IQ RESEARCH JOURNAL

www.iqresearchjournal.com
ISSN: 2790-4296(Online)
ISBN: 978-9956-504-74-9(Print)

IQRJ: Volume 002, Issue 9, Sept 2023
Original Research Article

The Effect Of Recovery Rate Drivers On The Value Of Gold.

Ngu Kanti Hedris, Atanga Desmond Funwie

Kesmonds International University, School of Business & Management Sciences, Department of Economics & Finance

Email address:
ngukanti@kesmondsuniversity.org, atanga@kesmondsuniversity.org

To cite this article:
Authors: Ngu Kanti Hedris, Atanga Desmond Funwie. Paper Title:
The Effect Of Recovery Rate Drivers On The Value Of Gold.
IQ Research Journal of IQ res. j. (2023)2(9): pp 01-13. Vol. 002, Issue 09 09-2023, pp.0617-0630

Received: 29 08, 2023; **Accepted**: 24 09, 2023; **Published**: 30 09, 2023

Keyword

Effect, Recovery Rate Drivers, Value, Gold

Received:
29 08, 2023

Accepted:
24 09, 2023

Published:
30 09, 2023

Abstract

The ultimate goal of this article was to point out most of the assumptions used in the precious metal mining industry that have a significant effect on performing valuations for those assets. Assumptions such as conversion rates and different metal prices were made, and different cases were set up because of the ongoing debate in the industry. So we have the market consensus price, which is the Wall Street view or equity research analysis view of where the metal prices are headed; the management view of the prices; and the third case will be the spot prices. This article requires further research as to what metal prices are suitable for performing gold valuation.

1. Introduction

Now we're ready to start laying out the assumption section of our model. We need to keep everything contained in one section. This does several things. One is that it allows for a single location, so it's easy to find. It makes it easier for ourselves and other users to understand how the model works. It simplifies the overall structure so that you can easily make changes to the model. It's critical for sensitivity analysis to know where all of the key drivers and inputs are located. When it comes to mining models, prices, costs, and all other figures are typically expressed in real dollar terms, meaning they do not include inflation. Let's take a look specifically at what some of the major assumptions in the model are going to be, extracted from Canadian Malartic Project Feasibility Study, Engineering Finance, 2008, 248–49.

We're going to look at the resource details, which are the OZ and grade of the material contained in the ground. We're going to look at the recovery rate, which is the proportion of the metal that's in the ground that can actually be extracted and sold. We'll look at the payability terms that smelters and refiners will charge. We'll look at metal price assumptions and how much we think the metal can be sold for in the future. We'll look at the milling rate, which is the speed at which the mine can actually refine and produce a saleable metal. We will look at operating costs on a per-unit basis. And we will look at capital costs. So all of these things are going to come together to allow us to calculate free cash flow to the firm and ultimately the net present value of this mining asset.

- **Purpose of the study**

The purpose of the study is to analyze the impact of model drivers such as conversion rates, recovery rates, and metal prices on the price of gold.

- **Significance of the study**

The study is significant in that it establishes key financial metrics and a significant relationship between these metrics, such as modeling meal, royalties and payability, resources and reserve metrics, metal pricing, milling, and mining modeling. All these combined are used in modeling one giant net present value for gold.

2. Literature Review

Let's start filling in the assumption section of our model. At the top of our assumption section, the very first thing we have for some key conversion rates as we go through the model is that we'll have to convert from grams to Troy Oz pounds to metric tons and Troy Oz back to grams. So we have these numbers here for easy reference and linking. Underneath that, we've got metal prices. This is really one of the most important assumptions in a financial model for mining assets. And we've got three different cases here because there's a lot of debate about what metal prices will be in the future and a lot of uncertainty. We want to have different cases. The first case is a management case. This would be the view of the company and the management team. Then we have a consensus case. This would represent the Wall Street view or the equity research view of where metal prices are headed. The third is a spot price, where we just take the most recent price for the metals. And run that in a flat line through the model in order to choose between the cases. We have a switch here where we can select options. Let's review how that works if we go to Data and Data Validation. We can have a setting here that, if we change it to a list, allows us to have this drop-down menu. The default is any value, so if we go back to that, we can delete what's in here and set this up again by going to Data Validation. Allowing only a list and then selecting for the list these three options: management, consensus, and spot. And then press OK, and when we go back into the cell, we have those options here. Beneath that, we have an index and match function that's going to look for the name in here, so management consensus or spot, and return its position here as 1-2 or three from the options. Let's look at how to build that formula. Now we're going to set it to index. And what we want to index are these three options, here numbered 1-2 and three. So Excel is asking us to tell it where the array is. That's what this is. Then it's going to ask for a row number and a column number. So the row number is going to be found using a match function, where we're going to match the lookup value right here with the options that are contained. In this part of the table, you select zero for an exact match. The column number that we're going to look at is column #0. There's no other column but the one we're in, so we put zero and now we can see that consensus is option two, management is option one, and the spot is option three. So this is working correctly.

2.1 Metal Prices

Now that we've got this dynamic selector in place, let's fill in the actual formulas for the metal prices. In 2019, for the management case, we're just going to continue with whatever the forecast was in 2018. And the same thing is going to be the case with consensus. We can copy and paste this formula down south. What we're saying is that we have three years of specific forecasts with specific prices, and from then on, we're going to flatline the price. So that's what's happening there. And with the spot case, all we have to do is set it equal to the prior. Because it's the spot. There's just one price assumption. So now, in 2019, we have brought all of these forecasts together. We can fill them all the way across to the end of the model. So there we have all of our prices. Now what we need to do is below that: we need to have right here the live case that's going to flow through the model. So to get the live case, we're going to use the choose function. Choose just selects between a series of options, and we're going to use this switch right here as the index number, so we can anchor that with F4. So in this case, we're choosing option one among the following choices: Two and three And then we can, so $1,500 an ounce is the first option. 1350 is the second option. And 1400 is the third option, So that seems to be working correctly. Let's fill it down. So we've got the silver lining all the way across. So that we get all of the different time periods. Now let's switch it, and we should see everything updated when we move it, which we do. So this is perfect. Now we've got this active price deck, or live case, that we're going to use for driving revenue in the model. Let's switch to the spot case that will be running through the model at this point.

Figure 1

LIVE SCENARIO	*3*	Units	Avg.	Total	**2016E**	**2017E**	**2018E**	**2019E**	**2020E**	**2021E**	**2022E**	**2023E**	**2024E**	**2025E**	**2026E**	**2027E**	**2028E**
Balance Sheet Check					-	-	-	-	-	-	-	-	-	-	-	-	-

Assumptions

Source	**Assumption**	
	Conversions	
	Grams - > Troy Ounces	0.03215
	Pounds - > Metric Tonnes	0.00045
	Troy Ounces - > Grams	31.1034768

Price Deck	**Metal Prices**		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Management Consensus	**Management**	1													
	Gold		1,500	1,600	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Spot	Silver		21	22	23	23	23	23	23	23	23	23	23	23	23
	Consensus	2													
	Gold		1,350	1,400	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450

Silver		20	21	21	21	21	21	21	21	21	21	21	21	21
Spot	3													
Gold		1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Silver		18	18	18	18	18	18	18	18	18	18	18	18	18
Active Price Deck in Model	Spot													
Gold	3	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Silver		18	18	18	18	18	18	18	18	18	18	18	18	18

2.2 Production Modelling.

The next schedule in our assumption section is the production schedule, and the production schedule is based on, as you can see here, the 2014 updated line plan on page four. Let's flip to that document now. Here is the updated mine plan, and if we scroll down to page 4, we can see the schedule right here. This is the annual mine plan production estimate. We're going to take the OR mild starting with the first year of the forecast, which is 2016. Remember, the time of this transaction is going to be from 2016 onward. So we take all of the numbers for Oregon melt from 2016 onward, select all of these, and paste them into the model, as well as the grade in each corresponding time period and the recovery rate in each of the corresponding time periods. And we paste those into the model. Let's flip back now and see those numbers there. As you can see, these are the exact same numbers that are found in the mine plan. The only thing we've added on our own, and let's do this together now, is a sum. Of all of them or that's milled each year so that we can look at our production schedule and make sure we're accounting for all of the aura that's going to be mailed each year. Let's also calculate the percent of the mine life that each represents to make this calculation. Say it, conquer the OR that's being milled in the current time period divided by the sum of all remaining OR to be milled, and we're going to anchor this last reference. S29F4, so that as we move the formula along, it always ends right in this column. Close the bracket and press enter, so we can see that it's 8.3% when we press F2 on the formula. Now let's build this all the way to the end. Fill it right with Control R, and let's see what happens. You can see how it moves along because we've used the proper anchoring, and what it's doing is telling us how much of my life is remaining at the end or how much has been used up. So by the end of twenty-eight, 28.100% of all the orders to be mailed had been milled. That's exactly what we would expect, and we're going to use this for our units of production approach to depreciation later in the model. So this. The production schedule is going to be a critical driver of the model for everything from revenue to operating costs, depreciation, and cash flow, and all of it's based on a mine plan document.

Figure 2

	Production Schedule			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
2014 updated mine plan	Ore Milled	tonnes	242,592,000	20,130,000	20,075,000	20,075,000	20,075,000	20,130,000	20,075,000	20,075,000	20,075,000	20,130,000	20,075,000	20,075,000	20,075,000	1,527,000
p 4	Grade	g/t		1.09	1.05	1.24	1.06	0.89	1.01	0.95	1.34	1.01	1.04	1.08	0.78	0.78
	Recovery	%		89.1%	88.6%	89.7%	89.5%	88.4%	88.9%	89.0%	88.9%	89.7%	89.8%	90.3%	88.6%	88.6%
	% of mine life			8.3%	9.0%	9.9%	11.0%	12.4%	14.1%	16.5%	19.7%	24.6%	32.5%	48.2%	92.9%	100.0%

3.Methodology

3.1 Reserve and Resources Modelling.

Now we're going to fill in the reserve and resource statement so we can reconcile the production schedule with the total reserves and resources that this company has. In order to do that, let's go to the updated reserve statement from 2014 included in the downloadable files. Here we are in the file called 2014 Reserves Update, and if we scroll down to the table, we can see that we've got tons of ore grade and the total amount of contained metal, in this case, the gold that's contained in there, and we're just going to take from the bottom here that the total proven reserves are 65.9 million tons with a grade of 0.92 grams per ton, which means the total contained gold is 1.94 million oz. And then you can see the same thing with probable reserves located below proven reserves. So we're going to take proven and probable reserves and put them into the model. So we've taken these numbers. I pasted them in. Let's go back to the model now. And you can see here that we've got proven and probable reserves with the same numbers as provided in the statement. Let's calculate the contained metal on our own. Now, by multiplying this out, we take the number of tons, multiply by the grade, and then convert the grams per ton to Troy oz. So we use F4 to anchor that. You can copy and paste the formula. We sum it up to get the total amount of gold. We can also sum up the tons to get the total tons, and then if we want to calculate the weighted average rate, we simply take the contained oz divided by the tons and convert that back to grams from oz. By multiplying by the conversion rate assumption here, And then we get a weighted average grade of 1.03 grams per ton for all of the reserves combined. In addition to the gold that's contained in this property, there's also some silver, and the silver is modelled as a ratio of 1.58 ounces of silver for every ounce of gold. So to calculate the silver reserve table, we simply take the tons from above because the tonnage is the same across the asset. We can then calculate the contained ounces of silver by taking all the gold and multiplying it by the silver ratio. Then we calculate the grade for silver by taking a sample containing silver. Dividing by tons and multiplying by the conversion rate again, since we want to get it back to grams per ton, So the grade for this asset in terms of silver is 1.64 grams per ton. So now we've got our reserve table completed for gold and silver. We can also use this to reconcile the production schedule. You can see that in the production schedule, the total tons of ore milled are 242 million, and in our reserve table, we've got 281 million tons. These are very close. They're not exactly the same, and we would expect to see this difference because this was provided in 2014. This reserve statement and our model start in 2016, so it makes sense that the production schedule is going to be slightly less than the total reserves that were available in 2014.

Table 1

Conversions	
Grams - > Troy Ounces	0.03215
Pounds - > Metric Tonnes	0.00045
Troy Ounces - > Grams	31.1034768

Reserves & Resources

	Gold		Tonnes	Grade (g/t)	Contained (oz)
R&R statement 2014	Proven		65,900,000	0.92	1,949,235
	Probable		215,300,000	1.07	7,406,600
	2P		281,200,000	1.03	9,355,835

Silver		Tonnes	Grade (g/t)	Contained (oz)
Ratio	1.58	281,200,000	1.64	14,782,219.46

3.2 Modelling Mill Capacity, Royalties and Payability.

Here, we're going to calculate mill capacity and throughput, royalties, and payability. In order to fill all these tables in We'll be referring to the technical report on page 249 to start with. Here we are inside the file called 2008 Feasibility Study for the Canadian Malartic Project. If we go straight to the section, we want the mill capacity. That's on page 249 of the document, and we can see here the mill capacity information. Let's zoom in a bit. And we'll see here that they have a nominal throughput rate of 55,000 tons per day, which results in an annual rate of 20 million tons per year. So let's go back to the model and make sure we have that information. So in the model, we have 55,000 tons per day. We assume that the mill operates 365 days per year. So all we do to get the annual rate is multiply those out, and that's the same number that we get in the technical report. So that's great. Now let's move on and look at the royalties, which we can find back in the technical report. On the report, we can see that the overall royalty payments are estimated to be 1.4% of gross revenues in the model. So read this whole section on your own and then flip back to the model. So here we've got the overall royalty, and we labeled the assumption as being 1.4% of the life of mine revenue found on the property (page 428 of the feasibility study), and it consists of a royalty to Royal Gold and a private royalty on the property. Now let's look up payability assumptions. We'll go back to the technical report on page 430. On this page of the report, you can see the assumptions for the gold payout and silver payout. These are our payability ratios that we're going to use for calculating the actual revenue in the model. So back in the model now, you can see those assumptions contained here.

Table 2

Tech Report	**Mill Capacity**			
p 249	Tonnes/day	55,000		365
Update p 185	Tonnes/year	20,075,000		
	Royalties			
Tech Report	Royal Gold	1.5%	4 Moz	
p 428	Private	2.5%	660 koz	
	Overall	1.4%		
Tech Report	**Payability**			
p 430	Gold	99.9%		
	Silver	99.0%		

3.3 Mine Operating Costs assumptions.

Now let's take a look at the mine's operating costs. We're going to be modeling them on a per ton mill basis, and we're going to get some original information from the feasibility study on page 402. Let's go there. Now we're back to the feasibility study. Let's go to page 402. And we can see here the operating cost summary. This was the estimate that was made at the time of the feasibility study in 2008. And you can see that we've got these same line items as we have in our model, but we've got some very different per-ton costs. The costs in our model are nearly double the cost estimates that are here. And that's because, from 2008 to 2014, there was enormous cost inflation in the mining industry. Thus these unit costs have been updated in the model to reflect more current operating costs in the industry. So it's important to make sure that if you're looking at a technical report that was dated a long time ago, Some of the assumptions are brought up to current, more relevant metrics. So back in the model here, you can see these same assumptions and the new estimates that we have here in terms of cost per ton mills that are going to flow through the model and lower down in the model. What we'll do is multiply each of these line items by the number of tons that are milled each year to get the total expense we've also got below that. An estimate for corporate, general, and administrative expenses as well as exploration is an expense. These are going to be modeled on a per-ounce basis, and we got this information from the financial statements of the company. It's important to note that we're modeling this company as a single-asset producer. That means we have to include corporate overhead in this tab if we are modeling a company that has many assets. We would have a separate corporate tab and put zero at the asset level. We'd have to be careful to consider whether corporate general and administrative expenses are going to be included in this asset-level model or not. So in this case, it's a single asset producer who includes corporate G and A in the operating expenses at the mine.

Table 4

	Mine Operating Costs		New Cost
Tech Report	Mining	$/t milled	7.61
p. 402	Processing	$/t milled	8.05
	Transport & Refining	$/t milled	0.10
	General & Admin	$/t milled	2.17
	Total	$/t milled	17.93
Financials	Corporate G&A	$/oz	15.00
	Exploration	$/oz	27.00

4.Data Analysis And Results

4.1 Capital Costs, Reclamation costs, PP&E and Taxes.

We can fill in the capital cost below as follows: What are the sanctions for this asset? Since this asset is already in production, there's not really going to be much development capital. All of the capital is going to be related to sustaining the operation of the mind. So if it were a new build or an asset that was going to be brought into production, there would be two schedules: one for the new development capital and one for the ongoing sustaining capital. So for this one, we're just focused on sustaining capital. Let's go to page 433 of the feasibility study. Here we are on page 433 of the feasibility study, and you can see that the total for sustaining capital is approximately $100 million, which starts in 2011 and goes on through the rest of my life. So if we go back to our financial model, we can talk about the assumption that is Put in place there. So since the operation of the mine began, it has turned out that there have been much higher capital costs than initially anticipated. And so we have reason to believe that this number should be a lot higher, like closer to the order of 250 million. So we've been given that number from a reliable source. Let's assume it's from equity research reports or someone who's close to the operation of the business. And so we can use a more updated estimate to model it. And what we want to do is allocate that $250 million based on production. So let's link up our total production schedule here. Remember, we said that the ore that's going to be milled is this ton of Drake here? And we can calculate each year the percentage that's going to be milled relative to the total. So here's the amount that's being milled. Let's divide that by the total. So we get a percentage and fill that all the way across. So now we have the way that we're going to allocate. That's $250 million of cost, and now we can take the number and multiply it by the percent we're going to allocate each year. Let's just get rid of those extra decimal places. Fill this all the way over with control R. So now we have approximately $20 million in sustaining capital that's going to be allocated each year. The last year was a very small year of production. So it's a very small capital cost number. Now let's take a look at reclamation costs and discuss those as well. On the technical report, we can see that the reclamation and closure costs are expected to be about $45 million. However, this study was done in 2008. And as we keep pointing out, these numbers need to be updated to reflect current costs. So we're going to take the liberty of adjusting this number in the model. So here we are back in the model, and because of the cost inflation that's been experienced, we believe it's reasonable to slightly more than double that reclamation cost estimate and use a very round number here of $100 million. So at least we know what the original source is, and we can have a backup or justification for why we changed it. Relative to the original study. Next, in our assumptions area, we've got some financial inputs, which include the property, plant, and equipment. Come out; that's located on the balance sheet at $1.85 billion. So we've just highlighted the fact that it comes from the most recent financial statements of the company. We've also highlighted an assumed tax rate of 30%. So these are going to be critical for calculating cash flow. We need an opening property, plant, and equipment balance to calculate depreciation, and we need a tax rate, of course, for cash flow as well.

Figure 3

	Capital Costs			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Tech Report p 433	Sustaining Capital		250,000,000	20,744,707	20,688,028	20,688,028	20,688,028	20,744,707	20,688,028	20,688,028	20,688,028	20,744,707	20,688,028	20,688,028	20,688,028	1,573,630
	Sustaining Capital	tonnes	242,592,000	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	1%
Tech Report p 435	**Reclamation** Total Reclamation Costs		100,000,000													
	Financial															
Filings	PP&E Opening Balance		1,850,000,000													
	Taxes		30%													

5.Conclusion and recommendation

5.1 Working capital assigned.

We will draw our conclusion based on the working capital assumptions. We have the accounts receivable days, meaning the number of days it takes to get paid when metal is sold. Then we have our accounts payable days, which is how long it takes the company to pay its expenses. The inventory days are the average days at which inventory Turns over. And then we have a discount rate of 5%. The assumption here is that because this is a real-term model, meaning it's not nominal, there's no inflation included. So 5% may sound low, but in nominal terms, that would be closer to seven or 7 1/2% in the gold mining industry. Discount rates are typically very low, partially because there is an insurance nature to the gold mining industry, and an insurance-type product generally has a lower cost of capital. But that would be a separate debate as to whether or not that is a good assumption. But for now, that is standard practice in the industry. And then finally, we have an assumption here for the purchase price of this asset: if you're going to acquire it, it would cost $3 billion. That's our assumption. And so we have that in the model laid out here.

Assumptions	Working Capital			
	Accounts Receivable days	2	Days in period	365
	Accounts Payable days	30		
	Inventory Days	20		
	Discount Rate	5%		
	Asset Acquisition Cost	**3,000,000,000**		

All of the assumptions are of paramount importance when building a mining model. To see the layout and model structure of a mining project, please consider going through my articles on gold valuation. We can now see what impact drivers such as recovery rates, conversion rates, payability, and metal prices could have on the equity value of gold.

References

Canadian Malartic Project Feasibility Study ,Engineering finance,2008, 248-49.

Artigas, J., Tsay, R., 2003. Effective estimation of stochastic diffusion models with leverage effects and jumps. Working paper. Graduate School of Business, University of Chicago.

Artzner, P., Delbaen, F., 1999. Coherent measures of risk. Mathematical Finance, 203-28.

Balkema, A., Laurens, D., 1974. Residual life time at great age. Annals of Probability 2, 792-804.

Bao, Y., Lee, T., Saltoglu, B., 2006. Evaluating predictive performance of value at riskmodels in emerging markets: a reality check. Journal of Forecasting 25, 101-28.

Beirlant, J., Teugels, J., Vynckier, P., 1996. Practical analysis of extreme values. Leuven University Press, Leuven.

Bollerslev, T., 1986. Generalized autoregressive conditional heteroscedasticity. Journal of Econometrics 31, 307-327.

Bollerslev, T., Chou, R., 1992. ARCH modeling in finance. Journal of Econometrics 52, 5-59.

Boudoukh, J., Richardson, M., Whitelaw, R., 1998. The best of both worlds. Risk 11, 64-67.