IMPACT OF TAXES ON THE PROFITABILITY OF PROJECTS

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1 Overview

The following paper provides data on the:

- Overall profitability of the mining industry and the level of taxes paid.

And using the copper industry as an example, it estimates the:

- Typical rate of returns expected from individual mining operations under a range of tax rates, and the
- Effect of business risk on the overall number of projects that are economically viable

As part of this analysis, the *effective* tax rate for the industry was calculated for mining operations in China and other countries. The *effective* rate is generally higher than the official corporate income tax rate – as it includes the impact of other taxes (such as royalties and withholding taxes) and various concessions provided by governments (such as accelerated depreciation and tax holidays).

The paper also identifies the value captured by the Government at various tax rates – and suggests that there may be an optimum rate at which the Government can maximise its returns. In detail, if the rate is set too high, no mines will be built, and no money will flow back to the Government. Conversely, if the rate is set too low, while several mines will be built, the State will capture little revenue from them.

2 Background

As discussed by the other speakers, mining is a high-risk investment. This is particularly so for exploration – as on average, for every one thousand exploration projects that are carried out, only ten of these result in discoveries that are worth developing into mines. And of these ten, only a few will be sufficiently large enough to make significant profits for the industry. It is important to recognise that the profits from these few mines have to pay for the large cost of all the exploration projects that didn't succeed.

The risk doesn't stop when the deposit is found. There are many technical and commercial challenges associated with building the mine. Furthermore, once the mine is in operation the project's profitability is affected by changes in commodity prices and exchange rates.

Unlike similar sized investments in manufacturing facilities, mining operations have very long lead-times before they start producing income. For example, it can take 2-5 years from the start of exploration before the discovery is made. It also often takes a further 5 to 10 years to convert the discovery into an operating mine.

Another key difference between mining and manufacturing is that the mining is not "foot-loose". If business conditions change, it is physically not possible to relocate the mine to a more favourable location. And finally, unlike factories, mines have finite lives. Consequently, a key part in extending the life of a given mining operation is the ability to explore for and develop additional mineral deposits nearby.

Given the high risk nature of the industry and the long lead times involved, the overall level of investment in the mining industry in a given country will be driven by the *value of the prize* and the *cost of financing* the mining project. The value of the prize is a function of the geological endowment of the country and the level of taxation imposed on a given mining operation. The level of business risk in investing in the country directly affects the *cost of financing*.

3 Profitability of the Mining Industry

Figure 1 shows that, on average, the international mining industry does not generate excessive profits. Based on the published reports from 261 major non-ferrous[1] and diversified minerals companies in the western world, over the last twenty years the industry generated an average annual return on shareholders funds of only 4.6%. By comparison, if the same investors had put their money into a much safer investment such as US treasury bonds, they would have achieved an average return of 7.8%.

The chart shows that the annual returns generated by the minerals industry are very volatile, and range from zero to 15% over the period 1982-2002. Over this twenty-year period, there are only three years where the return exceeded that of the Treasury Bonds. The key point is that, in the Western World, the returns generated by the minerals industry are very poor for the high level of risk involved.

3.1 Amount of Taxes paid

With respect to the above survey, between 1982 and 2002 the 261 mining companies generated an aggregate profit of US$483 billion (in constant 2003 dollar terms) and paid US$187 billion in corporate income taxes and royalties (see Figure 2). On this basis, the average tax rate paid by the industry was 39%.

The 39% average tax rate for the Western World is consistent with recent studies by the Minerals Council of Australia. Table 1provides details on the total amount of profit made by the Australian mining industry and the overall level and types of taxes charged by the Australian Government. As can be seen, in 2002, the industry paid 30.6% of its operating profit in income taxes, plus a further 19.0% in royalty-related charges – resulting in an overall direct tax rate of 49.6%. A further 6.9% was recovered through indirect taxes – such as levies on fuel and payrolls.

The Australian government also received revenues on taxes paid by the providers of goods and services to the mining industry. It is estimated that these secondary taxes amount to 20% of the total money spent by the industry[2]. The Government also raised revenue from operating its own rail and port facilities. In total, it is estimated that the overall income received by the Government was in excess of A$10 billion, out of total sales revenues of A$38.8 billion for the industry. For comparison, the net profit after-tax for the Australian mining companies was only A$2.7 billion.

The key message from the above analysis is that Governments generate significant earnings from the mining industry – and that the "headline" corporate income tax rate is only one of several sources of income.

[1] *The survey covers all of the top 100 publicly listed mining companies and includes major government-owned enterprises such as Codelco and KGHM. Non-ferrous minerals include – copper, gold, lead, zinc, nickel, aluminium, silver and platinum. The analysis also includes mining finance companies (such as Anglo American) but excludes mineral sands, coal and iron ore producers.*

[2] *Economic studies show that there is a strong correlation between the size of the National GNP and the overall amount of taxes raised by the Government. For most countries this is typically around 15 – 30%. For purposes of this paper, the author conservatively assumed that 20% of all expenditures by the mining industry end up as taxes for the national government.*

4 Typical Returns achieved by Individual Mining Projects : Case Study - Copper

While the overall returns generated by the mining industry may be low, individual mines may be spectacularly profitable. Indeed, it is the hope of finding such a mine that drives the industry to continue to operate in the face of poor profitability from its existing assets !

The three main factors that affect the economics of a given mine are its size, grade and location. Large high-grade mines under shallow cover in regions of good infrastructure can be very profitable to operate. The problem is that they are also very rare to find.

Figure 3 shows the tonnes and grade distribution of known[3] copper deposits in the world that contain more than 100,000 tonnes of copper metal (equal to 10 million tonnes of ore at a 1% copper grade). As can be seen, very few of these deposits are larger than 1000 million tonnes of ore and have a grade higher than 1% copper (ie there are very few large high-grade deposits).

Of related interest is the fact that the majority of the very largest deposits were found more than 30 years ago. In recent years it has become increasingly more difficult to find large copper deposits.

Figure 4 shows the minimum grade required for various-sized copper deposits to be economic. The analysis assumes that the deposit is located in an area with low costs and good infrastructure (such as the United States) and is buried under 50 metres of cover (which makes it relatively easy to mine as an open pit operation). It is also assumed that the mine is developed as a stand-alone operation (in other words it requires its own dedicated processing facilities).

In detail, Figure 4 shows that if the mining company wants to make at least a 10% return on investment, and that the *effective* tax rate[4] is 30%, the company need to find a deposit containing more than 100 million tonnes at 1.79% Cu grade, or 1000 mt @ 0.88% Cu. As can be seen, the majority of discoveries do not meet this hurdle.

The minimum tonnes and grade required will vary with location. For example, deposits that are buried under deep cover and/or are in more remote areas will have higher costs – and so will require higher grades to be economic. Similarly, deposits in high risk countries and/or countries with high tax rates will require better grades to be viable.

The challenge is that, as the break-even threshold increases, the number of known copper deposits that are economically viable dramatically reduces.

Figure 5, shows the estimated *Internal Rate of Return* (IRR) for finding these copper deposits. The corresponding *Net Present Values* (NPVs) of the various projects are summarised in Figure 6.

These numbers are based on the same assumptions as used above[5]. As can be seen, there is a wide range of IRRs and NPVs. Even so, as shown in Figure 5, less than half of the deposits modeled exceeded the minimum 10% return that companies typically require to develop a mine in a low-risk country. Adding in those (smaller) deposits with limited data, the author estimates that only 180 of the 995 identified copper deposits would be economic. In other words, in this scenario, only 18% of the deposits discovered are sufficiently profitable to be developed as stand-alone mines.

Figure 7 shows the effect of changes in the tax rate and business risk (as measured by the hurdle rate or IRR required to invest in the project) on the number of copper deposits that would be economically viable. As can be seen, based on a 10% IRR (or Hurdle Rate), lowering the tax rate from 30% to zero, increases the number of economic deposits from 180 to 224.

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[3] *The author has detailed information on 440 large copper deposits, which covers nearly all the very large deposits (ie greater than 1 million tonnes of copper metal), but only covers less than half of the deposits in the 0.1 to 1 million metal-tonne range. Separate studies estimate that the total number of deposits that containing more than 0.1 million tonnes of copper metal is around 995 deposits. This figure is used in the later part of the study to calculate the overall size and value of the copper industry.*

[4] *The effective tax rate measures the total mix of taxes charged to the project. Given that Governments often impose several different types of taxes (including royalties, import duties and withholding taxes) on the mining industry, the effective tax rate is can be significantly higher than the reported corporate income tax rate.*

[5] *The only exception is the depth. Those deposits that are known to be underground mines (such as the Olympic Dam mine in Australia) were modeled using their actual depths of cover - otherwise the model assumed that the deposit was buried under 50 metres of cover and mined as an open-pit operation.*

5 Overall Value Created by the Mining Industry : Case Study – Copper

Using the same example as above, at a 30% tax rate and a 10% IRR rate, only 180 out of the 995 available copper deposits are economic If these 180 deposits are developed into mines the combined Net Present Value at a 10% discount rate is estimated to be US$56 billion dollars (see Figure 8).

This value is distributed between the mining company and the Government. After adjusting for inflation and timing issues, the Government gets US$21 billion in direct taxes, and the company keeps US$35 billion.

It should be noted that, when combined together, the 180 projects would incur $193 billion in capital and operating costs (calculated using a 10% discount rate). As mentioned before, taxes on the wages and the sale of these goods generate extra income for the Government. Assuming that 20% of this comes back to the Government in secondary taxes, the Government will receive an extra $39 billion in value. On this basis, the Government receives ($21 + $39 =) US$60 billion in taxes.

It is significant to note that even under the extreme situation where the direct tax on the mining industry was set at zero, the government would still receive significant income from the secondary taxes on the goods and services produced within the country.

Figure 9 shows how changes in the overall tax rate affect how much money the Government will receive. At very high tax rates, very few projects get developed and the available income to the Government is small.

At a 10% Hurdle rate, it appears that the optimum tax rate is somewhere around 40%. It is significant to note that the curve is relatively “flat”. In other words, a change of +/- 10% in the tax rate has only a modest impact on the total revenues raised. Even so, the number of mining projects developed is sensitive to the total tax rate. Figure 7 shows that increasing the tax rate from 30% to 40% lower the number of viable projects by 13% (from 180 to 157).

As discussed before, high Hurdle Rates adversely affects the number of mining projects that are economically viable and therefore reduces the amount of tax revenues available to the Government. Figure 10 shows that doubling the Hurdle Rate from 10% to 20% reduces the total value captured by the Government by a factor of three. Furthermore, it is significant to note that the optimum tax rate has dropped from 40% to around 30%.

Caution! The above analysis on the optimum tax rates for the minerals industry assumes that the deposits have already been found and are waiting for the company to make a decision on whether the project returns (and tax rates) are sufficiently attractive to be warrant building the mine. In practice, this is not the case – as the industry first has to invest in exploration to find the deposits and then spend money on feasibility studies to evaluate the economic viability of any discoveries made.

As discussed earlier, exploration is a high-risk business and typically less than one in a hundred exploration projects results in a discovery that (might) be ultimately developed into a mine. To encourage the industry to explore, the profits made on the one successful project will need to cover the cost of the 99 unsuccessful exploration projects.

Figure 11 shows the effect of including the cost of exploration on the tonnes-and-grade required for a given copper deposit to be economic. The analysis assumes that the average exploration project takes three years to complete at a cost of US$1 million (in other words at a 1% success rate, the industry has to spend $100 million on exploration to make one economic discovery).

Figure 12 shows the value of the industry to the Government under varying discovery and tax rates. It shows that, at a 1% success rate, the total value captured by the Government is halved over what it would be at the Decision-to-Build stage (ie when we have found the deposit). Of greater significance is the observation that, to extract maximum value out of the industry, the Government needs to reduce its tax rates to encourage a high level of exploration. In particular, Figure 12 shows that, at a 1% exploration success rate, the optimum tax rate for the Government is 30% - versus an optimum rate of around 40% if all the deposits have already been found.

Caution! The optimum tax rate is driven by several factors – including the quality of the deposits and their location, the success rate and cost of exploration, and the financing costs used by Government and industry. Many of these factors are difficult to precisely measure. Even so, the above analysis helps in identifying the key drivers, and provides guidance on the general effect of changes in Government taxation policies on the level of investment in the minerals industry.

5.1 Effective Tax Rates

As discussed before, Governments apply a wide range of taxes, levies and incentives on the mining industry. This makes it difficult to make direct comparisons between countries. To make things even more complicated, the overall impact of these taxes depends on the quality of the project being assessed. For example, a low quality (high cost) operation will not be very profitable – and hence it will not pay much corporate taxes. However, in many countries this project will pay royalties. These royalties are based on the amount of production, not profitability. Consequently, for high cost mines, the royalty payments will form a large part of the overall tax burden of the project.

A worked example, using a 30% corporate tax and a 5% production royalty, is given below :

	Low-Cost Mine	High-Cost Mine
Revenue	$100.00	$100.00
less – Operating Costs	($40.00)	($70.00)
	--------	--------
equals – Operating Profit (A)	$60.00	$30.00
less – Royalty (5% of Revenue)	($5.00)	($5.00)
	--------	--------
equals – Profit Before Tax	$55.00	$25.00
less – Income Tax (30%)	($16.50)	($7.50)
	--------	--------
equals – Profit After Tax (C)	$38.50	$17.50
Total Revenue to Government (B) (Income Tax + Royalties)	$21.50	$12.50
Effective Tax Rate (A/B)	35.8%	41.7%
Capital Invested (D)	$250	$250
Return on Investment (C / D)	15.4%	7.0%

Note : For simplicity, this example ignores the issue of depreciation and ongoing capital expenditures (ie it is assumed that they cancel each other out) on the project cashflows

As can be seen, using the same tax rules, the High-Cost Mine pays a much higher effective tax rate (41.7%) than the Low-Cost Mine (35.8%). Assuming that they both require the same amount of capital to build, the High-Cost Mine generates a much poorer return on investment (7.0%) than the Low-Cost Mine (15.4%). Consequently, the investor needs a very low hurdle rate to justify building a High-Cost mine. The end result is that marginal (ie high-cost / capital-intensive mines) generally don’t get built in countries with high business risk.

To determine the effective tax rates of various countries, modeling work was carried out on the economics of developing 995 known copper deposits using the various tax regimes that apply in 12 different countries around the world. The results are summarised below:

	10% Hurdle Rate		15% Hurdle Rate		20% Hurdle Rate	
	Number of Mines built	Effective Tax Rate	Number of Mines built	Effective Tax Rate	Number of Mines built	Effective Tax Rate
Low-Risk countries						
Australia – West Australia	156	50.2%	33	42.0%	20	39.0%
Canada – Ontario	119	60.9%	27	55.3%	17	53.8%
Chile	188	42.6%	95	39.2%	22	37.4%
USA – New Mexico	173	49.0%	33	42.5%	20	40.8%
Medium-Risk countries						
China – Xianjiang	173	37.2%	93	32.5%	22	28.1%
China – Eastern Province	160	42.2%	58	36.2%	22	32.9%
Mexico	158	47.3%	32	40.7%	18	38.5%
Peru	157	46.5%	33	39.2%	20	36.3%
Mongolia	159	47.1%	92	42.9%	21	39.3%
High-Risk countries						
Argentina	160	49.3%	44	43.5%	20	41.3%
Indonesia	109	53.5%	28	47.3%	18	45.4%
Mali	33	66.2%	19	60.0%	17	55.6%

Note: *It is assumed that only those projects that exceed the investor's Hurdle Rate will be developed. Consequently, the effective tax rate corresponds to the aggregate tax and royalties revenues raised by the Government divided by the total pre-tax profits of those mines that are developed.*

Caution: The Model assumes the same capital and operating costs for all countries – namely a stand-alone mine with modest infrastructure in a low-cost country.

As expected, in a given country, the higher the Hurdle Rate, the fewer the number of projects that would get built. Those projects that do remain are generally the very large low-cost mines. As discussed above, production royalties have less of an affect the economics of these types of mines. This explains why, for a given county, the Effective Tax Rate is lower at the higher Hurdle Rates.

Two locations were considered in China - Xianjiang Province and (a typical province in) Eastern China. Because the former is in the "Western Areas" it attracts concessional tax rules – namely an exemption from Provincial taxes (normally 3%) and an extra 5 years of reduced taxes from the Central Government (ie 2 years tax holiday plus 8 years at 15% tax, before reverting to the normal rate of 30%).

The above Table indicates that, compared to (say) Australia or Canada, China appears to have very attractive tax rules. However, to make a proper comparison, one should take into account the different business risks for foreign companies operating in these countries.

Figure 13 plots the estimated effective tax rates for the above countries on the previously calculated optimum tax rate profile for the copper industry. The various countries have been classified into "Low", "Medium" and "High" business risk. As can be seen, the effective tax rates for Australia, Chile and USA sit very close to the estimated optimum tax rate of ~ 50% for Low-Risk countries. Canada is the only outlier, with an effective tax rate of 60.9% and it should be noted that Canada is progressively reducing its income tax rate.

For comparison, the effective tax rates of the Medium-Risk countries of China, Peru, Mexico and Mongolia lie above their estimated optimum tax rate of ~32%. The current tax rate appears to be 3% to 5% too high.

The High-Risk countries (of Argentina, Indonesia and Mali) have similar effective tax rates to the Medium- and Low-Risk countries. However, as can be seen in Figure 13, the effective tax rates all exceed the estimated optimum tax rate of ~25%. Under the current situation only the very highest quality mineral discoveries in these countries will be developed into mines. On this basis it is not surprising to observe that there is currently very little mineral exploration being carried out in these countries.

6 Conclusions

Studies show that Governments use a wide range of taxes and levies to capture significant value from the mining industry. On average, the Western World mining industry pays around 39% of their profits on direct taxes (such as income tax and royalties). In practice, Governments also receive significant revenues from indirect and secondary taxes. Examples of these would be levies on fuel and imported goods, and taxes on the companies and people that supply goods and services to the mining industry. While it is hard to calculate the precise level of charges from these other sources, studies on the Australian minerals industry suggest that the money collected by the State from these secondary sources is much larger than that raised through direct taxes.

Governments can use taxation policy to encourage the development of a viable mineral industry in their country. Obviously, setting the tax rate too low will mean that the Government will not capture the maximum value. However setting taxes too high is also counter-productive – as it reduces the number of mines built. More importantly, but not often recognised, high taxes discourage companies from exploring and discovering new deposits. Without this necessary step there is no opportunity to develop the industry in the first-place. Clearly there is an optimum tax rate – where the Government can maximise it return from the industry.

Detailed modeling of the copper industry indicates that the optimum point is a function of both the tax rate and the overall level of business risk in the country. Consequently, to operate effectively in high-risk countries, Governments have to offer very attractive taxation regimes to encourage companies to explore and build mines. It is interesting to observe that many of the Low-Risk countries have unconsciously set their effective tax rate very close to the estimated optimum level. However, this is not the case in many of the Medium- and Higher-Risk Countries – which have effective tax rates much higher than the optimum level. The underlying problem could be that many of these countries use the wrong reference point to benchmark themselves against. In practice they should compare their tax rules against other countries of similar risk levels, rather than with Low-Risk countries like Australia and Canada.

Another important outcome from this study is that the realization that, in a given country, the overall size of the minerals industry is a function of the geological potential[6], taxation regime (and investment rules) and the overall level of business risk. Not only is there strong merit in Governments fine-tuning its tax regime to attract new investment, but they also have an equally important role in reducing the overall level of business risk. Modest improvements in this area can have a profound effect on the overall level of investment. Recent evidence for this can be seen in the level of investment that has gone into expanding the mining industries of Chile and Peru. In both cases, the main impetus for this was a step reduction in the level of business risk.

Figure 14 summarises the value to Governments and Industry in implementing these key actions.

[6] *Although it is outside the scope of this presentation, encouraging more exploration can also increase the level of investment in the industry. In particular, Governments (through its Mining Departments and Geological Bureaus) have an important role to play in promoting exploration by enabling better access to land, and providing (at minimal cost) high quality geological data on the mineral potential of the country.*

Table 1: Revenue received from the Australian Government from the local Mining Industry, for year ending June 2002

		Millions of Australian Dollars		% of Operating Profit
	Total Sales Revenue		$38833	
	Operating Profit before direct taxes		$6225	100%
Direct Taxes	Production Royalties	($1182)		(19.0%)
	Income Tax	($1904)		(30.6%)
			($3086)	(49.6%)
Indirect Taxes (*)	Land Taxes	$51		(0.8%)
	Payroll Tax	$205		(3.3%)
	Fringe Benefits Tax	$69		(1.1%)
	Fuel Excise & Other Taxes	$103		
			($428)	(6.9%)
	Profit after Tax		$2711	43.6%
Secondary Taxes (ie taxes paid by other parties)	Income tax paid by Employees	($937)		
	Taxes on Shareholders	($5)		
	Taxes on Suppliers	($4757) est #		
			($5699) est #	
Other income to the Government	Rail and Port Charges *	($1253)	($1253)	
ESTIMATED TOTAL INCOME TO THE GOVERNMENT (including Taxes on Other Parties and revenue from Rail and Port Charges)			$10,466	

* The survey treated these charges as an operating expense and so were deducted prior to calculating the operating profit before tax

\# Estimated by the author based on ~20% of the value of the money spent on goods and services (excluding salaries – as the survey reported these separately)

Source: *Minerals Industry Survey Report 2002* prepared by the Minerals Council of Australia

Figure 1: **Market Return on Shareholder's Funds invested in major Western World non-ferrous mining companies versus the yield on 10-year US Government Bonds**

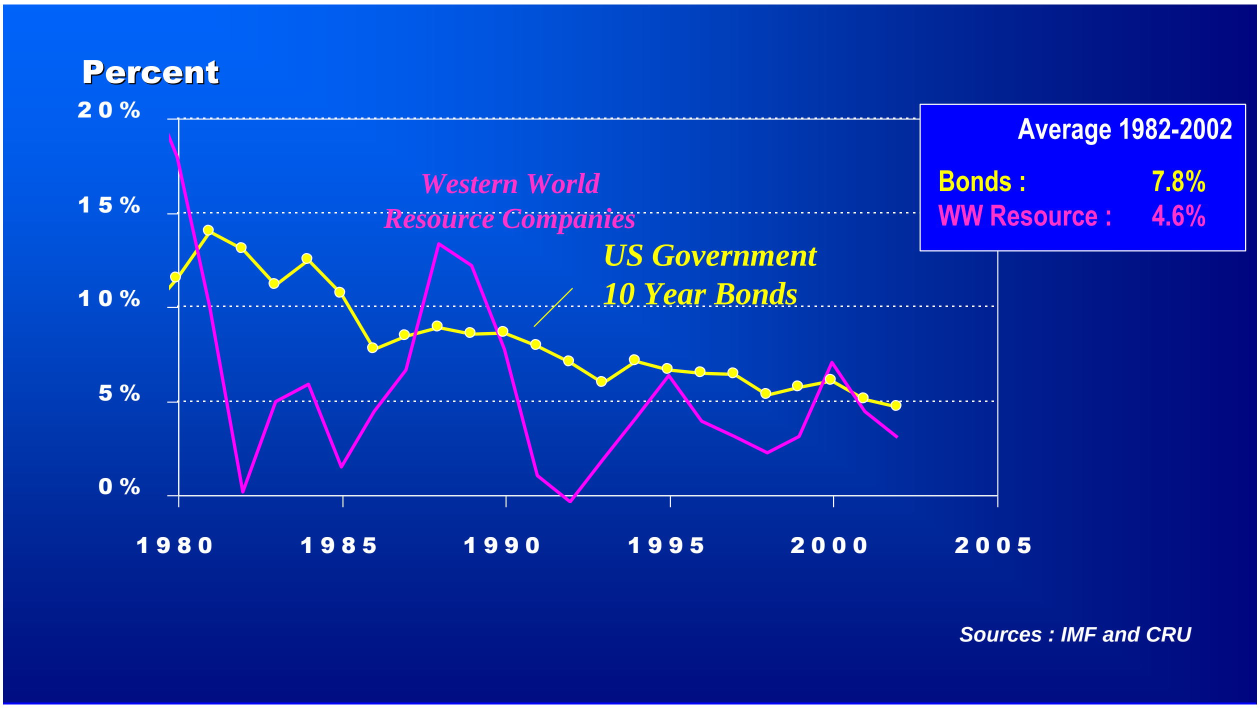


Figure 2: **Overall Profits and Taxes paid by major Western World non-ferrous mining companies**

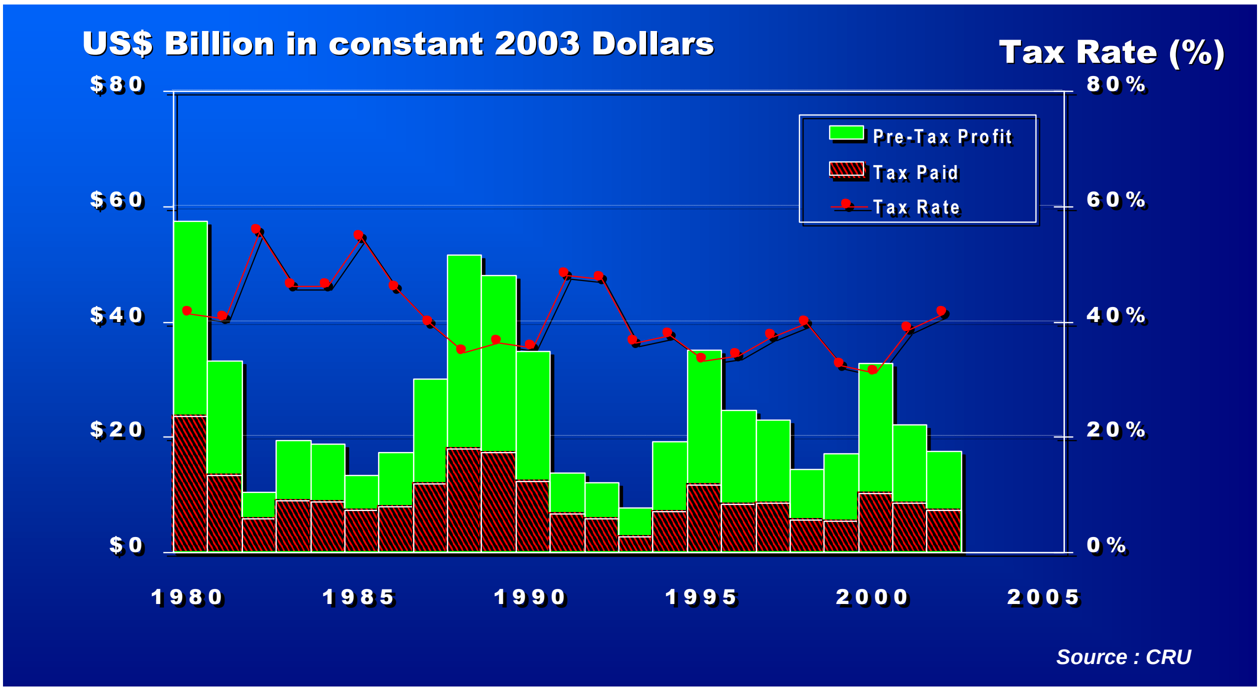


Figure 3: **Size and Grade of major copper deposits in the world**

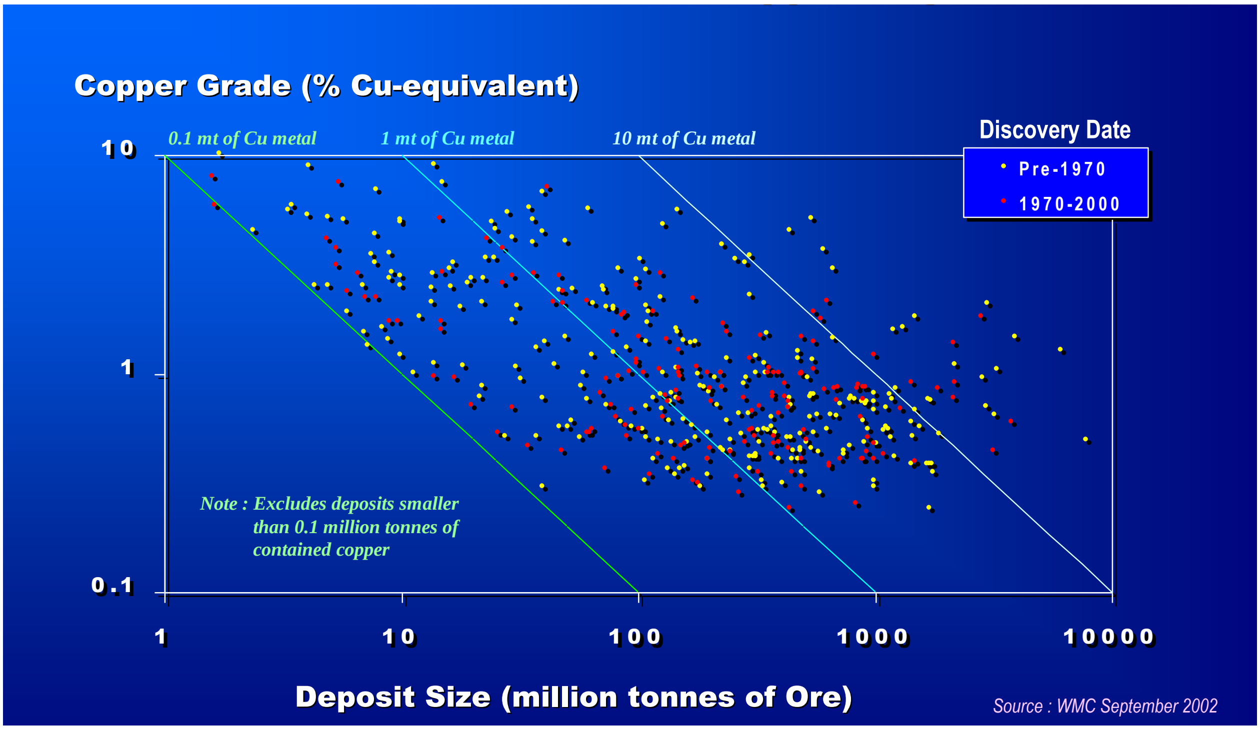


Figure 4: **Deposit size-and-grade required achieving a given return. Copper deposits based under 50 metres of cover in a low-cost country and 30% overall tax rate**

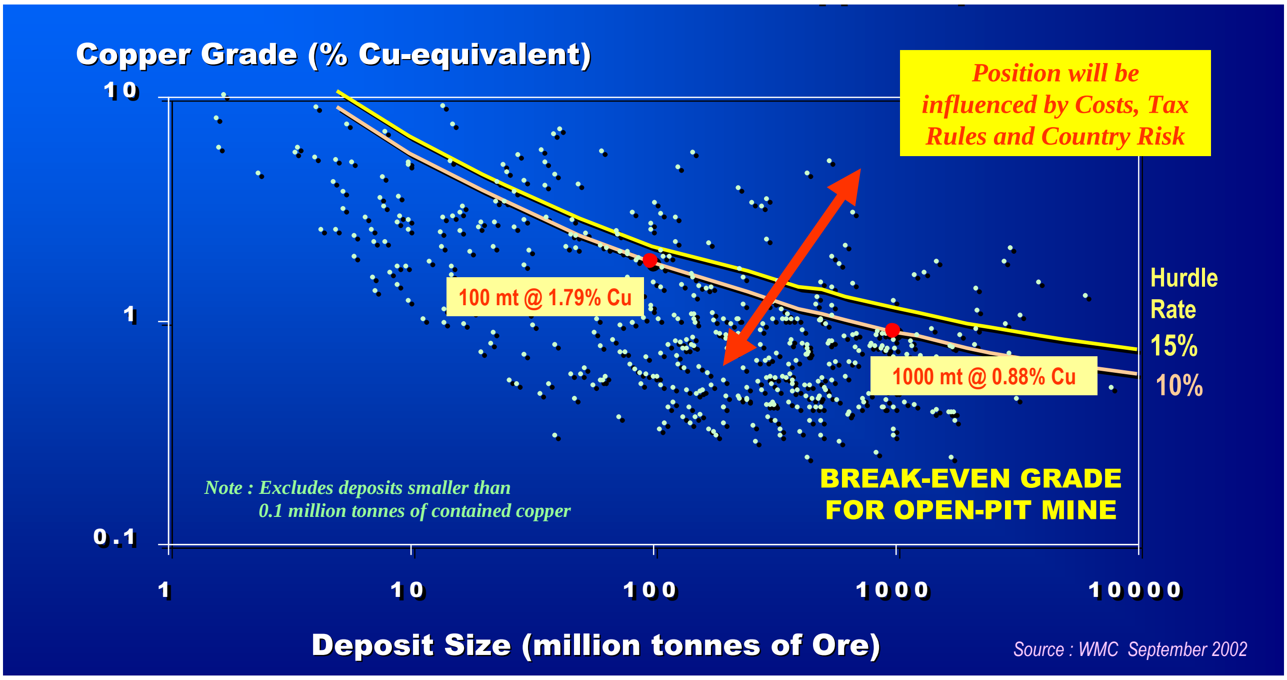


Figure 5: **Deposit size-and-grade required achieving a given return. For deposits based in low-cost country and 30% overall tax rate**

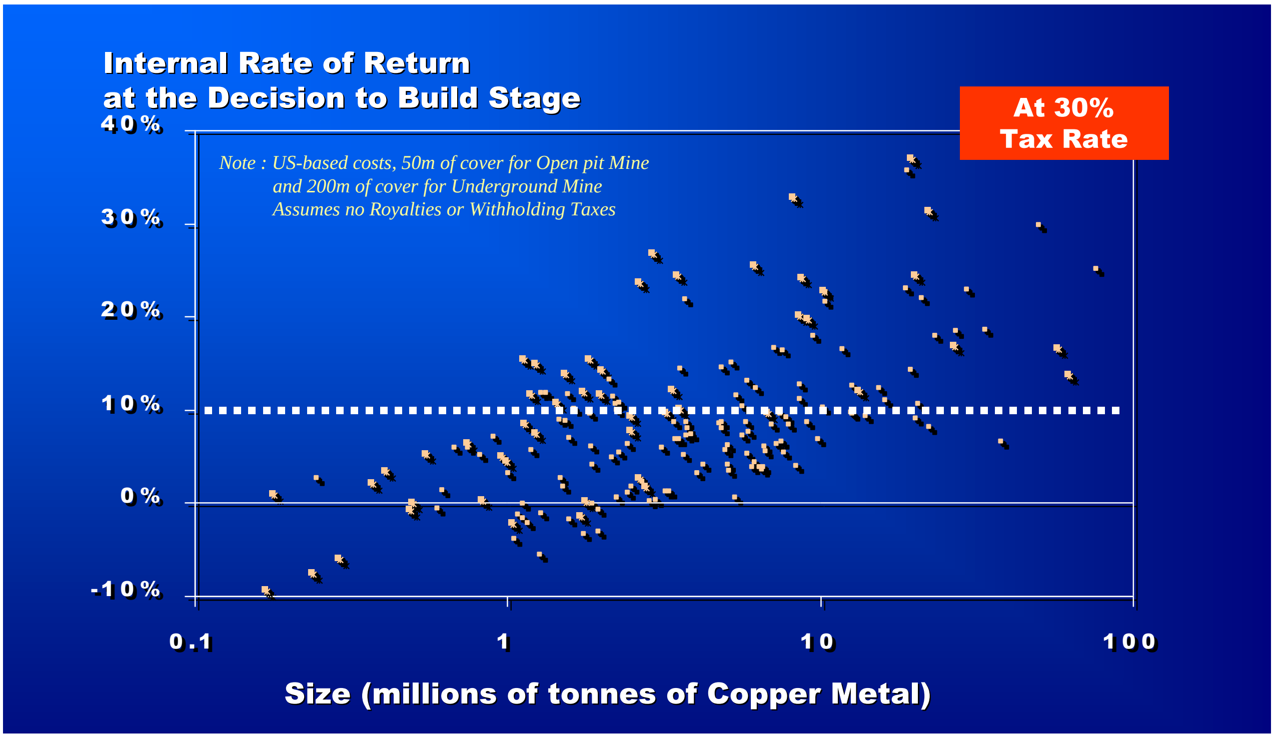


Figure 6: **Effect of changes in the tax rate and investment rate on the number of copper deposits that would economic. Deposit size-and-grade required to achieve a given return. For deposits based in a low-cost country**

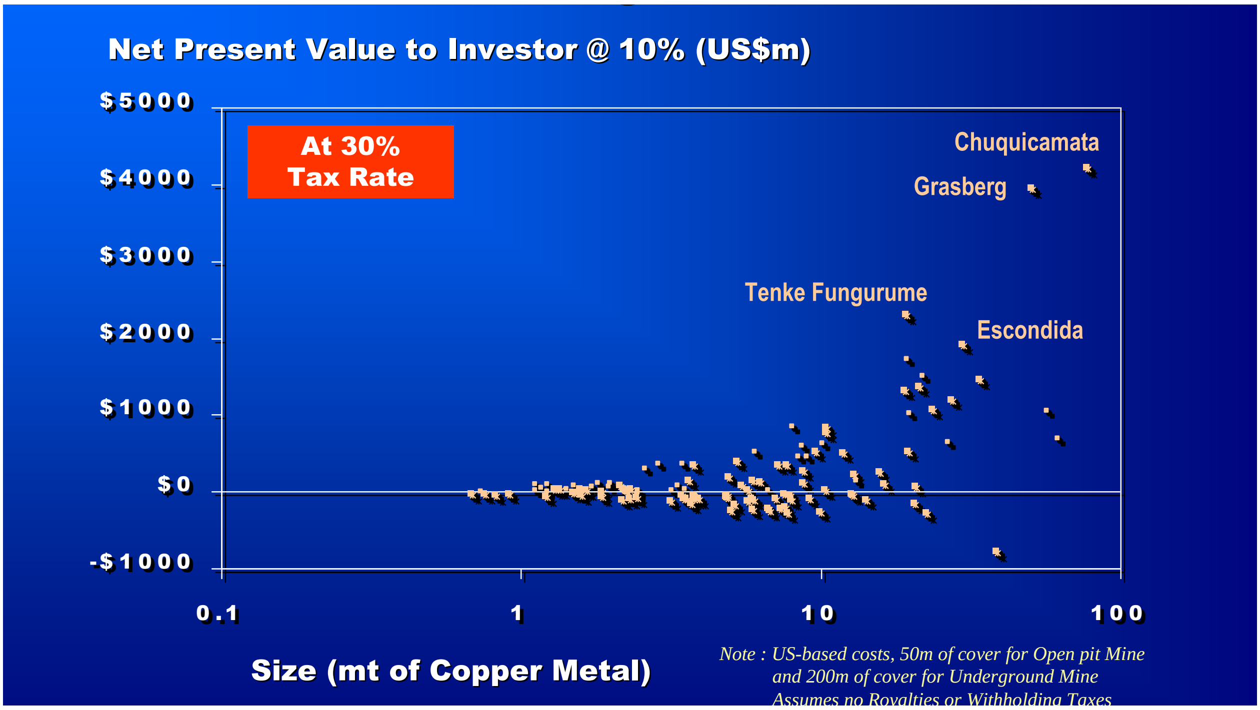


Figure 7: Effect of changes in the tax rate and investment rate on the number of copper deposits that would economic. Deposit size-and-grade required to achieve a given return. For deposits based in a low-cost country

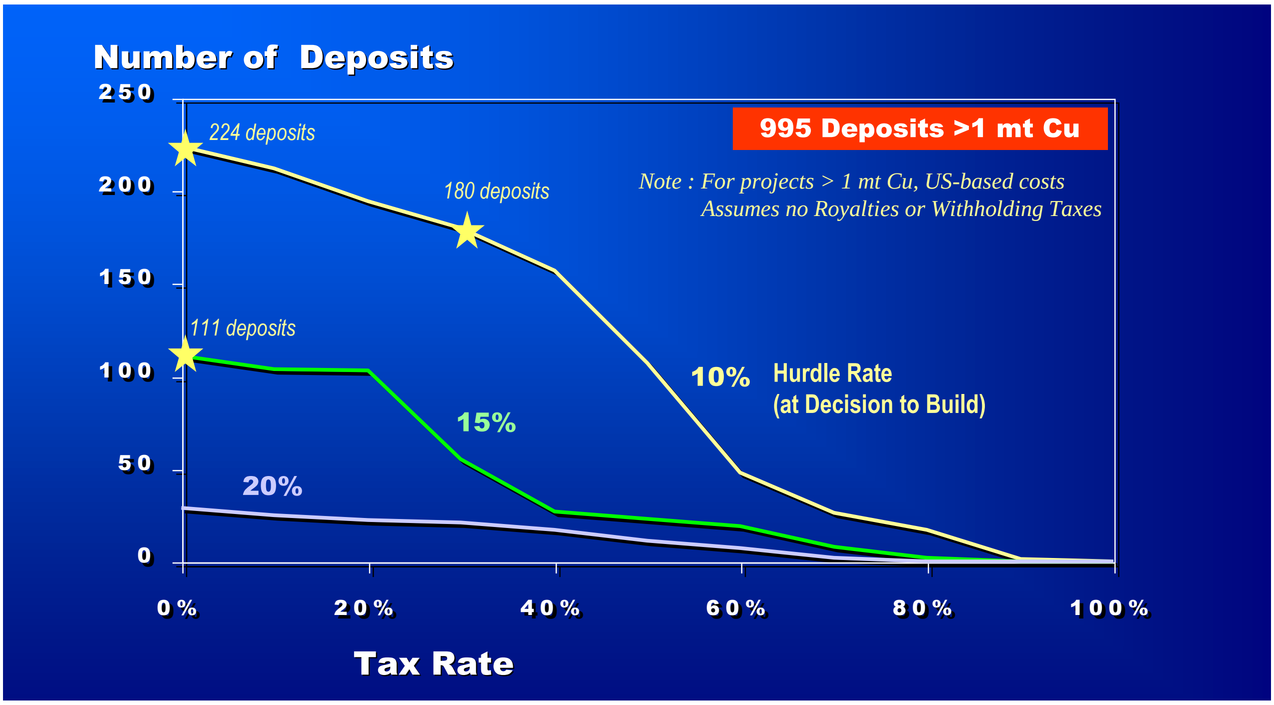


Figure 8: Estimated Value generated from developing a copper industry. Based on developing projects in a low-cost country with 30% tax rate and a minimum investment rate of 10%

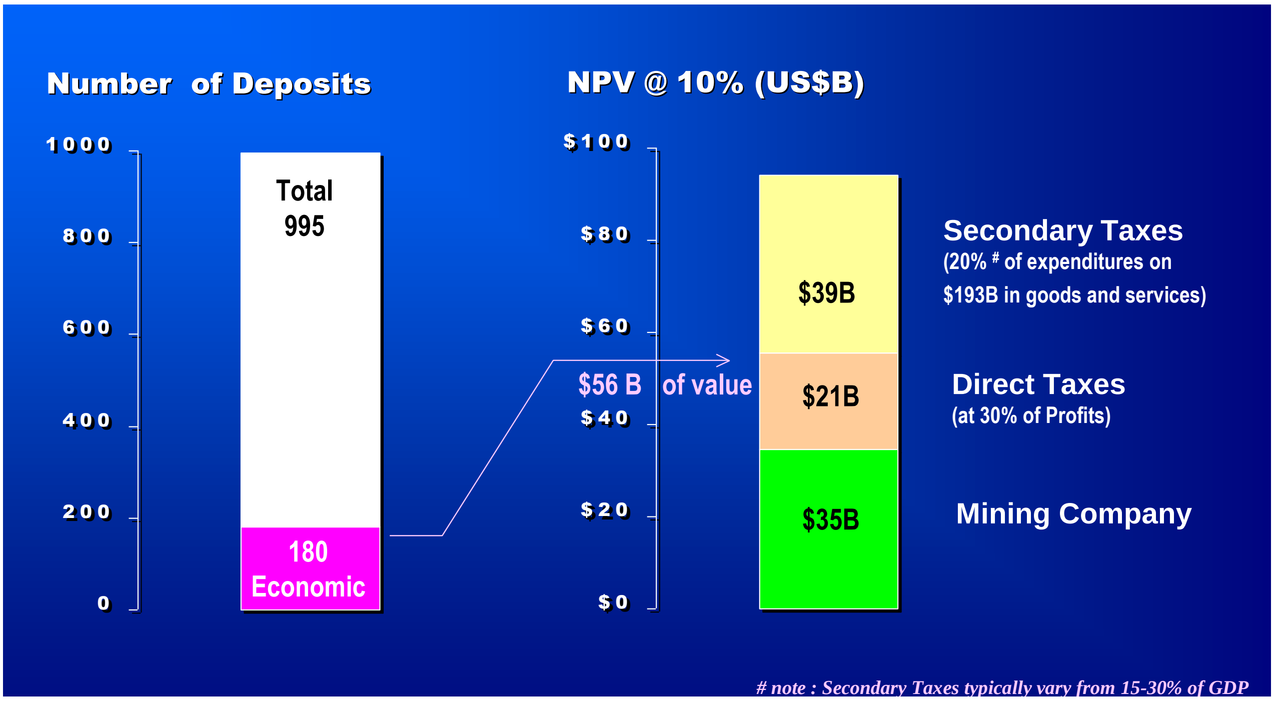


Figure 9: **Effect of tax rates on the estimated overall distribution of wealth from the copper industry. Based on developing projects in a low-cost country with a minimum investment rate of 10%**

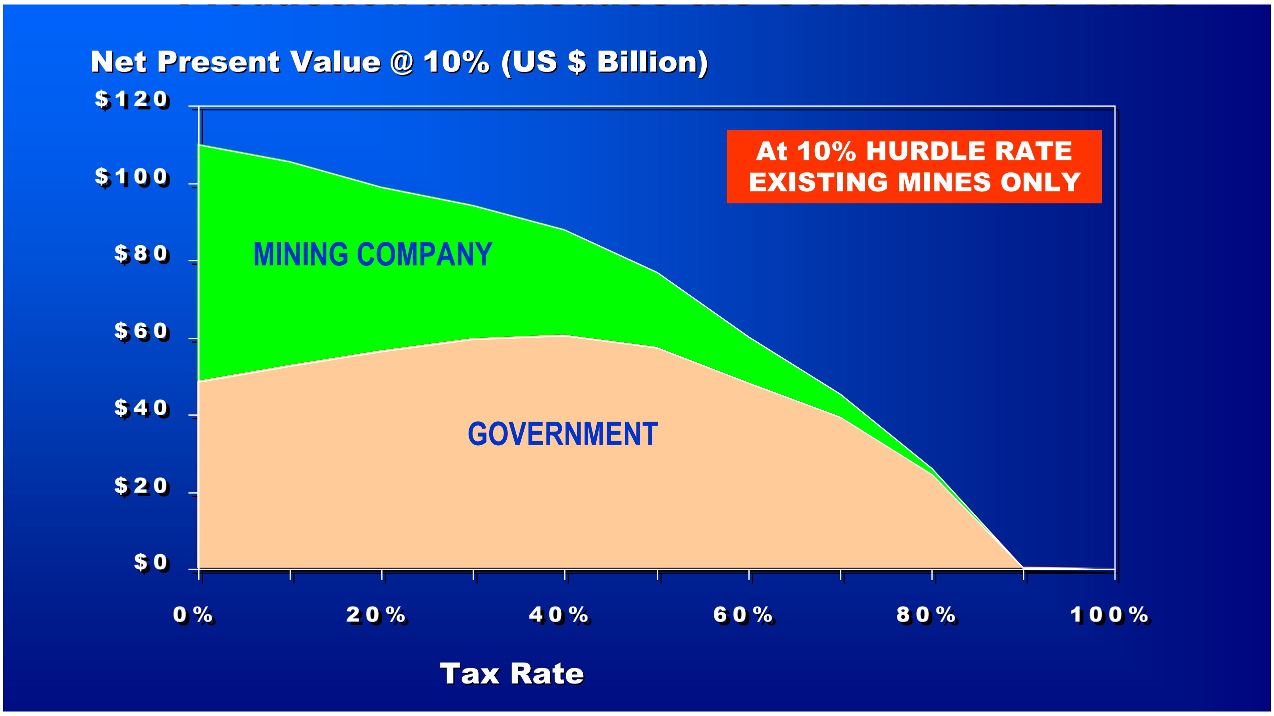
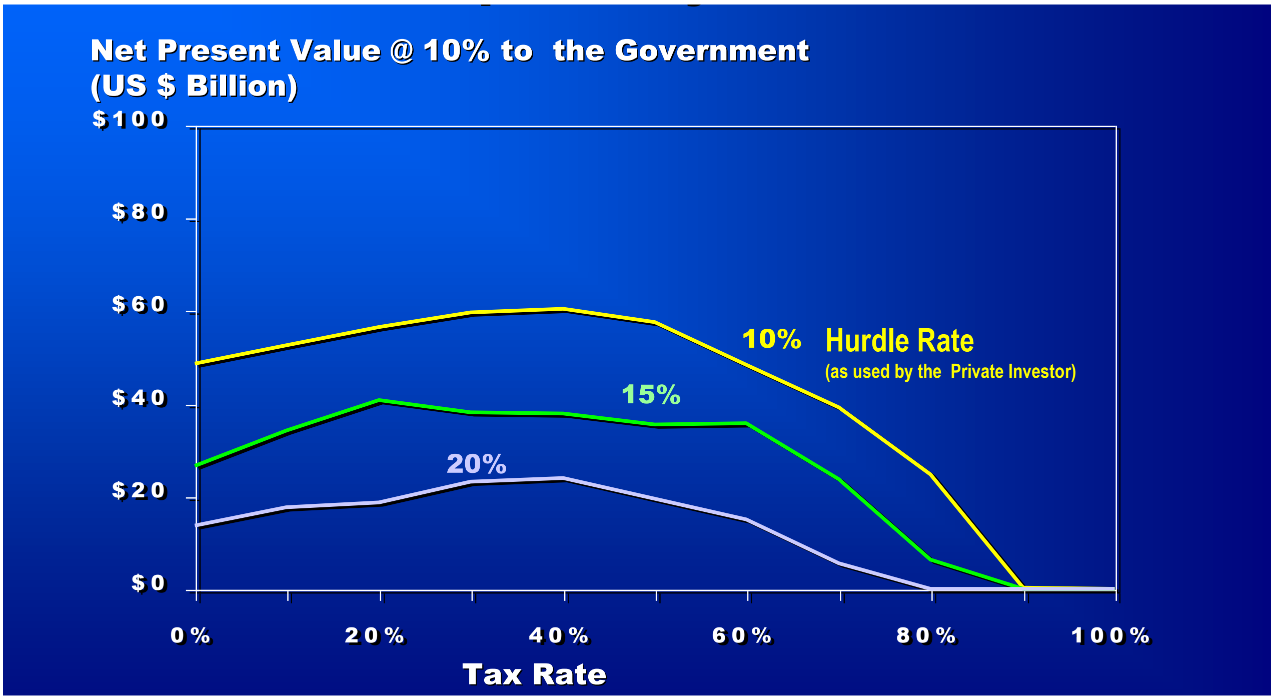


Figure 10: **Effect of Tax Rates and Hurdle Rates on the estimated value captured by the government. Based on developing copper projects in a low-cost country, and assumes the deposits have already been found**



Note: *In order to keep the analysis simple, I have used a constant 10% discount rate to calculate the Net Present Value of the tax revenues to the government.*

Figure 11: **Deposit size-and-grade required achieving a 15% rate of return at the start of exploration and at the decision-to-build stage. For copper deposits based under 50 metres of cover in a low-cost country at 30% overall tax rate**

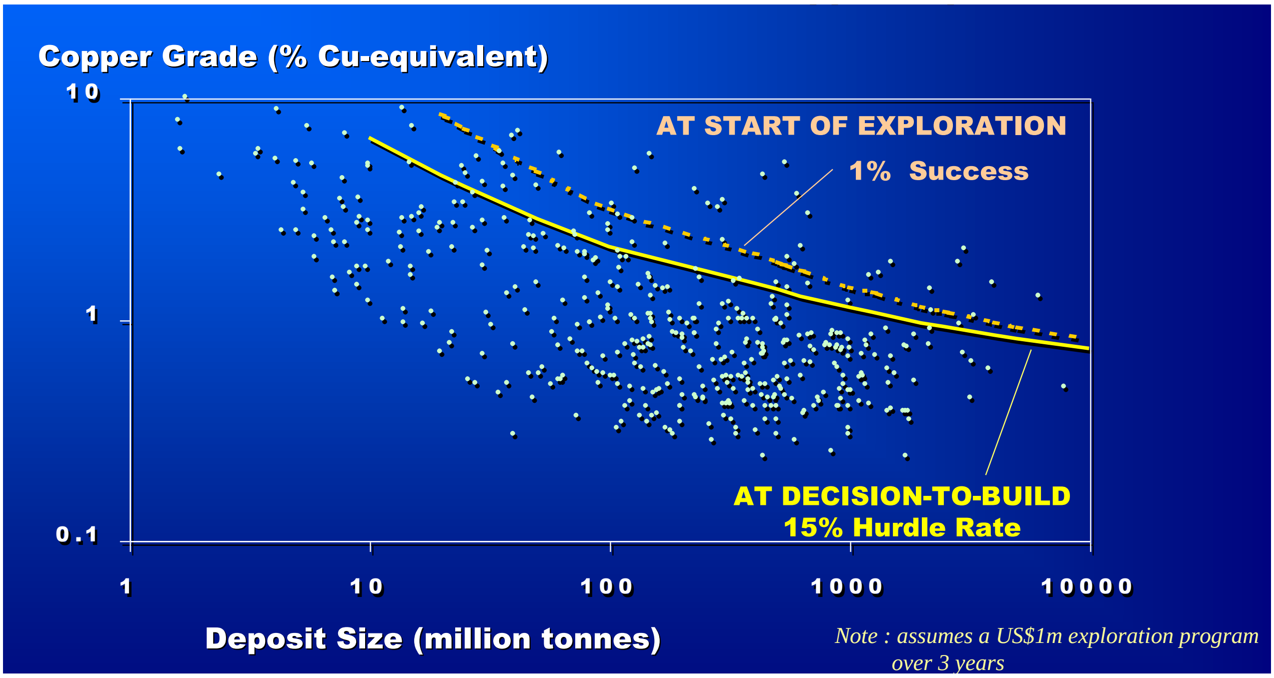


Figure 12: **Effect of Tax Rates and Discovery Rates on the estimated value captured by the government. Based on developing copper projects in a low-cost country, and assumes the average exploration project costs US$1m over three years**

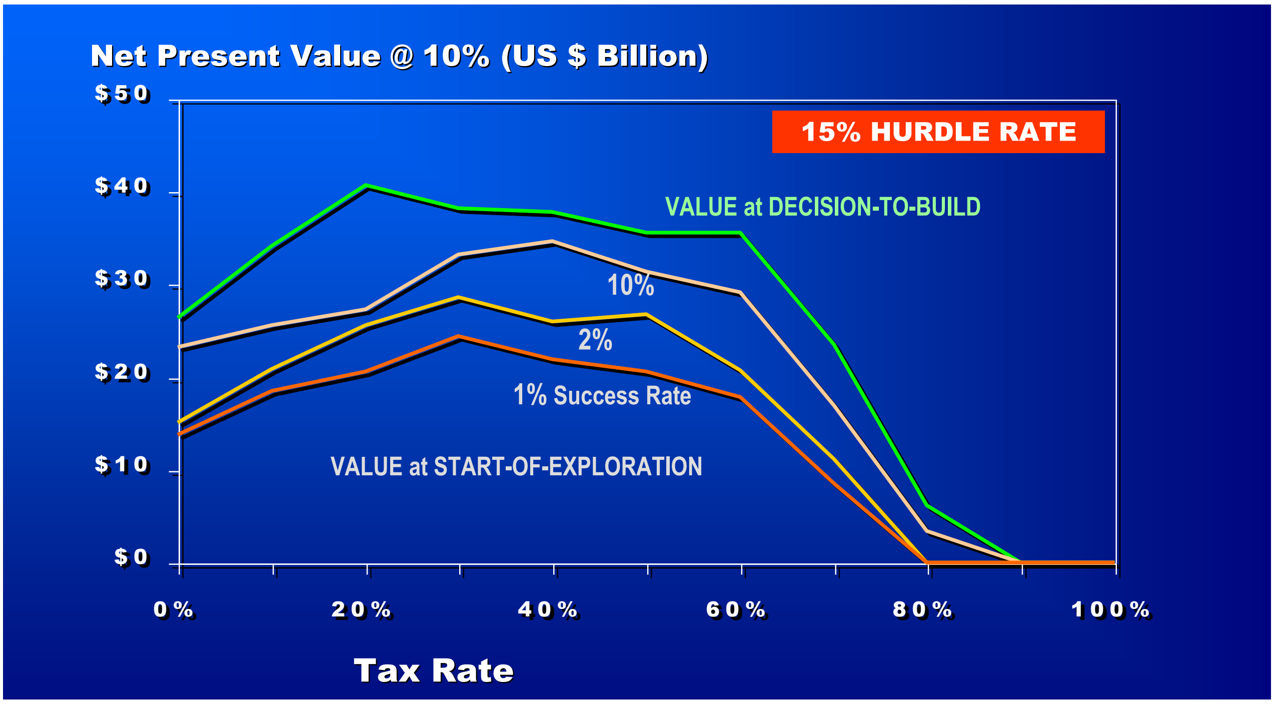


Figure 13: Estimated value to the Government of developing a Copper industry at various Tax Rates and Investment Hurdle Rates. Overlain on this is the estimated Effective Tax Rates for 12 countries.

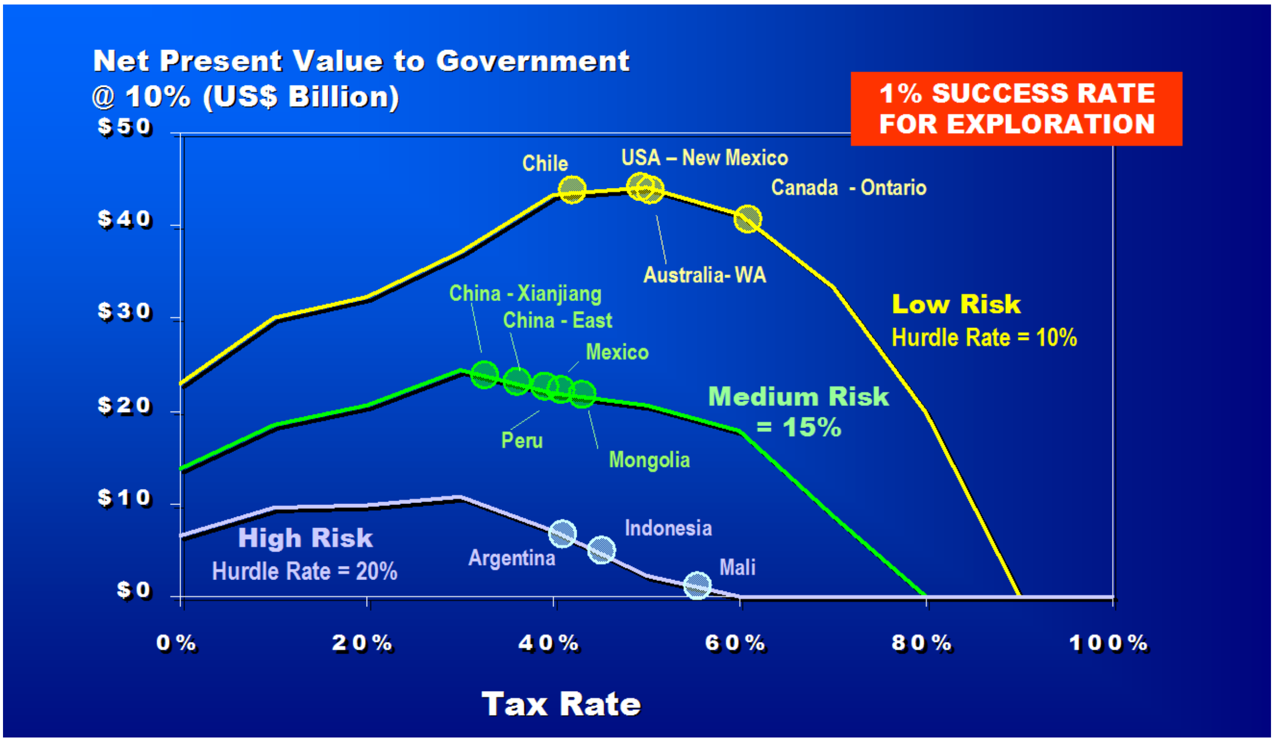


Figure 14: Conceptual Chart showing the three main factors Governments can do to maximise the value of its Mining Industry