Example of a Rising NPV Profile for a Mining Project

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13 September 2017

Abstract

This paper describes a situation where the NPV Profile for a mining project is rising in the initial periods of production. This is an interesting case because mining projects are typically characterized by decreasing NPV Profiles caused by declining reserves and ever-approaching end to mine life. In this example, the NPV Profile is increasing alongside mine production levels in the first half of the project life. The parameters for this model are based on simplifying assumptions for the potential production profile of Anaconda Mining, a publicly-traded mining company.

Keywords: Moving NPV, Mine Planning, Engineering Economics

JEL Codes: C00 General; C02 Mathematical Methods; G1 General Financial Markets;

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This paper picks up right where Bell (2017) left off with the observation that Anaconda Mining could undertake two major initiatives to increase gold production from their mining operations in the Maritimes of Canada. This paper shows what could happen if both these efforts were successful. In particular, I describe how this could create an interesting situation where the valuation of the mining project is actually increasing when it is in production.

It is interesting that the NPV Profile for a mining project could be increasing because mining production entails declining reserves. Mines are not renewable assets and they are modeled as having a finite lifetime. With the ever-approaching end of mine, it takes a significant increase in future cash flow to cause a rising NPV Profile for any length of time. In the example presented in this paper, the NPV Profile rises modestly for the first few years as production doubles and doubles again.

Basis for Calculations

As before, I use the current situation facing Anaconda Mining to calibrate the parameters of my model. Details of current production provided in Bell (2017) and can be summarized as follows.

Anaconda currently processes approximately 1,200 tonnes per day of ore into the front end of their mill at Pine Cove, which grinds the rock down to 20 microns and puts it through a flotation circuit. This part of the mill is currently running at capacity with ore from the Pine Cove Pit, which has grades of approximately 1-2 g/t gold. They also put approximately 50 tonnes per day into the back end of mill, which is the leach circuit. They produce approximately 50 ounces of gold per day from the leach circuit, which indicates that the grade of the concentrate currently produced from the Pine Cove Pit is approximately 1 ounce per tonne. As before, there is capacity in the leach circuit for 50 tonnes of concentrate or more.

Bell (2017) also provide details on what I assume is the first plan to increase production for Anaconda Mining, which is to ship whole ore from the Goldboro project to the Pine Cove mill. In short, I assume that allows company to replace half of current feed going into front end of mill with ore from Goldboro, which doubles estimated mine life from Pine Cove pit and other sources. Takes mine life from 5 to 10 years and doubles annual gold production because ore from Goldboro has higher grade.

This paper introduces the second plan for Anaconda to increase production, which is to produce a concentrate that can be fed into the back end of the mill. I assume that Anaconda can produce 50 tonnes per day of concentrate with grades of 2 ounces per tonne from high-grade ore at Goldboro. This concentrate will go into the leach circuit of the existing mill and increase total production by 100 ounces per day again. With all three things going, ore from Pine Cove pit, ore from Goldboro, and concentrate from Goldboro, I assume that Anaconda is facing total production of 200 ounces gold per day.

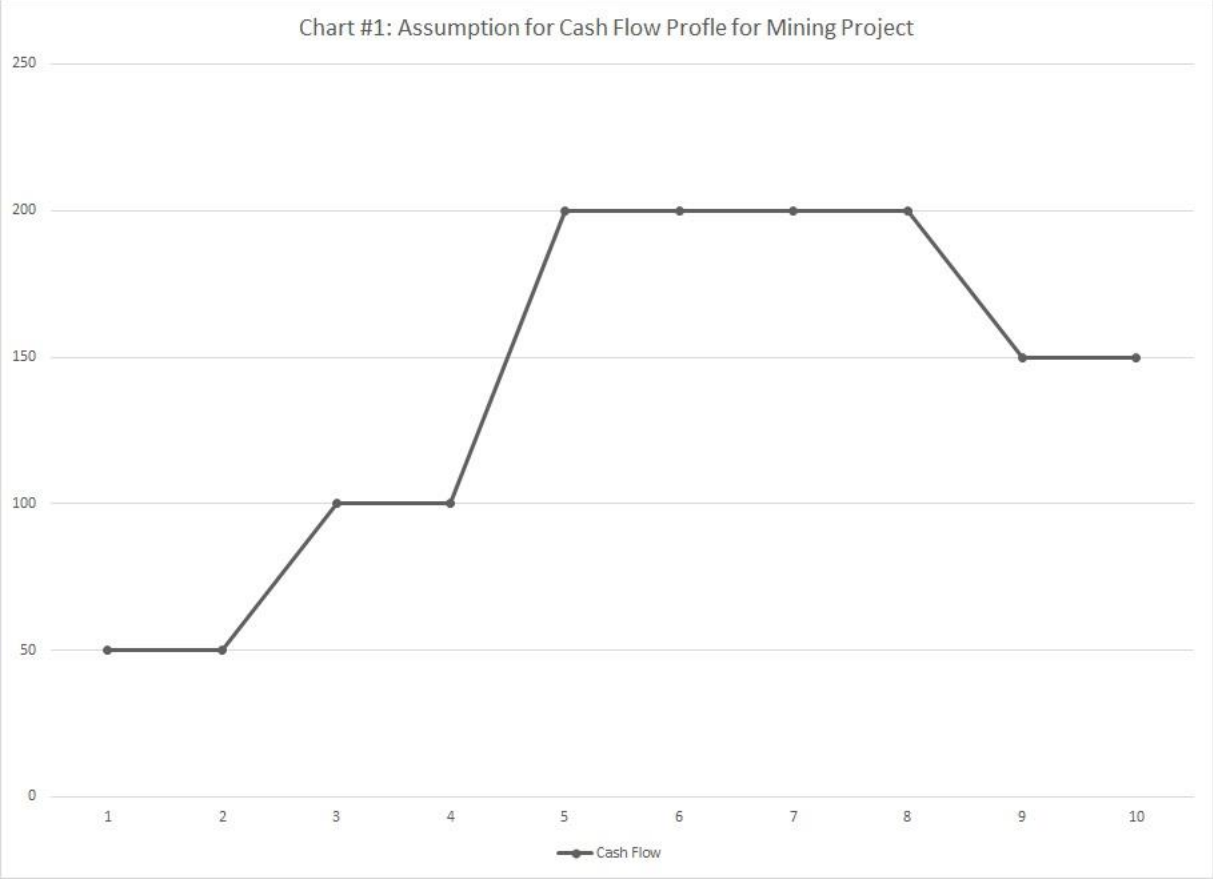
NPV Profile

As before, I normalize the initial value of cash flow and focus on the relative changes in these numbers rather than their actual values. In particular, I assume that any increase in production directly impacts the bottom line by the same amount. Please note that I am not considering the gold price or production costs in any meaningful way here.

I assume the following schedule for production, as shown in Chart #1 below.

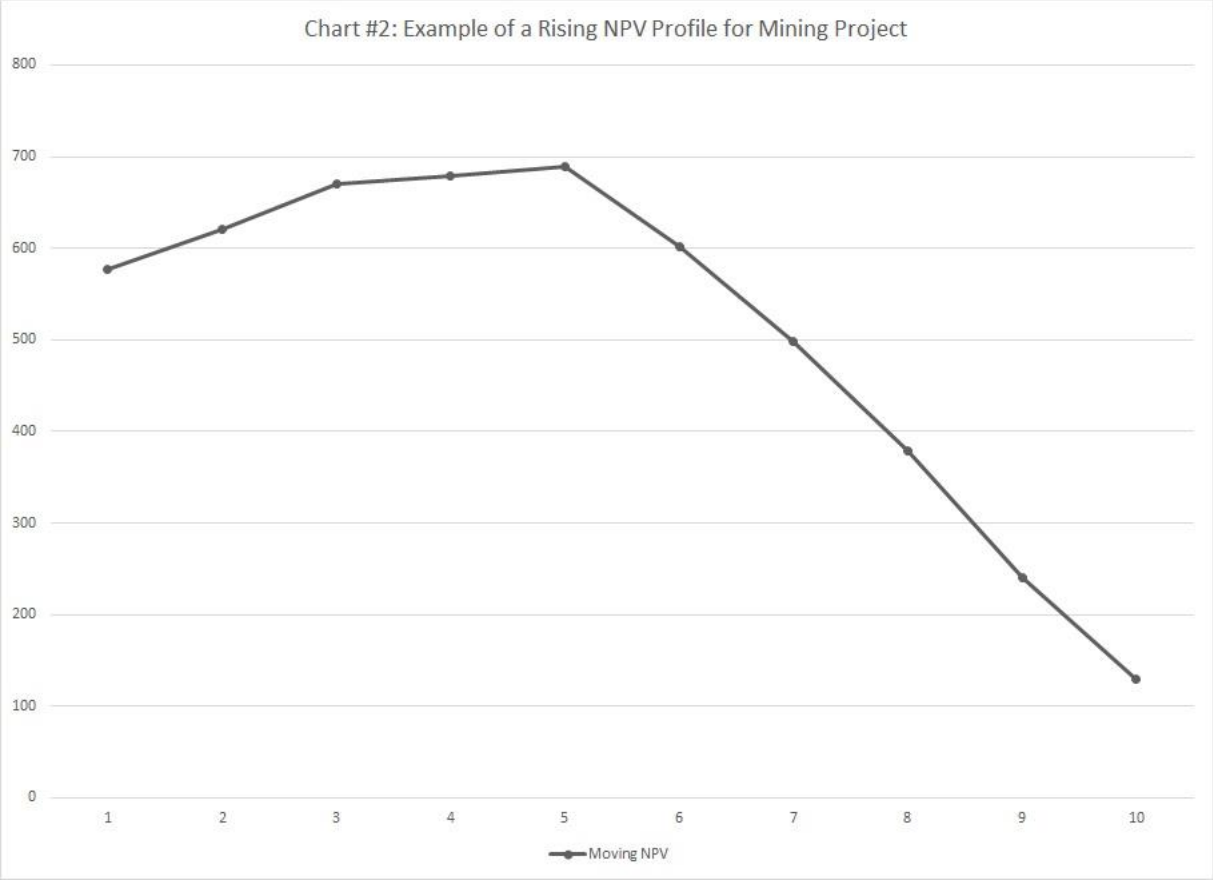
For the first two years, the company produces cash flow of 50 units under the base case where they are only mining from the Pine Cove pit. After producing for 2 years, this mine has 3 years of remaining life as discussed in Bell (2017). When they start shipping whole ore in Year 3, they double the remaining mine life of the Pine Cove pit to 6 years. As such, the Pine Cove pit is exhausted in Year 9 and causes a decrease in production by 50 units in Years 9 & 10.

When Anaconda starts shipping whole ore from Goldboro in Year 3, they double annual gold production and cash flow from 50 to 100 units. Then, they double it again in Year 5 when they start concentrating ore from Goldboro. I assume that the company continues to source sufficient material from Goldboro to maintain this throughout this 10-year period. I do not consider an extension to the project life beyond 10 years or if the company could replace the spare capacity caused by exhaustion of the Pine Cove pit in Year 9.



The Cash Flow Profile shown in Chart #1 reflects a staged-project where production changes at a few points. Some of the assumptions in Cash Flow Profile are generous, such as the fact that Anaconda gets an increase in production without any apparent capital costs in this model. However, these strong assumptions may prove reasonable as the company provides further public information about possible production scenarios.

The NPV Profile shown in Chart #2 shows just how much the large cash flow starting in Year 5 contribute to the valuation of the project in the initial years. As you move towards Year 5, the valuation actually increases: the project looks better in Year 3 than it did in Year 1 because the smaller initial cash flows are out of way and the larger cash flows starting in Year 5 are coming closer.



The NPV of a mining project generally decreases each year as some portion of the known deposit is mined and the associated value is removed from the calculation. This negative effect is a fundamental feature of producing mines, which can be described as depreciating assets. However, this drag on valuation can actually be overwhelmed by an increase in valuation as the project comes closer to a period of larger cash flows. Notice how the NPV Profile increases in Years 1, 2, 3, and 4 in this model as the project moves towards the larger cash flows starting in Year 5. Then, the NPV Profile declines after Year 5 because the cash flow is no longer increasing and the end of mine life is fast approaching.

Discussion

Although this is a toy model of the mine-planning problem currently facing Anaconda Mining, it is interesting to show that the NPV Profile can increase over time as a project approaches larger future cash flows. It is possible to get increases to valuation over time in other ways, such as rising gold prices, falling costs, or positive surprises from exploration success. However, generating a rising valuation in the deterministic framework of the NPV Profile here requires some unique features for the Cash Flow Profile. In particular, a big increase in cash flow. It may be interesting to note that the peak valuation in this model occurs right as the company first starts to generate this new higher level of cash flow.

This model simply considers changes to cash flow based on changes to the top-line production numbers, however, it is important to consider changes in costs. This detailed engineering work is beyond the scope of this short note, but Anaconda will provide further details publicly that may be used to improve on this modelling approach. For example, could Anaconda fund the installation of a concentrator from incremental cash flow generated by shipping whole ore from Goldboro?

References

Bell, Peter (September 6, 2017). *Application of the Net Present Value Profile to Anaconda Mining*. Retrieved from https://mpra.ub.uni-muenchen.de/81197