= Unleveraged free cash flow</td>
</tr>
</tbody>
</table>

The free cash flow produced is under the prerequisites that the firm is totally equity financed. Interest on debt as well as tax shields are ignored, hence the unleveraged cash flow. In order to achieve the leveraged cash flow, tax shields from the deduction of interest on debt is added to the PV of unleveraged cash flow. The value of equity is the firm value reduced for the market value of debt. When calculating the unleveraged cash flow PV, it is important to recognize that the capitalization rate, or discount rate, must be based on an equity beta rather than firm beta.
Unleveraged cash flow
+ Tax shield from interest reduction
= Leveraged cash flow

PV of leveraged cash flow
- Market value of debt
= Market value of equity

Weighted Average Cost of Capital - WACC

Cost of equity
Cost of equity is somewhat difficult to determine with accuracy since it is impossible to
know what every investor require in terms of return on their investment. The cost of equity
has to be estimated using either the dividend growth model or the Security Market Line
(SML) approach. In order to determine the required return of an asset, the market risk
premium, risk free rate and equity beta coefficient has to be estimated. (Ross et. al., 2005).

Risk free rate
The most commonly used approach to estimate the risk free rate is to use the US Treasury
Bills as a benchmark. At the moment US Treasury Bills (3 months) are paying 4.80% (2007-05-21), which can be considered the risk free rate (Ross et. al., 2005).

Market risk premium
When an investor takes on a risky investment he demands a risk premium. Market risk
premium is the estimated excess return in the market portfolio compared to the risk free
rate (Ross et. al., 2005).

Market risk premium:

\[ E(R_M) \] \[ - \] \[ R_j \]

Equity beta
The equity beta is the systematic risk of a risky asset compared to the relative market risk.
Beta is calculated as a regression analysis between the market and the chosen asset. It can
be considered the assets tendency to swing with the market. A beta of 1 indicates that the
asset has the same volatility as the market, while a beta higher than 1 indicates a higher
volatility than the market. An investor taking on a high beta investment is exposing himself
to a higher systematic risk than investing in the market portfolio but in also require a higher
rate of return (Ross et. al., 2005).

\[ \beta_i = \frac{\text{cov}(r_i, r_m)}{\text{var}(r_m)} = \frac{\sigma_{i,m}}{\sigma_m^2} \]

\[ \beta_i \] = Systematic risk
\[ \sigma_{i,m} \] = Covariance between asset and market portfolio return
\[ \sigma_m^2 \] = Variance in market portfolio return
**WACC Formula**

The relative weight of cost of equity and debt adjusted for the tax effect will be the weighted average cost of capital. It is the return that a company has to earn on its assets to maintain the stock value. When valuating using the discounted cash flow model, the discount rate will be the WACC since it is the required return on an investment made by the firm with the same risk as the existing operations (Ross et. al., 2005).

\[
WACC = \left( \frac{E}{V} \right) \times R_E + \left( \frac{D}{V} \right) \times R_D \times (1 - T_C)
\]

- \( V \) = Combined market value of debt and equity (E+D)
- \( E \) = Market value of equity
- \( D \) = Market value of debt
- \( R_E \) = Cost of equity
- \( R_D \) = Cost of debt
- \( T_C \) = Tax rate

**2.6 Critique towards one dimensional valuation**

When valuating a company according to either market comparables or fundamentals, the end product often differs widely. The problem that arises for an investor is which valuation is more accurate. In the fundamental discounted cash flow, an opinion of required return or forecast of commodity price will affect the discount rate, and hence the present value (Roberts, 2007).

On the contrary, valuating a project according to market comparables does not correct for the project specifics. Two projects with the same reserve estimates may differ widely in terms of mining and capital costs, resulting in a comparably unfair valuation (Roberts, 2007).

**2.7 Relative PV Valuation**

Craig Roberts (2007) argue that neither fundamental nor relative valuation should be considered alternative methods they should instead complement each other. This statement is backed by Ben McClure (2003) when he argues that a relative valuation approach can be misleading when disregarding the underlying fundamentals. They should be integrated to derive one value with concern to both methods.

**2.7.1 Fundamental and market values**

The matrix developed by Roberts (2007) reveals which parameters to take into account when making an accurate estimation of fundamental and market value for both projects and companies.
Figure 2.2 Fundamental and Market Values

- The fundamental value for a project is the present value of the cash flow generated from that specific project i.e. the relevant cash flow. The commodity price and production volume, along with a proper discount rate is estimated in order to calculate the PV of all cash flows generated from the project.

- The market value of a project is expressed as the adjusted market capitalization (AMC) or enterprise value (EV). AMC/EV is calculated in the following manner.

<table>
<thead>
<tr>
<th>Company market capitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working capital</td>
</tr>
<tr>
<td>Value of other investments</td>
</tr>
<tr>
<td>Value of hedge book</td>
</tr>
<tr>
<td>Liabilities</td>
</tr>
<tr>
<td>(Capital to production)</td>
</tr>
<tr>
<td>Adjusted market capitalization, AMC (or EV)</td>
</tr>
</tbody>
</table>

The principle is that in addition to value the projects held by a mining company, the market also takes into account things such as working capital, debt, hedge book value and other investments when deciding what to pay for a share in a company. When taking these considerations into account the market value have to be adjusted according to the table above. After the adjustment, the value of the mining project itself is isolated from the other assets and liabilities undertaken by the company (Roberts, 2007).

- A company’s fundamental value, the net asset value, is the aggregated present value of all the projects undertaken. On top of aggregated PV capital and investments are
reversed back in comparison to the AMC. If a company for example undertakes three projects, each with a present value of 50 million, the aggregated value of the projects is obviously 150 million. On top of the aggregated project value, the items isolated in the calculation of adjusted market capitalization are added back to get the fundamental value of the whole company. This represents not only the project values but rather the value of all the activities undertaken by the company (Roberts, 2007).

<table>
<thead>
<tr>
<th>Aggregated present value of projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Working capital</td>
</tr>
<tr>
<td>+ Value of other investments</td>
</tr>
<tr>
<td>+ Value of hedge book</td>
</tr>
<tr>
<td>- Liabilities</td>
</tr>
<tr>
<td>= Net Asset Value, NAV</td>
</tr>
</tbody>
</table>

Now it is possible to compare the market value of a mining project (AMC/EV) to the estimated fundamental value (PV) of the projects. A valuation indicates whether fundamental values are above or below values realized in the market (Roberts, 2007).

- The market value of the company is simply the market capitalization. An indication whether the market value is representative for the fundamental value of the company is a comparison of the net asset value. By comparing the market capitalization to the estimated NAV it is possible to calculate a premium or discount the market is paying to a specific fundamental value (NAV) (Roberts, 2007).

### 2.7.2 Parameters for valuation

According to Roberts (2007) the following comparable parameters should be considered when valuating a mining company.

<table>
<thead>
<tr>
<th>Comparable parameter</th>
<th>Information taken into account</th>
<th>Market valuation ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geological resource</td>
<td>Geological delineation</td>
<td>AMC / lb resource</td>
</tr>
<tr>
<td>Mineable reserve</td>
<td>Mining recovery</td>
<td>AMC / lb reserve</td>
</tr>
<tr>
<td>Recoverable metal</td>
<td>Metallurgical recovery</td>
<td>AMC / recoverable</td>
</tr>
<tr>
<td>Payable metal</td>
<td>Pay factor, unit deductions</td>
<td>AMC / payable</td>
</tr>
<tr>
<td>Gross revenue</td>
<td>Metal prices</td>
<td>AMC / gross revenue</td>
</tr>
</tbody>
</table>
### Net Smelter Return

- **Operating cash flow (EBITDA)**
  - Operating cost
  - AMC / operating cash flow
- **Cash flow after capital (EBIT)**
  - Capital (initial and sustaining)
  - AMC / EBIT
- **Net cash flow (Earnings)**
  - Interest and taxes
  - AMC / Net cash flow
- **Present value**
  - Discounting
  - AMC / PV

The table is organized in the sequence that the PV of a project is achieved. As the table moves down, more information of the project is taken into account, including all information in the upper parameter. When all relevant information is included, the project’s net cash flow and present value can be calculated. The ratios in the right hand column get more accurate the more information is included. The AMC / PV ratio includes all the quantifiable information about a project comparables to derive a single ratio for market to fundamental value (Roberts, 2007).

When only a market comparable valuation is used, a ratio higher up in the table incorporates less information and a higher chance of error. Valuating a mining project using only for example recoverable metal ignores project specific information and is therefore not as reliable as a ratio including more information. When valuating an advanced mining project or operating mine, all steps of the process of mining should be included for an accurate estimate (Roberts, 2007).

![NPV per recoverable unit](image_url)

**Figure 2.3 PV per recoverable unit**
Figure 2.3 illustrates how widely the PV per recoverable ounce can vary depending on for example operating costs and smelter terms. By estimating the average market value per dollar of PV for the comparables, the investor gets a more accurate estimate than using a simpler estimate like market value per unit of reserve (Roberts, 2007).

In order to valuate a mining project using a relative PV valuation model, estimates of market value, PV and thus the market to fundamental value ratio has to be established for each comparable company. This ratio indicates what the market is willing to pay for each dollar of PV value, given the set of assumptions such as price, inflation, interest and discount rate (Roberts, 2007).
3 Method

This chapter will describe how the authors have approached the problem and gathered information to solve the purpose. Issues that are explained in this chapter are the different methods and approaches used in this thesis.

When writing a thesis, the chosen methodology helps the authors investigate and write a thesis that fits the specific needs and wants, and will provide the best to answer the specific questions. In order to obtain the information needed in a study two types of methods can be used, a qualitative approach and a quantitative approach (Svenning, 2003). Both of them strive towards the same purpose; to create a better understanding of a phenomenon and how it affects us (Holme & Solvang, 1997). Which method to choose depend on if you need a total perspective, qualitative, or a deep understanding of the field of interest, qualitative. Some fields of study may be more appropriate to approach with the qualitative method and some with the quantitative method. Sometimes, both methods can be useful. Method chosen should be based on the theory used, the problem the researcher wants to approach and the purpose of the investigation (Trost, 2005). For this thesis the importance of primary and secondary data will also be addressed.

3.1 Qualitative vs. quantitative approach

According to Holme & Solvang (1997), the quantitative approach is based on the transformation of information into numbers in order to make an explanation of the studied field. The numbers are then used to provide the researcher with hard data to make a statistical analysis. The researcher approaches the phenomenon from the outside and the data is collected from a large sample with very brief information about the subject analyzed. The quantitative method goes more wide than deep (Holme & Solvang, 1997). The data does only answer questions like “how many” and not the question “why” it is in a certain why depending on the analyzed subject (Svenning, 2003; Trost, 2005). The research is carried out in a very systematic way with the use of e.g. structured surveys and questionnaires with fixed questions and answers to make it easier to transform the numbers into data (Holme & Solvang, 1997). The analyzed phenomenon is also highly affected by the researchers own ideas about which variables to use and how to interpret the data (Alvesson & Sköldberg, 1994). The use of a quantitative would not reflect the purpose very well and with this in mind the authors have chosen a quantitative method since the idea is to go more in-depth with the analysis of three uranium mining companies.

The qualitative approach, according to Trost (2005), puts more focus on transforming the information received into different patterns and to get a deeper understanding about the field of interest. The patterns are then analyzed and reported (Holme & Solvang, 1997). The goal is to find unique and specific details about the analyzed subject, not to generalize as in quantitative research. It is more about providing examples and through them make conclusions (Svenning, 2003). The collected data is very soft and sensible and answer the question “why” it is in a certain way. Since the information collection is very time-consuming, information is gathered from a very limited and carefully picked sample and aims for a deep knowledge about the studied phenomenon (Holme & Solvang, 1997). In order to make accurate examples and provide a good analysis the pre-study done before writing the thesis was quite important since it gave a good idea which companies that should be chosen and on what grounds further down it is presented how the selection and collection of data was done.
A qualitative study is conducted through different methods but mainly through in-depth interviews and/or observations (Svenning, 2003). Research is made very flexible, unsystematic and unstructured and no fixed questions and answers are given to the analyzed subject (Holme & Solvang, 1997). In the case of this thesis the qualitative study was made by investigating mainly annual reports since they provide most of the data needed for a good financial analysis of companies.

The advantage with a qualitative approach is that it gives a complete picture of the field of interest and provides the researcher with full understanding about coherences among the studied subjects (Holme & Solvang, 1997). This further motivates the choice of making a qualitative study since it is the complete picture that the authors strive for.

When conducting a qualitative study it also is easier to correct mistakes during the process compared to a quantitative study. If information is missing, if there is doubt regarding the collected information or if a question does not give a satisfying answer, the data can be re-checked (Holme & Solvang, 1997). This option have been invaluable during the work with this thesis since all results had to be changed a few times when new or more reliable data had to be taken into consideration.

There are also disadvantages with a qualitative method. Since the information gathered is not put quantified, the analysis of the information will be biased by the writer’s own knowledge, experience and emotions (Holme & Solvang, 1997). This problem though is something that every analysis from financial institutions and banks all over the world faces. The authors have tried to be as objective as possible to be able to provide a non-biased result and analysis.

The generalizations made in a quantitative analysis can be used as a measure of the population if it is made correctly. This is not the way with a qualitative analysis since the focus is more on the individual than on the entire sample (Holme & Solvang, 1997). We cannot use our result and conclusion as a measure of all uranium prospecting and mining firms however, it will give a good indication of their value.

### 3.2 Collection of primary and secondary data

When collecting data there are most often two categories mentioned; primary and secondary data. The optimal combination is to use different types of data enabling both categories to support and control each other in the best way. The primary data is data collected by a researchers specific problem at hand and secondary data, might not fit the specific problem but might help in finding a solution to it. Collecting these two types of data can be done in numerous ways, it might include interviews, or surveys but also collecting numbers from annual reports.

The data used in this report is denoted as secondary and was retrieved from annual reports from the investigated companies. This thesis has also used academic reports, books and Internet sources to find proper information regarding theories and concepts described. The main Internet sources used have been academic search engines such as Google scholar, Emerald Fulltext, Jstor and Ebrary. All sources are listed in the list of references.

When using Internet sources, the search words have been e.g. uranium, uranium bull-market, uranium mining, mining, nuclear power etc. The search engines have been used for key concepts and theories and companies web pages for annual reports. The Jönköping
University Library has been a great help when finding books and academic reports related to the topic.

Secondary data is used to give a general view of the market and future outlooks but also to get production figures and costs for respective company. Data from annual reports is used to find ratios and numbers that will be analyzed to find a value for the analyzed companies.

3.3 Analysis of the collected data

In analyzing the collected data the authors have tried to compare the information in the theoretical framework with the empirical findings. The focus lies on key ratios from the annual reports from the companies investigated.

There are mainly three methods for financial analysis; longitudinal, rule of thumb and the cross section analysis. The authors of this paper will use the cross section method of analysis since this approach compares the business ratio of a specific company with the business ratios of its competitors within the same industry. This method is thought to give the best view of the companies and the uranium industry as such (Nilsson et al., 2002).

The analysis is structured in a similar way as the theoretical framework in order to make it easier to follow. Each section brings up the use of the financial terms and theories with calculations needed to obtain an answer. The research questions and the purpose stated in the background will be covered in the analysis and then compiled in the conclusion to get an overall view of the result deriving from the empirical findings and analysis.

3.3.1 Making the valuation

In order to make a reasonably accurate estimation of a company’s value it is crucial to be very thorough. So the next step was to create a platform in Microsoft Excel in order to structure values and get an overview of cash flows and key ratios. The results can be seen in the next chapter. One crucial point was to estimate production over the coming years in order to be able to come up with a PV of their mining operation. By extensively reading annual reports from the selected companies the authors believe that they have made a fair estimation of future production over the coming years.

Factors in a PV analysis such as the beta values for respective companies have been found at Reuters (2007) website. And the market risk premium that is used is the average market risk premium in Canada from 1971 until 2002, and it is 5.5% (Alberta Energy and Utilities Board, 2002).

The risk free rate used in the CAPM model for all companies is the 10-year government bond rate since cash flows are calculated over the next nine years and therefore the authors chose this rate, however currently this rate does not differ significantly from the 3-month Treasury bill rate that usually is considered as the risk free rate. The interest rate is found at Reuters (2007).

All values in the thesis are in Canadian dollars if nothing else is pointed out.

3.3.2 Selection

The valuation of mining companies using comparable approaches is difficult. The selection of the companies that is a part of this investigation are corporations that have been selected
since they are the large companies and similar in size and development compared to other companies within the industry at Toronto Stock Exchange (TSX). These corporations have currently a working production/mining operation and they are quoted at the TSX.

The selected companies are:

- Denison Mines Corporation
- SXR Uranium One Incorporated
- Paladin Resources Limited

### 3.4 Validity and reliability

There are two major problems within the field of empirical research, the validity and reliability of the research. The validity problem is the same no matter if you do a qualitative or quantitative approach while the reliability differs between the two approaches (Svenning, 2003).

Validity refers to measuring what you are expected to measure, the connection between the theory and the empirical findings. Validity should not be a problem since the primary data from the annual reports provide valid data for the thesis. The data collected will be in line with the purpose of the research and match the real world, so that the researcher can make the right interpretations of the collected data (Svenning, 2003).

The reliability of the research is about the trustworthiness of the empirical findings and the interpretation of the same. For this thesis the main source will be annual reports, which is considered to have high reliability. Reliability is definitely something to consider when doing a quantitative study such as this since the fewer sources of information one have, the risk for faults occurring increases (Svenning, 2003).

To make this thesis more as valid as possible, extensive reading have been done both with academic articles within the finance field but also article from business magazines and newspapers. This knowledge has led to the frame of reference.

To improve the reliability in this thesis, the authors have followed the structure described in the method. Since we are dealing with a qualitative analysis within the uranium market it is hard to predict if other studies would show similar results since not many studies within this certain market has been made before. The sources used for beta values and interest rates are well known and established in the business community.
4 Empirical results and analysis

This chapter presents the results from the empirical study and an analysis is also included of the data in this chapter.

4.1 Future Market Outlook

The market for uranium does at present time look very good with an excess demand. These predictions are general but nonetheless important for making valuation of companies within the business. The upside seems promising especially now with a very high uranium price. Although we have a more modest look on the price of uranium than the current US $120/lb (May 15, 2007) the market is still strong for companies that already are mining or are in the very late stages of prospecting and have found extractable resources. The market for companies present in countries such as Australia, Canada and Kazakhstan is especially good since there are large deposits of uranium in these countries (See fig. 2.1).

4.1.1 Risks to forecast

There are always risks to forecasting and we have encountered quite specific risks associated with the uranium mining industry. These risks are mentioned in the companies’ annual reports, but summarized below in order to give a brief overview of possible issues that can affect a valuation and the future of the companies included in this thesis.

Commodity price risk
Commodity price assumptions are based on estimates of our research, a weighted average of what have been read in the press and stated by analysts. The timing and magnitude of price fluctuations is always a great risk and will most definitely affect the value of the mining exploration companies. The primary commodity price considered in this thesis is of course Uranium.

Financing risks
To finance mining projects, equity or project dilution may be taken in order to fund the equity portion of the capital costs if the projects are to be developed. This is particularly common when constructing new mines. Important to remember is also that shareholders may be subordinated lenders in order to be able to finance a project.

Geopolitical risks
Mining companies in general are subjected to extensive regulations by governments. It is every aspect of these projects that are scrutinized. These regulations relate to production, development, exploration, exports, imports, taxes, labour standards, occupational health, waste disposal, safety, mine decommissioning and reclamation. Compliance of all these standards will increase the costs for the mining companies, especially within the uranium industry since uranium is a heavy regulated commodity. In some cases the regulations might even prevent mining from occurring. In general developing countries are seen as more risky because a quick change in power could lead to drastic changes in policy however developed countries have other geopolitical issues especially with powerful environmental lobbies that can make mining difficult.

Technical risks
All mining operations are subject to unforeseen risks such as rock bursts, geological interruptions and equipment failure all which are negative to these companies. Usually these
companies have skilled employees that calculate the ore reserves and resources but these estimates are not always accurate and such things will also affect the companies result.

**Exploration risks**
Exploration may turn out not to yield anything however this is a risk that usually is taken into account since exploration is a primary part of a mining company but never the less, share price will be affected by bad news.

**Public safety risks**
Looking back over the years when nuclear power have been used there have been two major accidents – Three Mile Island and Chernobyl. One was contained and the other was not. These are the only major accidents that have occurred during the years of civil nuclear power in 32 countries. The risk from western nuclear plants is minimal compared to other commonly accepted risks (World Nuclear Association, 2006c).

**Alternative fuels**
Alternate sources of energy like wind, solar, hydrogen fuel cells. They are all advancing but not yet enough to make any significant difference in the global power supply. Significant technological breakthroughs have to be made in order for these sources of energy to contribute significantly to the power supply so therefore it can be expected to se demand for fossil fuels and nuclear power to dominate the energy supply for a long time yet (World Nuclear Association, 2006f).

A more direct threat to uranium mining is nuclear fuel recycling. This means that the waste from reactors is recycled and used again in a reactor. This product is known as Mixed Oxide Fuel (MOX), this fuel can generally be used to replace up to 30% of the fuel elements in an existing reactor without any modifications at all. But the process is complicated and dangerous since MOX have much more problems associated to radiation than virgin uranium does. The current MOX contribution to the nuclear fuel business is rather small when looking at the whole industry (World Nuclear Association, 2006f).

**4.1.2 Demand**
Historical values shows that the world energy production and consumption has been growing at approximately 2-3% per annum and most projection suggests that this will continue at least until 2030 (Criqui & Kouvaritakis, 2000).

In December 2006 there were 435 reactors currently in operation producing 368 246 Mega Watts (Also denoted ad MWe and refers to the electric output from a generator or roughly 360 GWe) of power. There are currently 28 reactors under construction, 64 planned and more that 158 have been proposed globally with more added each month. The World Nuclear Association (WNA) have speculated in 2030 production from the current reactors plus 100 new reactors with current average capacity levels that the output would reach 542 200 MWe, a 45% increase derived from nuclear power today. The upper case scenario from WNA predicts that capacity could grow as high as 740 200 MWe, a 102% increase from today’s production. This would in turn mean 462 new reactors by 2030, a graph of the predicted growth can be seen in figure 4.1 (World Nuclear Association, 2006a).
4.1.3 Supply
All current operating reactors require approximately 180 MM lbs of uranium but as mentioned earlier only about roughly 60 percent is supplied by primary production, the remaining percentage is coming from secondary sources (World Nuclear Association, 2006b).

Predictions made by World Nuclear Association states that the current market conditions can hold up until 2012 at which time a significant shortfall will be in place if mining does not increase significantly the coming years. But when reading reports from the corporations the demand will most likely be met, but not by much so the supply-demand balance will remain tight according to our estimations (World Nuclear Association, 2006b).

4.1.4 Elasticity
When looking at the specific case of uranium, the demand for uranium is inelastic since there are no substitutes that can be used in a nuclear power plant, the budget share is not large since the cost of producing nuclear power is not the fuel but rather the capital investment in equipment. Timing is not an issue since buyers of uranium have to ignore this factor; they have to have fuel even if the prices rise quickly as they have done the last years. An inelastic demand for uranium will have a positive impact on the price over the next years.

4.1.5 Price forecast
With the uranium price currently sitting at US $120/lb (May 15, 2007), up over 60% in 2007 alone, it has become difficult to forecast short to mid-term targets for the commodity. In the market right now there are five powerful drivers; Cigar Lake (probably the worlds largest uranium deposit known so far) delay, the central core-effect for new reactors, investment and hedge fund participation and continued production misses by major producers. Together these factors continue to put significant upward pressure on the uranium price. We have estimated a possible price scenario in the graph below that we have used in our models with a price ranging from US $90/lb 2007 and peaking at US $110/lb in 2008-2009 and then to decline some when supply catches up with demand around 2012.
Further, hedge funds are/have been aggressively bidding on available materials in effort to benefit from the expected appreciation, which has pushed prices even higher. Analysts within the business also estimates that around 80% of the expected global production between 2008-2012 have already been contracted and as such those forces looking to secure supply is competing for a limited supply have driven the spot price to the highest level ever. It is important to remember that in our calculation we have not used the spot price but rather a reasonable estimated average of the uranium price.

4.2 Denison Mines Corp.

Denison Mines Corporation is an intermediate uranium producer with focus on North American assets. Denison’s assets include an interest in two licensed and operating uranium mills, with its 100% ownership of the White Mesa mill in Utah and its 22.5% ownership of the McClean Lake mill in Saskatchewan, Canada. Denison currently produces uranium from five active uranium mining projects in North America and enjoys a portfolio of world-class exploration projects, including properties close to the Company’s mills in the Athabasca Basin in Saskatchewan and in the Colorado Plateau, Henry Mountains and Arizona Strip regions of the Southwestern United States. Denison also has exploration properties in Mongolia and, indirectly through its investments, in Australia and Zambia. Denison is also the manager of Uranium Participation Corporation. With mining underway in the US and production in Canada, it has a strong production profile moving towards a 4 MM lbs per annum by 2008. The company can boast with one of the largest diversified global exploration portfolios (Denison Mines, 2007).

<table>
<thead>
<tr>
<th>Net debt</th>
<th>Market cap</th>
<th>Equity Beta</th>
<th>Dept/Equity</th>
<th>Tax rate</th>
<th>Shares outstanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2 451 200 000</td>
<td>3.11</td>
<td>0</td>
<td>36.12%</td>
<td>191 500 000</td>
</tr>
</tbody>
</table>

In order to establish the firms cost of capital, and the discount rate, the capital structure has to be considered. A high leverage, debt/equity ratio, generally results in a lower cost of capital since debt is cheaper to rise than equity. However, a too high debt/equity ratio results in an elevated cost of debt since the firm’s credit rating will deter. In Denison’s case,
no debt at all is on the balance sheet. This result in a considerably higher cost of capital than if the firm was to have some financing through debt.

Table 4–2 Denison cost of capital

<table>
<thead>
<tr>
<th>Weighted Average Cost of Capital</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost of capital</strong></td>
<td></td>
</tr>
<tr>
<td>Risk free rate 10 year G. Bond</td>
<td>4.81%</td>
</tr>
<tr>
<td>Market risk premium</td>
<td>5.5%</td>
</tr>
<tr>
<td>Equity beta</td>
<td>3.11</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Required return</strong></td>
<td>21.92%</td>
</tr>
<tr>
<td><strong>Cost of debt</strong></td>
<td></td>
</tr>
<tr>
<td>Net debt</td>
<td>0</td>
</tr>
<tr>
<td>Interest paid on debt</td>
<td>0</td>
</tr>
<tr>
<td>Cost of debt</td>
<td>4.81%</td>
</tr>
</tbody>
</table>

**WACC**

- Cost of equity: 21.92%
- Cost of debt: 4.81%
- Tax Rate: 36.12%
- Debt/Equity: 0.000
- WACC: 21.92%

Currently the 10-year US government bond is trading at an interest rate of 4.81% (2007-05-19). In the calculation of weighted average cost of capital this is considered the risk free rate. The historical market risk for Canadian equity is 5.5% (Alberta Energy and Utilities Board, 2002). The required return of equity is based on a beta value of 3.11, resulting in a cost of equity of 21.92%. Using the CAPM model, the authors have estimated the required return an investor would demand for placing the investment. Since Denison does not have any debt on its balance sheet, the WACC is equal to the cost of equity, hence the free cash flow generated from the operations will be discounted by 21.92%.

Table 4–3 Denison cash flow forecast

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production</strong></td>
<td>962,000</td>
<td>4,057,000</td>
<td>4,029,000</td>
<td>6,327,000</td>
<td>7,264,000</td>
<td>5,977,000</td>
<td>5,644,000</td>
<td>5,644,000</td>
<td>6,393,000</td>
</tr>
<tr>
<td><strong>Uranium price</strong></td>
<td>90.00</td>
<td>110.00</td>
<td>110.00</td>
<td>100.00</td>
<td>100.00</td>
<td>90.00</td>
<td>85.00</td>
<td>80.00</td>
<td>80.00</td>
</tr>
<tr>
<td><strong>Cash cost</strong></td>
<td>22,45</td>
<td>23,5</td>
<td>23,46</td>
<td>15,87</td>
<td>15,75</td>
<td>17,78</td>
<td>17,72</td>
<td>18,75</td>
<td>20,28</td>
</tr>
<tr>
<td><strong>Net income</strong></td>
<td>64,983,100</td>
<td>350,930,500</td>
<td>348,669,660</td>
<td>532,290,510</td>
<td>611,992,000</td>
<td>431,658,940</td>
<td>379,728,320</td>
<td>345,695,000</td>
<td>381,789,960</td>
</tr>
<tr>
<td><strong>EPS</strong></td>
<td>0,339</td>
<td>1,833</td>
<td>1,821</td>
<td>2,780</td>
<td>3,196</td>
<td>2,254</td>
<td>1,983</td>
<td>1,805</td>
<td>1,994</td>
</tr>
<tr>
<td><strong>Cash flow from operations</strong></td>
<td>71,481,410</td>
<td>386,023,550</td>
<td>383,536,626</td>
<td>385,519,561</td>
<td>673,191,200</td>
<td>474,924,854</td>
<td>417,701,152</td>
<td>380,264,500</td>
<td>419,968,956</td>
</tr>
<tr>
<td><strong>CFPS</strong></td>
<td>0,373</td>
<td>2,016</td>
<td>2,003</td>
<td>3,058</td>
<td>3,315</td>
<td>2,480</td>
<td>2,181</td>
<td>1,986</td>
<td>2,193</td>
</tr>
<tr>
<td><strong>Capital expenditure</strong></td>
<td>18,018,000</td>
<td>105,272,000</td>
<td>19,688,000</td>
<td>21,299,000</td>
<td>12,199,000</td>
<td>12,199,000</td>
<td>12,759,000</td>
<td>672,000</td>
<td>585,000</td>
</tr>
<tr>
<td><strong>Free cash flow</strong></td>
<td>53,463,410</td>
<td>280,751,550</td>
<td>363,848,626</td>
<td>384,300,500</td>
<td>671,972,200</td>
<td>473,605,834</td>
<td>409,942,152</td>
<td>379,592,500</td>
<td>419,383,956</td>
</tr>
</tbody>
</table>

Initially during 2007 production is estimated to be slightly less than 1 MM lbs, rising to approximately 4 MM lbs by 2008 due to the mining operations in the US. The author’s forecast of uranium price, presented earlier in this chapter, is the foundation for establishing the cash flow from operations. Cash cost is an average of the total operating cost, divided by mining volume. Since cash cost per lb includes the fragment of all cost associated with mining and administration, the net income is calculated as the mining volume times the margin of sales and cash cost.
Production 

\[ (\text{Uranium price} - \text{Cash cost}) \] 

\[ = \text{Net income} \] 

\[ + \text{Non-cash items} \] 

\[ = \text{Cash flow from operations} \] 

\[- \text{Capital expenditure} \] 

\[ = \text{Free cash flow} \]

Based upon the calculations illustrated above, a free cash flow for each of the analyzed companies has been produced.

Table 4–4 Denison discounted cash flow

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>43,853,021</td>
<td>188,889,526</td>
<td>200,793,343</td>
<td>264,489,071</td>
<td>249,497,151</td>
<td>144,236,171</td>
<td>102,405,333</td>
<td>77,778,664</td>
<td>70,485,133</td>
<td>358,886,960</td>
</tr>
<tr>
<td>Present value</td>
<td>1,701,344,374</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV/Share</td>
<td>8.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At a discount rate of 21.92%, the present value of all free cash flow until 2015, including terminal value, is C $1,701,344,374. The terminal value is achieved by assuming a 5% cash flow growth to perpetuity.

As of 2007-05-10 the current stock price of Denison Mining Corporation was C $12.8, with a total amount of diluted shares outstanding of 191,500,000. The present value per share is calculated according to table 4-4, and equals to C $8.88 per share. According to the theory of relative PV valuation the discounted cash flows should be compared to an industry comparable to give the investor an indication of what the market is willing to pay for each dollar of PV.

Table 4–5 Denison comparable ratios

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS</td>
<td>0.34</td>
<td>1.83</td>
<td>1.82</td>
<td>2.78</td>
<td>3.20</td>
</tr>
<tr>
<td>P/E</td>
<td>37.72</td>
<td>6.98</td>
<td>7.03</td>
<td>4.61</td>
<td>4.01</td>
</tr>
<tr>
<td>CFPS</td>
<td>0.37</td>
<td>2.02</td>
<td>2.00</td>
<td>3.06</td>
<td>3.52</td>
</tr>
<tr>
<td>P/CFPS</td>
<td>34.29</td>
<td>6.35</td>
<td>6.39</td>
<td>4.19</td>
<td>3.64</td>
</tr>
<tr>
<td>Share price 2007-05-10</td>
<td>12.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The ratios in table 4-5 was calculated from the cash flow forecast in table 4-3. Based on the forecasted rise in production volume, the current P/E ratio is high, although the 2008 and onwards ratios is relatively low. Cash flow per share is inherently slightly higher than earnings per share.
4.3 SXR Uranium One Inc.

SXRx Uranium One Inc. is engaged in the exploration and development of uranium and gold resource properties in South Africa, Australia and Canada. According to themselves they are also actively pursuing growth opportunities in the western United States. The Corporation is an emerging mid-tier uranium producer with the objective of commencing uranium production at its Dominion Project in 2007 and at its Honeymoon Project in early 2008. Expected production in 2007 is approximately 2 300 MM lbs (SXRx Uranium One, 2007).

Table 4-6 SXR capital structure

<table>
<thead>
<tr>
<th></th>
<th>Net debt</th>
<th>Market cap</th>
<th>Equity Beta</th>
<th>Dept/Equity</th>
<th>Tax Rate</th>
<th>Shares outstanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>SXR Uranium One</td>
<td>185 000 000</td>
<td>2 414 820 000</td>
<td>2,19</td>
<td>0,077</td>
<td>36,12%</td>
<td>144 600 000</td>
</tr>
</tbody>
</table>

Compared to Dension, SXR has slightly more debt. The debt ratio is however very small resulting in the same scenario as Dension, with a high cost of capital. SXR presents the investor with lower systematic risk than Denison and Paladin. A lower beta value combined with a higher debt ratio, SXR’s weighted average cost of capital is 15.64% compared to Denison’s 21.92% and Paladin’s 25.45%.

Table 4-7 SXR cost of capital

<table>
<thead>
<tr>
<th>Weighted Average Cost of Capital</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of equity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk free rate 10 year G. Bond</td>
<td>4,81%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market risk premium</td>
<td>5,5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity beta</td>
<td>2,19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of equity</td>
<td>16,86%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of debt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net debt</td>
<td>185 000 000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest paid on debt</td>
<td>3039000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of debt</td>
<td>1,64%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WACC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of equity</td>
<td>16,86%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of debt</td>
<td>1,64%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax Rate</td>
<td>36,12%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt/Equity</td>
<td>0,077</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WACC</td>
<td>15,64%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The authors believe the risk level is highly associated to the inherent uncertainty regarding classified reserves as well as the high volatility and recent spike in the uranium price. The market’s efficiency to discount the spiking uranium price has lead to a high volatility within the whole industry. Due to the beta value, the equity return required by investors drives the WACC and discount rate to levels not usually associated with stable mining companies.

Table 4-8 SXR cash flow forecast

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (lbs)</td>
<td>2 293 000</td>
<td>6 709 000</td>
<td>7 736 000</td>
<td>9 528 000</td>
<td>12 617 000</td>
<td>16 301 000</td>
<td>16 196 000</td>
<td>16 456 000</td>
<td>16 207 000</td>
</tr>
<tr>
<td>Uranium price</td>
<td>90</td>
<td>110</td>
<td>110</td>
<td>100</td>
<td>100</td>
<td>90</td>
<td>45</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Cash cost</td>
<td>12,5</td>
<td>11,85</td>
<td>14,32</td>
<td>14,81</td>
<td>12,79</td>
<td>12,83</td>
<td>12,53</td>
<td>12,46</td>
<td>15,63</td>
</tr>
</tbody>
</table>
Out of the three valued companies, SXR has the by far largest classified reserves scheduled for mining. The considerably largest amounts will be mined after 2010 resulting in a market supply increase, not solely filling the demand shortage, but contributing to the total supply increase. Since the authors have forecasted the uranium price to begin a drop towards a state of market equilibrium in 2012, SXR will not fully capitalize on extreme uranium prices. Due to the high discount rate, large quantities of production late in time is not appreciated as well by the market as near term production.

Table 4–9 SXR discounted cash flow

<table>
<thead>
<tr>
<th>Year</th>
<th>Free cash flow</th>
<th>Discount rate</th>
<th>PV</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>40 147 025</td>
<td>15.64%</td>
<td>34 716 009</td>
<td>1 145 835.29</td>
</tr>
<tr>
<td>2008</td>
<td>668 582 535</td>
<td>15.64%</td>
<td>499 928 475</td>
<td>1 091 271.11</td>
</tr>
<tr>
<td>2009</td>
<td>721 993 114</td>
<td>15.64%</td>
<td>466 833 835</td>
<td>294 999.11</td>
</tr>
<tr>
<td>2010</td>
<td>741 508 642</td>
<td>15.64%</td>
<td>414 592 947</td>
<td>2 516 381.23</td>
</tr>
<tr>
<td>2011</td>
<td>1 154 351 570</td>
<td>15.64%</td>
<td>558 110 527</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>1 323 004 542</td>
<td>15.64%</td>
<td>553 120 652</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>1 227 884 808</td>
<td>15.64%</td>
<td>443 907 608</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>1 164 238 917</td>
<td>15.64%</td>
<td>363 959 867</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>1 091 271 711</td>
<td>15.64%</td>
<td>294 999 110</td>
<td></td>
</tr>
</tbody>
</table>

Present value: 6 146 550 263
PV/Share: 42.51

In the table below it is obvious that the usual comparative ratios for SXR are very small compared to its peer companies. Since the initial production is small, the 2007 P/E ratio of 13.59 could by all means be considerably larger. The forecasted ratios indicate a very low market capitalization relative to earnings and cash flow.

Table 4–10 SXR comparable ratios

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS</td>
<td>1,229</td>
<td>4,554</td>
<td>5,119</td>
<td>5,613</td>
<td>7,609</td>
</tr>
<tr>
<td>P/E</td>
<td>13.59</td>
<td>3.67</td>
<td>3.26</td>
<td>2.98</td>
<td>2.19</td>
</tr>
<tr>
<td>CFPS</td>
<td>1,315</td>
<td>4,873</td>
<td>5,477</td>
<td>6,006</td>
<td>8,142</td>
</tr>
<tr>
<td>P/CFPS</td>
<td>12.70</td>
<td>3.45</td>
<td>3.05</td>
<td>2.78</td>
<td>2.05</td>
</tr>
</tbody>
</table>

Share price 2007-05-10: 16.7

4.4 Paladin Resources Ltd.

Paladin Resources Ltd is a uranium focused mid tier mining company. Paladin has projects in Australia and Africa. Now the strengthening of the uranium market continues and with the looming supply shortages, strong upward pressure on uranium prices is expected to be maintained offering Paladin an excellent opportunity to capitalize and become a significant supplier of natural uranium (Paladin Resources Ltd., 2007).

Table 4–11 Paladin capital structure

<table>
<thead>
<tr>
<th>Paladin Resources</th>
<th>Net debt</th>
<th>Market cap</th>
<th>Equity Beta</th>
<th>Dept/Equity</th>
<th>Tax rate</th>
<th>Shares outstanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>320 000 000</td>
<td>4 478 970 000</td>
<td>4.08</td>
<td>0.071</td>
<td>30%</td>
<td>517 800 000</td>
<td></td>
</tr>
</tbody>
</table>
Along with the analyzed companies, Paladin has a similar extremely low debt/equity ratio. The market capitalization is similar to Denison and considerably higher than SXR, even though both these companies have larger production forecast.

Table 4–12 Paladin cost of capital

<table>
<thead>
<tr>
<th>Weighted Average Cost of Capital</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of equity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk free rate 10 year G- Bond</td>
<td>4,81%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market risk premium</td>
<td>5,5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity beta</td>
<td>4,08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Required return</td>
<td>27,25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of debt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net debt</td>
<td>320 000 000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest paid on debt</td>
<td>9 500 000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of debt</td>
<td>2,97%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WACC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of equity</td>
<td>27,25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of debt</td>
<td>2,97%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax Rate</td>
<td>30,00%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dept/Equity</td>
<td>0,071</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WACC</td>
<td>25,45%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Paladin is the company that presents the investor with the highest systematic risk with a beta value of 4,01. Since the debt is so small, the WACC is close to the cost of capital that inherently is very high due to the beta value. This will result in a high discount rate and a PV per pound of recoverable uranium smaller than its peer companies.

Table 4–13 Paladin free cash flow

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>850 000</td>
<td>3 347 000</td>
<td>6 769 000</td>
<td>6 769 000</td>
<td>6 769 000</td>
<td>6 769 000</td>
<td>6 769 000</td>
<td>6 769 000</td>
<td>6 769 000</td>
</tr>
<tr>
<td>Uranium price</td>
<td>90</td>
<td>110</td>
<td>110</td>
<td>100</td>
<td>100</td>
<td>90</td>
<td>85</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Cash cost</td>
<td>12,58</td>
<td>19,46</td>
<td>14,18</td>
<td>14,18</td>
<td>14,18</td>
<td>14,18</td>
<td>14,18</td>
<td>14,18</td>
<td>14,18</td>
</tr>
<tr>
<td>EPS</td>
<td>0,127</td>
<td>0,585</td>
<td>1,253</td>
<td>1,122</td>
<td>2,991</td>
<td>0,926</td>
<td>0,860</td>
<td>0,860</td>
<td></td>
</tr>
<tr>
<td>Cash flow from operations</td>
<td>69 097 350</td>
<td>318 189 249</td>
<td>681 035 859</td>
<td>609 961 359</td>
<td>609 961 359</td>
<td>538 886 859</td>
<td>503 349 609</td>
<td>467 812 359</td>
<td>467 812 359</td>
</tr>
<tr>
<td>CFPS</td>
<td>0,133</td>
<td>0,615</td>
<td>1,315</td>
<td>1,178</td>
<td>1,178</td>
<td>1,041</td>
<td>0,972</td>
<td>0,903</td>
<td>0,903</td>
</tr>
<tr>
<td>Capital expenditure</td>
<td>85 000 000</td>
<td>85 000 000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free cash flow</td>
<td>-15 902 650</td>
<td>233 189 249</td>
<td>681 035 859</td>
<td>609 961 359</td>
<td>609 961 359</td>
<td>538 886 859</td>
<td>503 349 609</td>
<td>467 812 359</td>
<td>467 812 359</td>
</tr>
</tbody>
</table>

The initial production 2007 is relatively small, rising through 2008 and remaining constant approximately 6,8 MM lbs throughout the forecast period. Paladin has the lowest scheduled mining recovery. The cash cost is attractively low, leaving a large margin per pound of uranium.
Table 4–14 Paladin present value

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Free cash flow</td>
<td>-15,902,630</td>
<td>233,189,249</td>
<td>681,035,859</td>
<td>609,961,359</td>
<td>609,961,359</td>
<td>538,886,859</td>
<td>503,349,609</td>
<td>467,812,359</td>
<td>467,812,359</td>
<td>491,202,977</td>
</tr>
<tr>
<td>Discount rate</td>
<td>25,45%</td>
<td>25,45%</td>
<td>25,45%</td>
<td>25,45%</td>
<td>25,45%</td>
<td>25,45%</td>
<td>25,45%</td>
<td>25,45%</td>
<td>25,45%</td>
<td>25,45%</td>
</tr>
<tr>
<td>PV</td>
<td>-12,676,323</td>
<td>148,168,589</td>
<td>344,938,291</td>
<td>246,262,094</td>
<td>196,300,488</td>
<td>138,242,144</td>
<td>102,928,682</td>
<td>76,253,921</td>
<td>60,783,540</td>
<td>248,755,051</td>
</tr>
<tr>
<td>Present value</td>
<td>1,549,956,481</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PV/Share</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,99</td>
</tr>
</tbody>
</table>

The current stock price at C $8,65 (2007-05-10) is not at all representative for the PV per share. By a fundamental valuation, one would conclude that the stock is greatly over valued. Compared to its peer companies the fundamental valuation is considerably higher.

Table 4–15 Paladin comparable ratios

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS</td>
<td>0,13</td>
<td>0,59</td>
<td>1,25</td>
<td>1,12</td>
<td>1,12</td>
</tr>
<tr>
<td>P/E</td>
<td>68,06</td>
<td>14,78</td>
<td>6,91</td>
<td>7,71</td>
<td>7,71</td>
</tr>
<tr>
<td>CFPS</td>
<td>0,13</td>
<td>0,61</td>
<td>3,32</td>
<td>1,18</td>
<td>1,18</td>
</tr>
<tr>
<td>P/CFPS</td>
<td>64,82</td>
<td>14,08</td>
<td>6,38</td>
<td>7,34</td>
<td>7,34</td>
</tr>
</tbody>
</table>

|          | Share price 2007-05-10 | 8,65 |

The current comparative valuation for 2007 is in terms of P/E and P/CFPS very high, although the future multiples is much more moderate. Since production is estimated to rise significantly during 2007 and 2008 the latter multiples should be focused upon rather than the current valuation. With a relatively high discount rate across the industry is unfortunate to have the large cash flows far away in time. A high production early in the forecast period results in a greater impact on PV rather than distant future cash flows.

4.5 Relative PV Valuation

The relative PV valuation theory states that neither fundamental nor comparative analysis should be used separately but rather combined. The present value of the established cash flows cannot solely be the base for the value of the firm and nor can comparative valuation ratios. Table 4-16 presents the current market comparative valuations for each company. The values are collected and summed up from the cash flow analysis of each company, representing the full forecast period.

Table 4–16 Relative PV valuation

<table>
<thead>
<tr>
<th></th>
<th>Denison</th>
<th>SXR</th>
<th>Paladin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market capitalization</td>
<td>2,451,200,000</td>
<td>2,414,820,000</td>
<td>4,478,970,000</td>
</tr>
<tr>
<td>Mining recovery</td>
<td>46,297,000</td>
<td>104,043,000</td>
<td>50,730,000</td>
</tr>
<tr>
<td>Net income</td>
<td>3,447,757,990</td>
<td>8,074,750,540</td>
<td>3,997,151,440</td>
</tr>
<tr>
<td>Cash flow from operations</td>
<td>3,792,811,789</td>
<td>8,639,982,864</td>
<td>4,197,009,012</td>
</tr>
<tr>
<td>Free cash flow</td>
<td>3,636,860,789</td>
<td>8,132,982,864</td>
<td>4,112,009,012</td>
</tr>
<tr>
<td>PV</td>
<td>1,701,314,374</td>
<td>6,146,550,263</td>
<td>1,549,956,481</td>
</tr>
</tbody>
</table>

|          | AMC/Mining recovery | 52,95 | 25,21 | 88,29 |
|          | AMC/Net income     | 0,71  | 0,30  | 1,12  |
|          | AMC/Free cash flow from operations | 0,65 | 0,28 | 1,07 |
|          | AMC/Free cash flow | 0,67 | 0,30 | 1,09 |
By a quick look it is easy to establish that there seems to be no uniformity in the markets valuation. The authors will elaborate further, explaining the events that could cause the market to justify a variation in the comparatives. Since there is such a high degree of variation, one has to conclude that there is not a consistent valuation within the industry. Even though Paladin has the least volume of scheduled mining they are by far the highest valued company. The market capitalization is not representative for the present value of the established cash flows for either company.

Since cash cost vary between the companies, valuation based on solely mining recovery does not present the investor with a fair value of the asset. Denison has a considerably higher cash cost of approximately $22.5/lb, compared to SXR at $12.5 and Paladin $14.18. Based on cash cost an investor should value each pound of uranium recovery higher in the case of Paladin and SXR than Denison. The theory highlights the risk of getting trapped in the simplicity of relative valuation, something an investor valuating merely by recoverable resources would be. To achieve a proper estimate of the value of mining resources one must acknowledge the cash cost associated to the mining operations.

The current market valuation comparable of AMC/mining recovery differ widely between the companies. As the authors have established, a valuation bases on recoverable resources is not an adequate estimate. However, the market is too inconsistent in its valuation to be motivated by cash cost of operations. The difference in valuation should be explained by the deviation of cash cost. Currently, the deviation in cash cost cannot by far explain the markets ability to value mining resources in such a different manner.

Net income is derived from the uranium market price, cash cost and production volume. A fair valuation of the recoverable resources would with correction for cash cost result in a similar valuation of net AMC/Net income between the companies. An impact that can explain a valuation variation based on net income would be if the company had items on the balance sheet resulting in a considerable lower free cash flow than its peers. It is however easy to establish that this is not the case. The valuation cannot by any comparative be considered consistent across the analyzed companies.

The further down in the list of comparatives (Table 2-1), the more information affecting the PV is included. As an investor one has to incorporate as much information as possible in order to achieve a fair valuation. A variation in comparative ratios in the top of the list can therefore be motivated, but the market value per dollar of PV should be similarly valued for every company in the industry. In the valuation of the three peer companies, the market seems to have widely different perception of the actual company value based on present value. SXR could by a glance be considered to be greatly undervalued in comparison to a overvalued Paladin. The authors are not satisfied with the current market valuation and would like to establish a more accurate measure to clarify a reasonable method for valuating a uranium mining company. A benchmark has to be recognized in order to draw conclusion about the current valuation.

According to the theory, one should determine an industry standard ratio valuating each dollar of PV to a market value. In the analysis of the three companies the authors have concluded that deriving a comparative ratio of AMC/PV does not provide an accurate estimate. The market’s valuation is too inconsistent for such a ratio to be applicable.
4.6 Valuation model

By applying the theoretical framework, the authors have developed a model for valuating mining projects. Several key ratios are considered along with the fundamental value of the cash flows. This model is designed to assist in a quick valuation of mining companies reserves.

4.6.1 Uranium price and discount factor

The most essential that will be the foundation of the analysis is the forecasted uranium price as well as the appropriate discount rate for the specific company. Based on the uranium price forecast presented in this analysis along with a discount rate, an averaged present value can be produced. For the development of a model for valuation the authors have chosen to illustrate an example using a discount rate of 15% and a forecasted uranium price according to the forecast used in the analysis.

\[
\sum_{i=1}^{n} \frac{P_u}{(1 + WACC)^n}
\]

- \(P_u\) = Price forecast of uranium
- \(WACC\) = Discount rate achieved through WACC calculation
- \(n\) = Number of years

Table 4–17 Average uranium price PV

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium price</td>
<td>90</td>
<td>110</td>
<td>110</td>
<td>100</td>
<td>100</td>
<td>90</td>
<td>85</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Discount rate</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>PV</td>
<td>78.3</td>
<td>83.2</td>
<td>72.3</td>
<td>57.2</td>
<td>49.7</td>
<td>38.9</td>
<td>32.0</td>
<td>26.2</td>
<td>22.7</td>
</tr>
<tr>
<td>Averaged PV</td>
<td>51.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

The averaged PV of C $51.2 will be used to estimate the value of the recoverable reserves that will be the foundation for adjustments to the rough reserve value.

4.6.2 Quick valuation of recoverable mining

By assessing the mining reserves and cash cost, an investor can get a rough view of the value of a mining project. In the analysis it is obvious that the largest impact of the PV is the recoverable reserves and the actual cost of mining these. The quick valuation ignores such things as balance sheet items affecting cash flow as well as capital expenditure. It might seem as an inferior way of establishing the company value, but it will provide the investor with a pointer of the actual value of the reserves. One can thereby assess the company specifics affecting the free cash flow and adjust for these. The example valuation performed will assume a recoverable reserve of 50 MM lbs.

\[\text{Uranium price average PV} \times \text{Recoverable reserves}\]

\[51.2 \times 50 000 000 = 2 560 000 000\]
4.6.3 Adjusting for cash cost

Obviously a valuation solely based on the recoverable resources is not sufficient to make an investment, but rather a first glance of whether the current valuation is reasonable or not. The next step in achieving a reasonable valuation is to adjust the value of recoverable resources for cash cost. It is important to consider the impact of a high discount rate when adjusting the market value for cash cost. An overall low cash cost will affect the value far more greatly in the beginning of the forecast period, especially when taking into consideration the recent surge in uranium price.

From the analysis it can be seen that the cash cost over time is for each company fairly similar for the whole forecast period. To adjust the value of the mining reserves, one could therefore calculate an average and apply to the valuation model. For the exemplified valuation exercise an average cash cost of C $20/lb is assumed. The cash cost is then subtracted from the value of the recoverable reserves.

\[
\sum_{i}^{n} \frac{C_{C}}{(1 + WACC)^{n}} \times R_{R}
\]

\[C_{C} = \text{Cash cost per pound of uranium}\]
\[R_{R} = \text{Recoverable reserves}\]
\[WACC = \text{Discount rate achieved through WACC calculation}\]
\[n = \text{Number of years}\]

The deduction of present value of cash cost from the value of recoverable reserves is calculated in this example to C $530 175 991. This is derived from an average cash cost PV of C $10,6 per pound and a recoverable reserve of 50 MM lbs.

The rough value of the recoverable reserves is now adjusted for cash cost, resulting in a valuation one step closer to the fair value of the company.

2 560 000 000 – 530 175 991 = 2 029 824 009

4.6.4 Adjustment for cash flow

The items producing non-cash deductions to the net income has to be added back in order to get the free cash flow from operations. For a quick assessment of the valuation, this is a time consuming step in the process. One has to review each item and make a forecast prediction to establish the cash flow from operations. From the analysis of the three companies the authors have established a simplified way of making surprisingly accurate predictions of non-cash elements. The relation between net income and cash flow from operations is in a linear relationship. One can therefore assume a fixed rate in relations to the value of the recoverable reserves adjusted for cash cost.

\[\text{Recoverable reserves adjusted for cash cost} \times (1 + \text{cash flow adjustment rate})\]
\[2 029 824 009 \times (1 + 0,10) = 2 232 806 410\]

For the example valuation the authors have assumed a 10 percent lift back to the value of recoverable reserves adjusted for cash cost to get the cash flow from operations. Due to high depreciation from large investments, the valuation of the three mining companies per-
formed earlier in the report indicates a cash flow approximately 10 percent higher than the net income.

4.6.5 Capital expenditure

Capital expenditure cannot be assumed to be linear to the production volume. An initial capital expenditure could be sufficient for large production volumes, while other companies have capex planned for future investments. The most accurate and reasonable way of establishing the investments needed is by assessing the companies planned investments. Since they may arise very differently over time, the capital expenditure has to be discounted back to present value to present the investor with a fair deduction from the cash flow.

$$\sum_{i=1}^{n} \frac{CAPEX}{(1+WACC)^n}$$

$CAPEX = $Capital expenditure

$WACC = $Discount rate achieved through WACC calculation

$n = $Number of years

For the example valuation the authors have assumed investments to be made with C $70 000 000 per annum during the initial three years. The present value of these investments with the discount rate of 15 percent equals to C $159 825 758.

Value of cash flows – Present value of CAPEX

$$2 232 806 410 - 159 825 758 = 2 072 980 652$$

An assessment of the above mentioned corrections to the value of the recoverable reserves will present the investor with a fairly accurate view of the fundamental value of the proven reserves. For the exemplified valuation a fair value would be C $2 072 980 652.

4.6.6 Valuation model applied to Denison, SXR and Paladin

The developed valuation model is applied to the analyzed companies in order to establish its accuracy compared to the current market valuation. The key variables and calculations of the valuation are listed below.

**Denison**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WACC</td>
<td>21.92%</td>
</tr>
<tr>
<td>Forecast period (years)</td>
<td>9</td>
</tr>
<tr>
<td>Recoverable reserves</td>
<td>46 297 000</td>
</tr>
<tr>
<td>Uranium price average PV</td>
<td>51.2</td>
</tr>
<tr>
<td>Value of recoverable reserves</td>
<td>2 370 496 400</td>
</tr>
<tr>
<td>Cash cost average PV</td>
<td>19.5</td>
</tr>
<tr>
<td>Cash cost PV deduction</td>
<td>903 100 147</td>
</tr>
<tr>
<td>Value adjusted for cash cost</td>
<td>1 467 306 253</td>
</tr>
<tr>
<td>Cash flow adjustment rate</td>
<td>10%</td>
</tr>
<tr>
<td>Cash flow adjustment</td>
<td>146 730 625</td>
</tr>
<tr>
<td>Value adjusted for cash flow</td>
<td>1 614 036 879</td>
</tr>
</tbody>
</table>
With 191 500 000 number of shares outstanding the fundamental value per share is equal to C $8.35. Fundamentally the current stock price of C $12.8 (2007-05-10) should be the present value of the future cash flows.

**SXR**

<p>| | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>WACC</td>
<td>15.64%</td>
<td></td>
</tr>
<tr>
<td>Forecast period (years)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Recoverable reserves</td>
<td>104 043 000</td>
<td></td>
</tr>
<tr>
<td>Uranium price average PV</td>
<td>51.2</td>
<td></td>
</tr>
<tr>
<td>Value of recoverable reserves</td>
<td>5 327 001 600</td>
<td></td>
</tr>
<tr>
<td>Cash cost average PV</td>
<td>13.3</td>
<td></td>
</tr>
<tr>
<td>Cash cost PV deduction</td>
<td>1 384 003 107</td>
<td></td>
</tr>
<tr>
<td>Value adjusted for cash cost</td>
<td>3 942 998 493</td>
<td></td>
</tr>
<tr>
<td>Cash flow adjustment rate</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Cash flow adjustment</td>
<td>433 729 834</td>
<td></td>
</tr>
<tr>
<td>Value adjusted for cash flow</td>
<td>4 376 728 328</td>
<td></td>
</tr>
<tr>
<td>CAPEX PV</td>
<td>318 328 860</td>
<td></td>
</tr>
<tr>
<td><strong>Implied value of resources</strong></td>
<td>4 058 399 468</td>
<td></td>
</tr>
</tbody>
</table>

The PV of future cash flows are considerably higher than the implied value of the recoverable resources.

**Paladin**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WACC</td>
<td>25.45%</td>
<td></td>
</tr>
<tr>
<td>Forecast period (years)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Recoverable reserves</td>
<td>51 580 000</td>
<td></td>
</tr>
<tr>
<td>Uranium price average PV</td>
<td>51.2</td>
<td></td>
</tr>
<tr>
<td>Value of recoverable reserves</td>
<td>2 640 896 000</td>
<td></td>
</tr>
<tr>
<td>Cash cost average PV</td>
<td>14.6</td>
<td></td>
</tr>
<tr>
<td>Cash cost PV deduction</td>
<td>752 494 889</td>
<td></td>
</tr>
<tr>
<td>Value adjusted for cash cost</td>
<td>1 888 401 111</td>
<td></td>
</tr>
<tr>
<td>Cash flow adjustment rate</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Cash flow adjustment</td>
<td>207 724 122</td>
<td></td>
</tr>
<tr>
<td>Value adjusted for cash flow</td>
<td>2 096 125 233</td>
<td></td>
</tr>
<tr>
<td>CAPEX PV</td>
<td>121 764 268</td>
<td></td>
</tr>
<tr>
<td><strong>Implied value of resources</strong></td>
<td>1 974 360 966</td>
<td></td>
</tr>
</tbody>
</table>

The implied value of Paladins resources is slightly higher than the PV of future cash flows. The markets ability to value the company differently is due to the expectations of future return of explorations projects. The authors agree with the theory stating that fundamental and comparative analysis cannot be used separately but rather complementary. A forecast and valuation of exploration projects has to be incorporated in the PV to present the inves-
The authors however believe the presented valuation model is reasonably accurate in establishing the value of proven mine reserves.

4.6.7 Assessing the value of exploration projects

The authors have established that a market valuation equal to the fundamental value of the proven reserves is not a fair value for an exploring company. The key point in establishing the market value is to make assumptions regarding the cash flows produced from exploration projects, as well as the terminal value of these.

The value gained from the valuation model has to be adjusted for exploration projects. Since the dimensions and probability of the project vary widely between companies in the industry, it is not reasonable to set a standard coefficient to use as a multiple for the fundamental value. Instead one has to forecast all projects and make apply the valuation model to each project. The value should be adjusted for the inherent risk of failure associated with the exploration.
5 Conclusion

This section will summarize the results in the analysis and answer the research questions and the purpose of the thesis.

Is the current market value of advanced uranium mining companies representative for their actual fundamental value?

The current market values of the companies in this report vary significantly. The actual fundamental values that have been calculated are very different from the market values and they also vary in between the companies as well. Denison mines have according to the authors analysis a PV/share of C $8.88 and the current share price is C $14.92 (2007-05-21). SXR Uranium one have a PV/Share of C $ 42.51 but an actual share price of C $16.6 (2007-05-21) and Paladin Resources a calculated PV/share of C $2.99 and the share is currently priced at C $7.93 (2007-05-21). However these present values does not reflect the corporations prospecting projects. Since these possible future income sources are not established yet, it is one explanation why the values differ to this extent. The estimations concerning possible mining recovery of prospecting projects is only estimations and could proven to be wrong over time.

Which specific valuation aspect, fundamental or comparative, could be used when valuating uranium companies?

Both fundamental and comparative aspects should be taken into consideration when doing a valuation. The comparative method could be a good way to screen the industry for possible investment objects but then fundamental values have to be considered. Key ratios that is good to look upon in the screening process is not only the usual numbers as P/E, cash flow/share but also a ratio specific for the mining industry; Adjusted market capitalization/mining recovery.

The fundamental side of the valuation and a more in depth comparative method is needed when a possible investment object have been found and from that continue with discounted cash flow analysis. Important to stress is that the relative valuation with ratios including mining recovery is inferior since it does not take into account the cash cost for mining. The companies in this thesis have very different cost for mining and therefore the profits will differ significantly even if they might have the same extractable reserves.

What valuation method is the most suitable for establishing a fair market value of advanced mining projects?

The authors believe that no method alone is a good way to value a company to establish a fair value of advanced mining projects instead one have to look upon many different methods and in the end put them together in order to give a reasonably good estimate. The core in valuing mining projects/companies is to estimate their possible mining capacity and to be able to estimate mining reserves that would be possible to extract. Next step should be to try and give a possible forecast of the price for the core commodity that the company is mining and from that base build a good valuation concerning other values such as corporate finances, investments and future expectations.

It is important to remember that no method is perfect, they all have flaws but if you are aware the possible drawbacks with each method it is easier to adjust an analysis for them in order to give a better estimate of a corporation’s possible value.
6 Final discussion

This chapter of the thesis gives a discussion of the subject, what more or else that could have been done and some final thoughts and reflections are presented that have emerged during the study.

All valuations of companies today differ from each other, not only because the companies investigated are different but also because different people with different knowledge and backgrounds do the valuations. Especially in valuing mining companies it is immensely difficult to estimate production figures of the coming years since they are very uncertain. The price of the underlying commodity, in this case uranium is also very difficult and will differ even between professional analysts. No method can be said to be right, but no method is wrong either. What is done in a report like this one is only one possible forecast for a company and hopefully it gives a indication of the future but in time it could be proven to be wrong. However the basic model is one that could be followed since it is only the estimations that will differ, not the theory behind the valuation.

Other aspects is the time taken doing a analysis, since this thesis was begun SXR Uranium one have presented plans to merge with another large uranium mining company, UrAsia Energy, and news like this offsets production figures for the future and therefore present values in the future for SXR is not valid when this merger have taken place.

Suggestions for further studies

- Investigating how mining reserves is calculated, this will though be a task for geology students and not business administration graduates.
- Competences needed within a mining company in order to run it efficiently.
References


