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# VARIABLE ROYALTIES:

## An answer to volatile mineral prices

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This policy paper was written by Anna Fleming and David Manley (NRGI), and Thomas Lassourd (IGF), with input from National Treasury, South Africa and support from IGF and ATAF

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**In many mineral-rich countries, variable royalties represent a potential improvement over inflexible fixed-rate royalties. They provide more flexible revenue than fixed-rate royalties and are easier to implement than profit-based or cash flow-based taxes.**

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To tax mining companies, governments regularly face two challenges. The first is that because many mining companies are multinationals, profit-shifting and tax base erosion are common. As this handbook makes clear, this is a particular challenge for tax officials in many developing countries.

The second challenge is that mineral prices have been volatile and are likely to continue to be as the global economy transitions to low-carbon energy use.<sup>1</sup> This energy transition is revealing itself to be both hungry for metals and making some metal markets highly volatile. This volatility comes both from the changing use of metals, as manufacturers innovate and switch between metal uses, and sudden changes in supply, as new deposits are found or disruptions limit the supply. Mining countries stand to benefit a great deal from the demand for their metals, but as many governments have experienced before, price volatility significantly challenges their ability to tax companies.

A variable-rate royalty, or “variable royalty” for short, appears to offer an answer. It has similarities with its cousin, the fixed-rate or ad valorem mineral royalty, a payment levied on some measure of the gross sales value of production from a mine. But unlike its fixed-rate cousin, a variable royalty has a rate that varies with some measure of mineral price or profitability.<sup>2</sup>

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<sup>1</sup> Particularly so for “minor metals,” many of which are “critical” to industrial processes in the energy transition (Renner & Wellmer, 2019).

<sup>2</sup> In the oil industry, governments have been levying variable royalties for decades, and some have designed production-sharing arrangements based on production or gross sales that are part of the same genus of tax types.



More complex versions of variable royalties even use operating profits as a base rather than gross revenue, and they are therefore closer to corporate income taxes than to ad valorem royalties.

A variable royalty presents an upgraded version of a simple fixed-rate royalty. Compared to a fixed-rate royalty, a variable royalty adjusts more to volatile mineral or metal prices. This means it generates more revenue when prices are high and less revenue when prices are low. Like fixed-rate royalties, most—but not all—types of variable royalties remain simpler to administer than taxes based on profits and can be explained in simpler language to citizens concerned with how much their country is getting from the mining industry.

Few governments actually call such taxes by the name *variable royalties*. They instead use a plethora of terms—from revenue tax to special mining tax to windfall tax. They have also been called “progressive” royalties or referred to as having “step-scale” and “sliding-scale” royalty rates (Natural Resource Governance Institute, n.d.). All these taxes or levies share characteristics that mean they behave in a similar way.

However, governments have not always levied variable royalties successfully. Officials have come to realize that it is important to get both their design and implementation right. This chapter reviews examples of variable royalties from 15 countries, showing what to emulate and what to avoid.

## Assessment of Variable Royalties

Variable royalties can help governments improve mining revenue collection while accommodating an investment-friendly mining policy. But they need to be designed with care, accounting for mining costs and adjusted to specific commodities.

### Variable Royalties Can Improve Revenue Collection

In countries where mining revenues depend more on mineral royalties than income taxes, variable royalties could be an improvement.

As discussed in this handbook, corporate income taxes are a key component of most mining fiscal regimes. Between 2013 and 2020, mining companies that were members of the International Council on Mining and Metals paid a global aggregate of USD 185 billion to tax authorities around the world, about USD 66 billion in royalties and USD 119 billion in corporate income taxes (International Council on Mining and Minerals, 2021).

However, in countries with poorly resourced tax administrations, royalties tend to generate more revenue than corporate income taxes. In a previous posts, the authors illustrated the aggregated payments to dozens of governments and the proportion of each type of tax collected by the



respective governments.<sup>3</sup> They showed that some countries receive comparatively little revenue from profit-based taxes, instead collecting more royalties and other types of payments from mining companies.

For these countries, royalties are particularly important. Compared with profit-based taxes, royalties are relatively simple to administer, more easily sharable with local governments, and payable almost as soon as a company extracts the ore from the ground (Otto et al., 2006), at least for the most common type of variable royalty based on gross revenue. Building on these advantages, variable royalties can increase the total revenue collected from companies by adjusting the royalty rate to a price or profitability index even when income tax receipts are disappointing. This depends, however, on the tax base and the scale that each variable royalty uses—a subject discussed later in this chapter.

## Variable Royalties Can Accommodate Mining Investment

The flexibility of variable royalties can work in favour of mining investment. If properly designed, they collect more revenue when companies have the highest ability to pay and less in more challenging economic contexts. They can also have a stabilizing effect on the fiscal regime.

Fixed-rate royalties are often called “regressive” because, as they are based on production or sales value and do not consider costs, they do not adjust to changing profits (Otto et al., 2006). When companies make large profits, royalties only increase proportionally to gross revenue, whereas taxes based on profits or economic rents capture more of the profits. Conversely, royalties are payable even if a company is suffering losses. This can result in companies not expanding mines into high-cost areas; closing projects prematurely; and, in the extreme, not investing at all (International Monetary Fund, 2012).

This inflexibility of fixed-rate royalties pushes governments to change royalty rates often to adjust to new price levels. Although not wholly about royalty changes, the regressive nature of the Zambian mining tax regime contributed to the government’s decisions from 2001 to 2017 to change the mining tax regime nine times following the rise and fall of the copper price (Manley, 2017). Each rise antagonized the mining companies, and each fall antagonized civil society and many voters who wanted heavy taxes on the industry. Changes also took time. By the time the government had responded to a price rise by legislating a new tax term, the price had already fallen, making the now higher rate even more burdensome for companies. Changes also created mistakes, leading to further antagonism and delays (Manley, 2021).

If calibrated correctly, variable royalties are upgrades that address the need to chase the roller coaster of prices and profits. While they are still not as flexible to changing profits as profit-based taxes, they tend to be less regressive than fixed-rate royalties, as long as mining costs are not

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<sup>3</sup> Lassourd, Manley, *As Mining Enters the Renewables Era, Taxation Challenges Persist*, NRGi, October 2019, <https://resourcegovernance.org/blog/mining-renewables-taxation-IGF>



strongly correlated with the commodity price, an issue we discuss below. As variable royalties have different rates for different price or profitability levels, they should not require as many changes.

In South Africa, the current variable royalty was designed with this objective in mind. Government officials knew that there was no perfect tax policy and that a resource-rent tax, although desirable on paper, would be too complicated to implement. They came up with a variable royalty whose rate varies according to companies' profit margin (earnings before interest and tax [EBIT]) but whose base remains ad valorem: gross revenue. The South African government was aiming for a balance in tax policy between simplicity and good, efficient royalty design (H.R., SARS, personal communication, December 2022).

We also consulted tax specialists in mining companies. The general position of companies is that if the package includes a variable royalty and the overall tax burden and progressivity are acceptable given the risks of the project, they will not object. In addition, some mining companies operating in conflict-prone jurisdictions see variable royalties as easier to administer for governments with limited capacity in cost monitoring and tax auditing. One interviewee suggested that in some jurisdictions with particularly cumbersome tax court processes, a royalty is preferable to a corporate income tax as it largely avoids disputes with government lawyers (V. M., personal communication, November 14, 2019).

Companies also care about the stability of fiscal terms (Yunis & Aliakbari, 2021). Most agree that the stability of tax terms might justify a loss of efficiency in the tax regime and would agree to pay a variable royalty that came with stronger commitments to fiscal stability. Indeed, the mining industry proposed such a variable royalty in several legal reforms in Africa in recent years: in 2014 in Cote d'Ivoire, where a version of the industry proposal was ultimately adopted; during the Democratic Republic of the Congo's 2018 mining code reform, where it was not; and in 2019 in Mali, when the government reviewed the country's mining code.

## Variable Royalties Need to Consider Mining Costs

The specific design of variable royalties is important. If the rates are not set at the right level, and if they do not account for mining costs, they will not achieve their objectives.

Although royalties are based on sales revenue and not profit, officials still need to understand the costs of mines when designing the royalty and choosing rates to ensure companies will be able to afford to pay it. This is not easy. Costs are often not well known at the stage of setting the tax regime for a mining company.<sup>4</sup>

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<sup>4</sup> This admittedly can make setting all types of royalties more problematic than profit-based taxes. The problem of understanding costs is effectively front-loaded for the designers of royalties. For profit-based taxes, costs have to be verified month to month, but through this repetition, learning-by-doing may help improve tax authorities' abilities.



This challenge applies even more to variable royalties based on prices. The risk lies in how mining companies' costs might change in relation to prices. If operating costs closely follow prices, then a higher price does not lead to higher profits before tax. The more the rates of a variable royalty increase as the commodity price increases, the more a company is paying despite not making much higher profits.

The positive relationship between average mining costs and metal prices is commonly recognized by the industry and in academic literature (V. M., personal communication, November 14, 2019; see also O'Connor et al., 2016). To add to this literature and better understand the relationship between costs and prices, we interrogated the S&P Capital IQ Metals and Mining Database (the "S&P database" from the S&P Global Market Intelligence).

We looked at two types of costs: development costs and all-in sustaining costs (made up of operational costs and sustaining costs). Typically, a company incurs development costs when developing or expanding a mine. There appears to be no correlation between development costs and the metal price.<sup>5</sup> One reason might be that mining companies cannot easily adjust capital costs, and other non-operating costs prices change because expenditure is either planned years ahead (e.g., development and expansion) or unavoidable (e.g., interest charges). Another reason is that capital costs are reported in the S&P database with less precision than other types of costs and are typically lumped into a single year, while, in reality, they are probably spread out over several years by companies.

However, this picture changes for all-in sustaining costs (AISCs), which companies incur after they have developed their projects. These costs were strongly correlated with price. The reason is that cash costs, the biggest component of AISCs, are primarily made up of mining costs that vary with commodity price cycles: energy, labour costs, mining services, intermediate chemical products, etc.

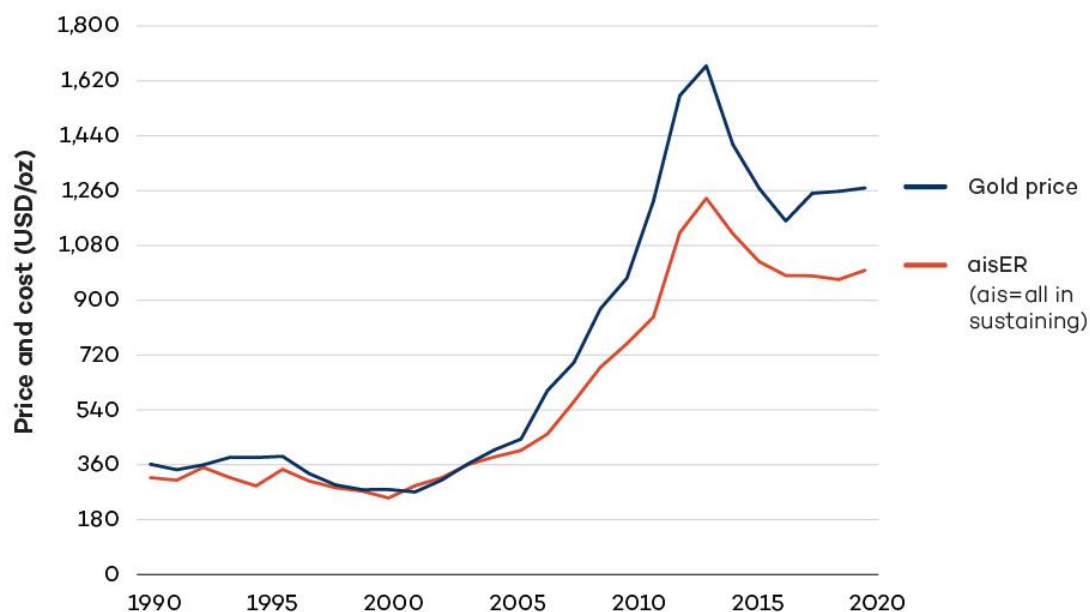
Figure 1 shows that prices and the average AISC for all gold mines in the S&P database have moved together since 1991. In the gold market, prices boomed from around 2002 to 2014. We found similar patterns in the copper and iron ore markets. In all three markets, the costs of extraction rose and fell with prices, although the difference between prices and costs—profits—rose too.

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<sup>5</sup> In regressing year-on-year change in average development costs in the gold industry against year-on-year change in price, we found an R value of only 0.037. In other words, a very weak correlation between the two variables (authors' calculations using S&P Global Market Intelligence, 2019).



**Figure 1. Prices and average global all-in-sustaining costs<sup>6</sup>**



This means that rates of price-based variable royalties should remain at moderate levels, as discussed further in this chapter. However, this price-cost correlation might not be such a problem if the variable royalty is levied on a by-product metal—for example, antimony as the by-product of some lead ores or cobalt as the by-product in the extraction of some copper or nickel ores. As a by-product, the investment decision is less sensitive to the cobalt price, and, in turn, is less sensitive to the royalty rate on this by-product. Changes to the prices of mining inputs, from tires to engineers, also generally reflect the rise and fall in the demand for its major metals—copper or nickel, not necessarily cobalt. For example, over the past 70 years, the prices of copper and nickel rose and fell in tandem, moving with the global economic cycle. The cobalt price so far has not.<sup>7</sup> These two facts give governments an opportunity to apply a heavier variable royalty to by-product metals like cobalt, which they might not be able to do with most major metals.

<sup>6</sup> Global mean AISCs not including royalties, measured as the cost in USD of extracting one unit of metal. Source: authors' calculations based on data from S&P Global Market Intelligence, 2019.

<sup>7</sup> The correlation between nickel and copper (0.7) is much closer than between either copper and cobalt (0.3), or nickel and cobalt (0.3) (Renner & Wellmer, 2019; authors' calculations based on data from S&P Global Market Intelligence, 2019).



## Implementation of the Idea: Variable royalties around the world

Many governments have levied variable royalties on their mining industries. We looked at 15 examples applied to gold or copper mining.<sup>8</sup> We categorized these variable royalties using two factors:

1. **Royalty base:** gross revenue (including minor deductions for smelting or transport in some cases) or some form of net revenue (operating margin, profit).
2. **Variable-rate structure:** commodity price or some measure of profitability (operating margin, R-factor).

**Table 1. The structure of variable royalties**

		Royalty base	
		Gross revenue	Net revenue
<b>Variable-rate structure</b>	Mineral prices	<b>Category 1.</b> Bolivia, Burkina Faso, Cote d'Ivoire, Guinea gold contract, Kyrgyzstan, Mauritania, Mongolia, Myanmar, Queensland, Zambia.	
	Profitability	<b>Category 2.</b> Niger, South Africa.	<b>Category 3.</b> Chile, Peru, Nevada.

The table shows that the countries we examined fall into three categories:

- Category 1: Royalties with a gross revenue base and a variable-rate structure based on mineral prices.
- Category 2: Royalties with a gross revenue base and a profit-based variable-rate structure.
- Category 3: Royalties with a net-revenue base and a profit-based variable-rate structure.

We excluded from the survey royalties that have a variable-rate structure based on production levels, annual production value, or cumulated production. These structures are relatively common

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<sup>8</sup> We included fiscal instruments that government has explicitly called "royalties" as well as other instruments that function much like a sliding-scale royalty. During our research, we also reviewed royalties no longer applied (e.g., Ghana, Zambia), as well as a proposal submitted by industry bodies during the recent Democratic Republic of the Congo mining code amendment that was not ultimately adopted.



in the petroleum sector, but we only found one instance in the mining sector.<sup>9</sup> The interest in variable royalties is their response to price changes or adaptability to mines with different costs. Production-based royalties do not provide this flexibility.

## Category 1: Royalties with a gross revenue base and a variable-rate structure based on mineral prices

Category 1 royalties are the simplest form of variable royalties. Their rate varies based on mineral prices defined in law or regulation, and their base is annual, quarterly, or monthly gross revenue, in some cases allowing the deduction of smelting or transport expenses (a common element of royalties referred to as the “net back”).

The designers of some of the examples in this category took a conservative approach, with rates that vary between 2% and 6% across the price bands. These rates are close to the rates found in fixed-rate mineral royalties around the world. If calibrated correctly, these royalties are unlikely to make a major dent in profits, but they also will not deter investors who worry about their costs increasing as prices rise.

However, our survey of variable royalties revealed a common challenge. Having set the prices and rates of bands in their variable royalties, some governments have found that these bands were either too high or too low compared to subsequent prices. The resulting effective rates have been either the very highest or lowest of the variable royalty throughout much of the price cycle.

An example of setting bands too low is the Bolivian royalty. Given historical prices, the applicable rate ends up being the highest rate in the range. The Bolivian government included a price-based royalty in the 2007 revision of the mining law, with a range of 4% to 7% when the gold price was between USD 400/oz and USD 700/oz. Since then, gold prices have been much higher than USD 700/oz, and the applicable rate has remained at the maximum rate of 7%. In effect, this has behaved as a fixed royalty on gross production value. Similarly, the royalty system in Queensland, with the upper limit of the highest price band at USD 890, has also effectively behaved as a fixed royalty of 5% since 2009.

Conversely, an example of setting bands too high is the Kyrgyz variable royalty. The Kyrgyz government levies a variable royalty on all but one of its gold mining companies—called the revenue tax.<sup>10</sup> Figure 2 shows that for most of the last 20 years, the international gold price has

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<sup>9</sup> In the mining sector, the Canadian Northwest Territories impose sliding-scale royalties based on the value of production, where the maximum rate of 5% is reached when the production value is equal or higher than CAD 45 million per year (Government of Northwest Territories, 2022). This royalty seems designed to encourage medium-sized mines in the province rather than to maximize revenue collection across industrial mines. In Michigan, United States, the state metallic mineral royalty rate ranges from 2% to 10.5%, depending on the sales value per tonne (Government of Michigan, n.d.).

<sup>10</sup> The largest—Kumtor, currently owned by Centerra—operates under a contract that does not use a variable royalty.

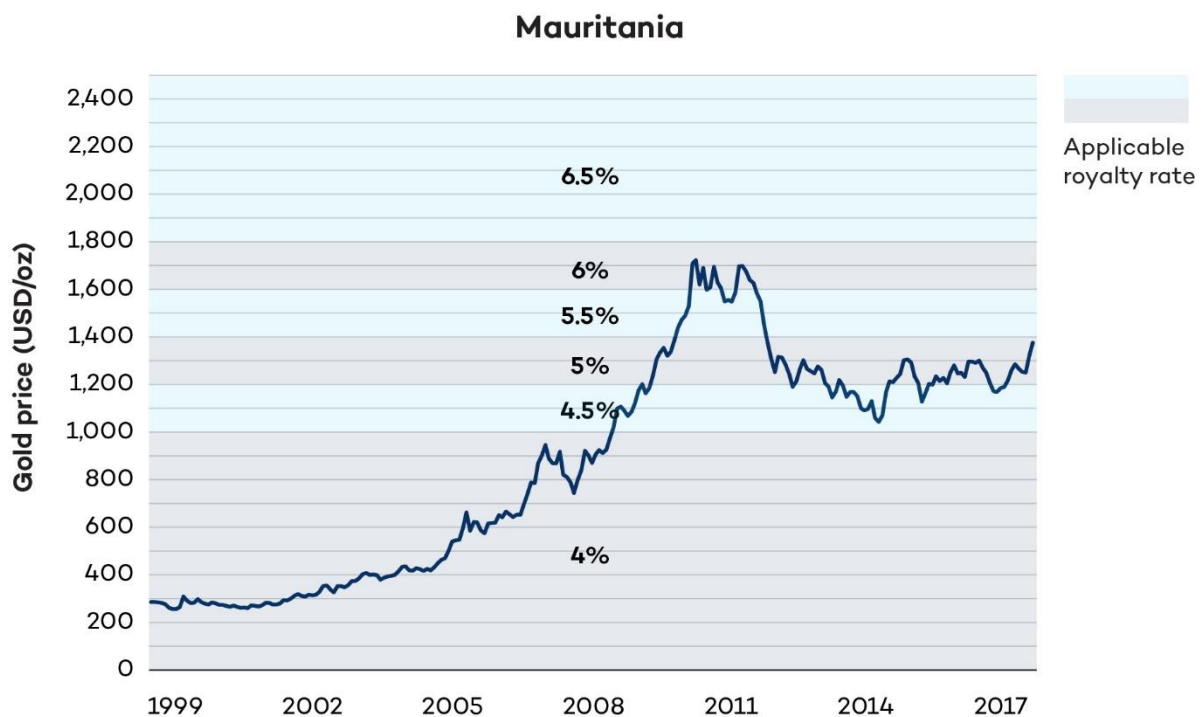




been below USD 1,300 per ounce, the lowest band, with an applicable royalty rate of 1%. Only since 2020 have gold prices reached levels that have triggered higher royalty rates.

The Myanmar government levies fiscal regimes with a mix of legislation and contracts with companies. Contracts with miners include various production-sharing arrangements, in addition to a fixed-rate royalty. One example is the China Non-Ferrous Metal Mining Group-owned Tagaung Taung mine, one of the largest mines in the country. The government's share moves between 1% and 12% with the price of nickel. The main difference between the variable royalties used in other countries and this production share is that the Myanmar state company, representing the government in the production share, has the option to collect the production in-kind—that is to say, as a cash payment—or as the physical concentrate of nickel, zinc, and lead respectively.

**Figure 2. Category 1 examples: Mauritania, Bolivia, Kyrgyzstan**





### Bolivia



### Kyrgyzstan



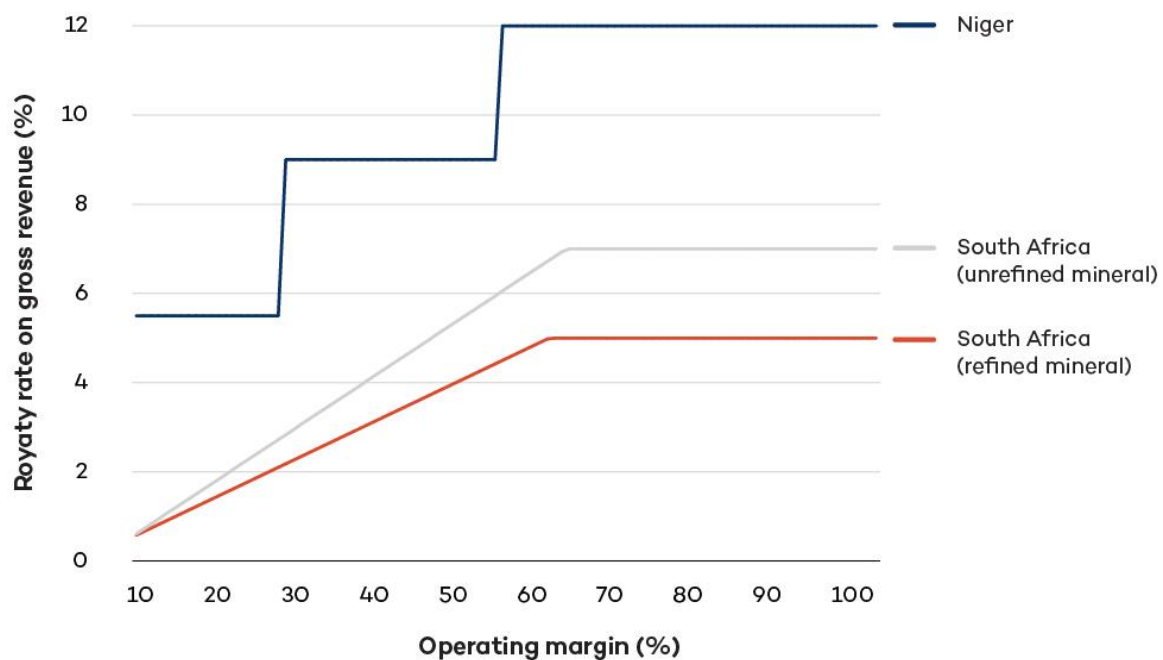
Data source: Fleming et al., 2019; Index Mundi, 2022. See [appendix \(.xlsx\)](#).



## Category 2: Royalties with a gross revenue base and a profit-based variable-rate structure

The second category includes royalties that are also based on the gross revenue of a mine, but their rate varies according to a measure of profitability. For most of the variable royalties in this category, this profitability measure is the operating margin. While exact definitions vary, the operating margin is typically defined as the ratio of EBIT to gross revenue. In most cases, we found EBIT to be gross revenue minus operating costs, depreciation of capital expenditure, and production-related fees and taxes—excluding financing costs and income taxes. Financing costs are typically one of the most difficult to verify, so excluding them makes it easier for a tax authority to verify the operating margin of a taxpayer (Devlin, 2018).

**Figure 3. Niger’s and South Africa’s variable royalty regimes**



Data source: Fleming et al., 2019; Index Mundi, 2022. See [appendix \(.xlsx\)](#).

Because these variable royalties are based on gross sales, their maximum percentage cannot be too high; otherwise, it could become unbearable for some mines. Figure 3 illustrates how the two provisions apply at different levels of operating margins. The Niger regime adopts an aggregate approach, with the rate increasing in steps at operating margins of 20% and 50% and applying to the whole operating margin. The South African royalty uses a formula to set a royalty rate that increases linearly with the operating margin—a “sliding scale.” There is no minimum rate, so the royalty rate increases from 0% to a maximum of either 5% or 7%, depending on whether the



taxpayer is selling refined or unrefined minerals. The maximum is reached just short of an operating ratio of 60%.<sup>11</sup>

### Category 3: Royalties with a net revenue base and a profit-based variable rate

The third category includes royalties, for which both the royalty base and the variable-rate structure depend on a measure of operating profit. This category is related to variable profit taxes; they are only considered royalties because they are called royalties by their governments or imposed in lieu of a mineral royalty as a specific tax on mining activity. In both Peru and Chile, the variable-rate structure is based on an operating margin, which is defined as the ratio of operating profit or operating income to gross revenue. This operating profit is defined in slightly different ways in different countries but, in both cases presented here, is relatively close to the accounting definition of EBIT. No country seems to use the alternative measure of operational profit, which would be earnings before interest, tax, depreciation, and amortization (EBITDA).<sup>12</sup>

Peru applies two taxes on large-scale mineral extraction that both function as variable royalties: a modified mineral royalty and a special mining tax. The royalty rate ranges from 2% to 12% and applies marginally to each 5% band of operating margin. The special mining tax follows a similar structure, with higher rates for companies that have signed stability agreements. Figure 5 illustrates the variable effective Peruvian royalty rate on total operating profit (Acosta et al., 2019).

In Chile, there is no fiscal instrument called “royalty,” but the state imposes a “specific tax on mining operations,” defined in the income tax law as a tax on operating profit, with two sliding scales depending on the project size.<sup>13</sup> The tax applies marginally to different bands of the operational profit margin. Figure 4 shows the net effective rate of this tax on mining companies’ operating profits as the operating margin increases, from a minimum of 5% to a maximum of 14% for mines producing over 50,000 tonnes of copper per year.

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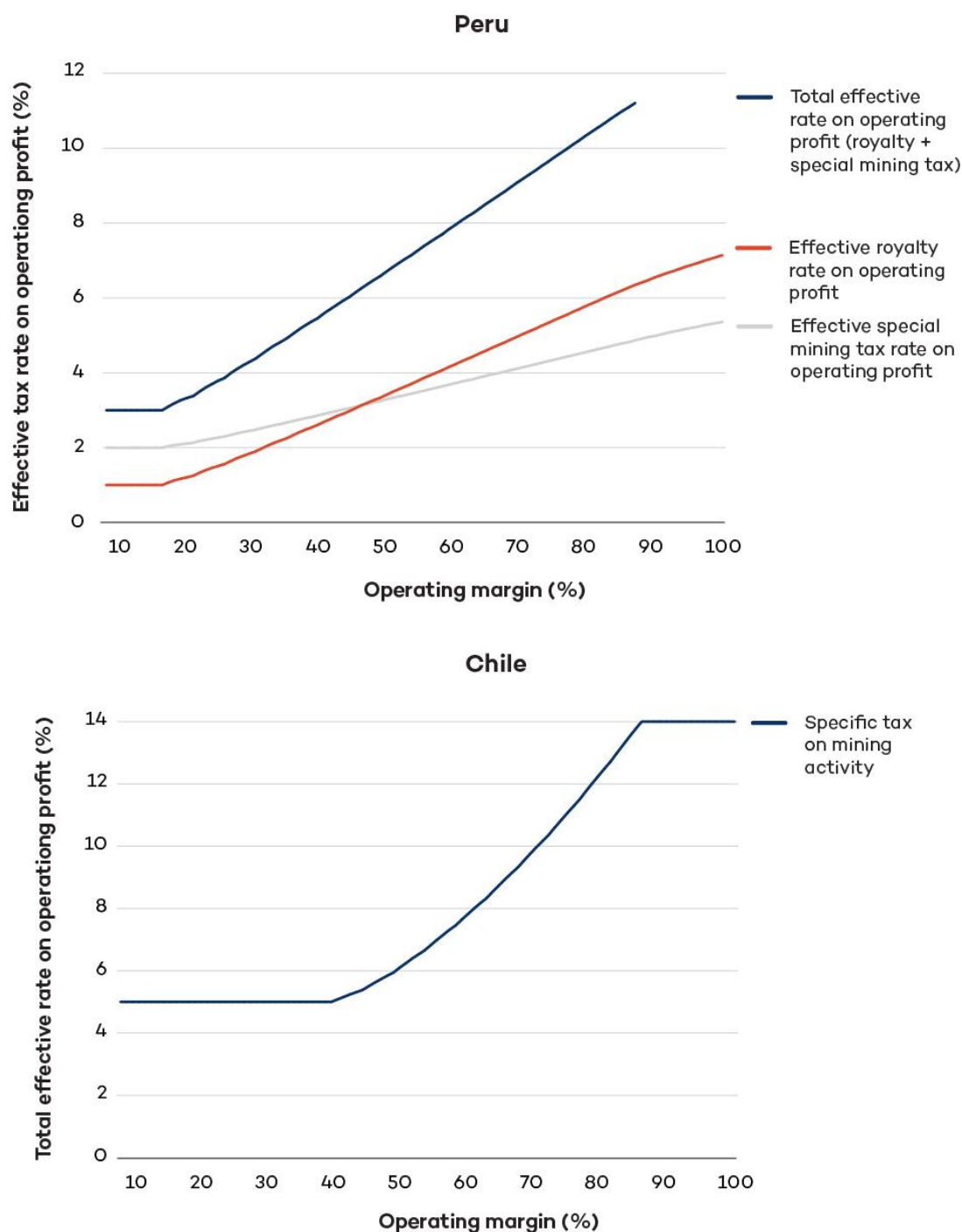
<sup>11</sup> From 1987 until 2006, Ghana had a similar type of royalty, but with higher rates, set by a formula between a minimum of 3% and a maximum of 12% for operating margins between 30% and 70%.

<sup>12</sup> As argued in Section 1, one implication of choosing EBITDA over EBIT is the simplification of the tax base. Depreciation and amortization require extra effort for tax auditors to verify and the high value of these costs mean that a small proportional difference in their valuation can significantly reduce the available tax base. Challenges to verifying depreciation and amortization are particularly great if the tax authority starts to only monitor a mining company once production starts—after most development costs have been expended.

<sup>13</sup> There is a smaller scale for mines producing between 12,000 and 50,000 tonnes per year and an exemption for smaller mines.



**Figure 4. Operating profit-based royalties/taxes in Peru and Chile**



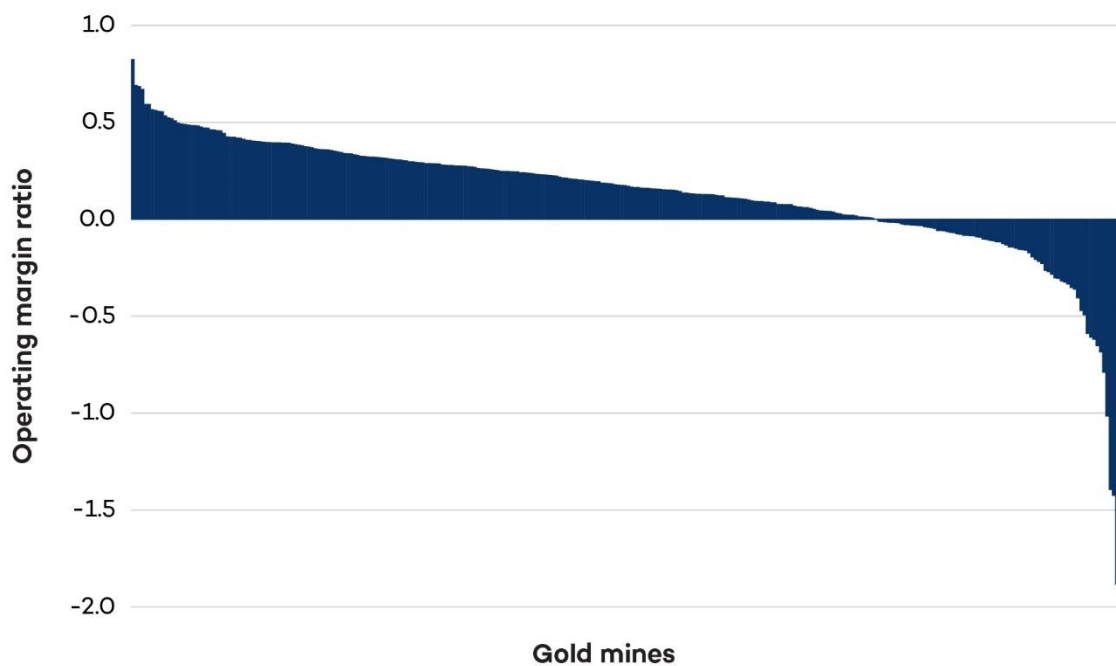
Source: Fleming et al., 2019. See [appendix \(.xlsx\)](#).

Like price-based royalties, royalties with profit-based rates also need to be correctly calibrated. Variable royalties from categories 2 and 3 should be calibrated against the range of profit margin ratios of mines. Indeed, profit margin ratios are generally much lower than 100%. Mines' profitability will vary from year to year, but in most years, there will be very few mines with profit



margin ratios above 50%. Figure 5 shows the distribution of profit margin ratios in 2018 for the gold mines in our database. Many will also have negative margins, especially in the early years of a mine's life, when depreciations for capital expenditures are high. Against this distribution, the rates of South Africa's royalty seem well adjusted, from a 0% to a 60% operating margin ratio. However, this may not be the case for Chile and Peru. The maximum rate of the special mining tax is only reached at a level of 85% of the operating margin ratio in Chile, an almost implausible scenario, and 100% in Peru, a mathematically impossible scenario.

**Figure 5. The range of operating margin ratios for gold mines, 2018**



Data source: Fleming et al., 2019; S&P Global Market Intelligence, 2019.  
Note: Each vertical bar represents the ratio of operating profits over gross sales for a single mine - the thousands of mines included in the S&P Global Market Intelligence database are here sorted by level of operating profit margin



## Politics of Reform: Introducing a variable royalty in a mineral fiscal regime

There is no specific approach to introducing variable royalties into a country's mineral fiscal regime. However, government officials might wish to follow three steps: policy objectives, design, and calibration.

### Policy Objectives

First, the role of a variable royalty should be clear from the outset, as it will determine what type of instrument to choose and its place in the overall mining fiscal regime. If it is to compensate for the depletion of the non-renewable mineral reserve, it may be replacing a fixed-rate royalty. If its main objective is to provide a share of windfall profits, it might be an addition to an existing fixed royalty and include a 0% minimum rate at low prices so that its addition does not make the overall fiscal regime overly regressive.

Second, any variable royalty should be considered as one part of the entire fiscal regime. The royalty should be applied to help ensure the entire fiscal regime meets the government's policy objectives for the sector. For example, if the objective is to attract investment, then the fiscal regime should be progressive. Some types of variable royalties will make the regime more progressive than others. Policy-makers should also consider the effect the royalty has on other parts of the fiscal regime—for example, if companies are allowed to deduct royalty payments from their taxable corporate profits.

Third, in introducing a variable royalty, the government should communicate with the public. As a specific and significant tax on mineral production, royalties are often the most visible part of mining companies' fiscal obligations, especially when they are redistributed to local governments or development projects. They receive a lot of scrutiny from parliaments, the media, and civil society organizations. Officials should think about how it will be understood by the public.

Last, levying a variable royalty will disrupt existing mines. Officials might consider the tax stability. For instance, they could exempt existing mines from the new royalty for a period; they could compensate companies by eliminating another tax; or they could discuss with companies how introducing a variable royalty might serve both parties' interests. For example, they could argue that a variable royalty will stop future governments from making sudden changes to the royalty regime.

### Design

There are four design choices to establish the overall structure of a variable royalty.

#### **Design choice 1. Tax base category: Gross or net revenue**

In the previous section, we explained that the variable royalties that governments have chosen in the past come under one of three categories. The first design step is therefore to choose which of



these three categories is most suitable. The design and implementation of royalties increase in complexity from category 1 to 2 and then to 3, but they are also increasingly progressive, an important feature for many governments. The policy objectives defined before, and the considerations summarized in Table 2, will help determine which category of royalty to select from.

**Table 2. Design features of different categories of variable royalties**

	Reliability at low profit levels	Progressivity as profits change	Tax base simplicity	Variable-rate structure simplicity	Need to update the variable-rate structure periodically
Category 1	Good	Poor	Good	Good	Yes
Category 2	Poor/fair	Fair	Good	Fair	No
Category 3	Poor	Good	Poor	Poor	No

**Design choice 2. Tax rate application category: Aggregate, marginal, or sliding, based on a formula**

Officials sometimes do not appropriately consider the choice between aggregate and marginal application of royalty rates on the royalty base. Most price-based royalties in category 1 use an aggregate approach—the rate applies to the full royalty base. So companies face steep changes in payments around the limits of the price bands, also known as “cliff edges.” This could incentivize companies to report lower sales prices to remain in the lower band (Steel 2018). A marginal approach removes this problem, as the increased rate in a price band would only apply to the share of the value of production attributable to the price above the limit of the previous band.<sup>14</sup> But the rates then need to increase steeply in each band to achieve the same overall objective. As a result, it is more complex and makes it much more difficult to communicate to the public.<sup>15</sup>

Our survey shows that the marginal approach is indeed more common for operating profit-based royalties (category 3) than price-based royalties (category 1). For instance, in Chile, for each band of operating margin, the rate applies only to the operating profit of that band; that means that if the operating margin is 52%, a 13% tax applies when the operating margin is higher than 50% and lower than 55%, but only to the amount of the operating profit equal to 2% of gross revenue (52% minus 50%). Lower rates apply to lower tranches of operating profit. Because category 3 royalties are already relatively complex, the marginal approach may be a less costly feature than category 1 or 2.

Rather than a purely marginal approach, several countries have adopted a sliding scale based on a formula that determines the applicable rate of royalty within a range of royalty rates bound by

<sup>14</sup> This also applies to category 2 royalties—see Figure 4 comparing Niger and South Africa’s royalties as a function of mines’ operating margins.

<sup>15</sup> People subject to progressive personal income taxation may be familiar with the marginal approach, which is used in many developed economies but less often in developing countries.





minimum and maximum rates—for example, Bolivia, Queensland, and, indirectly, Myanmar with the Bawdwin PSC for category 1 royalties or South Africa for category 2. These formulas vary in complexity—Bolivia’s is the simplest, and Myanmar’s is the most complex—but they offer the economic neutrality of the marginal approach in a way that may be slightly more easily understood by the public.

### **Design choice 3. Future adjustments**

A potential challenge for price-based variable royalties (category 1) is the long-term increase in prices that do not reflect a temporary windfall but the normal effect of inflation that affects both mineral prices and costs. Over a long period of time, original price bands are unlikely to reflect contemporaneous market conditions, and the top royalty rates become applicable for prices across the whole price cycle, as the examples of Bolivia and Queensland above show. How long a period of time? We analyzed the difference over the last 35 years between nominal monthly gold prices and two inflation-adjusted price series—one based on 1986 prices and the other based on 2019 prices. We observed that nominal and real prices track each other relatively closely for about 10 years and diverge significantly after 15 years. However, the historically high rates of inflation many countries are experiencing at this time of writing will quicken this divergence, so governments should be ready to review their variable royalty schedules soon.

To address this challenge, governments might either create a rule that automatically adjusts price-based royalty bands yearly with a measure of inflation (such as the U.S. Consumer Price Index<sup>16</sup>) or regularly legislate changes to the royalty bands. Despite the advantages of the former approach—it reduces work by legislators and the risk of political entanglements—this type of adjustment seems quite rare for price-based royalties: we only found it in one instance, in a mining agreement signed by the Government of Guinea in 1993.<sup>17</sup> And even when that agreement was renegotiated in 2016, the price bands were significantly increased to reflect higher gold prices. The latter type of adjustment, on the other hand, requires governments to be careful: if a government revisits variable royalties too often, it undermines one of the objectives of the royalty—to provide a stable fiscal regime. Most of the price-based royalties in our sample have been legislated in the last 15 years, so we have not been able to observe how often governments need to revisit the price bands.<sup>18</sup>

### **Design choice 4. Calibration**

Once the broad design is chosen, the fourth task is to calibrate the parameters of the variable royalty. For price-based (category 1) royalties, what rates should apply at different price levels or within different price “bands”? This choice determines the overall level of the royalty and its flexibility to price or profits (depending on the tax base chosen). The calibration should be done mineral by mineral to account for the specific price and cost dynamics of each mineral market. As

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<sup>16</sup> <https://www.bls.gov/cpi/>

<sup>17</sup> See: <https://resourcecontracts.org/contract/ocds-591adf-3612985124/view#/pdf>

<sup>18</sup> Only the Government of Zambia has reviewed the price bands of its royalty, but more to reflect short-term market changes and possibly public debt pressures than the natural long-term effect of inflation.



discussed above, understanding the evolution of costs in different mineral markets is critical. Governments should design variable royalties with very progressive bands to capture a share of potential price windfalls but with a ceiling at a reasonable rate because eventually costs tend to follow prices.

Calibrating a price-based royalty ideally requires understanding how the mineral price might move in the future. However, there is no way to know this for sure—attempts to accurately forecast most commodity prices have so far been unsuccessful. We therefore think calibrating variable royalties against some period of historical prices is most practical. This process might look like this:

1. Measure a suitable history of mineral prices, at least 10 years, to cover a large cycle.
2. Set one price-rate band to correspond to the median price in this history, then set the highest and lowest bands.
3. Choose the number of intervening bands. Fewer bands are simpler, but more bands allow policy-makers to fine-tune their variable royalties and reduce the sharpness of cliff edges between bands. In practice, there appears to be no set number; examples vary:
  - i. Category 1. The number of bands range from 3 (e.g., Burkina Faso) to 12 (Kyrgyzstan). A typical number is around 5.
  - ii. Category 2. The two examples we found both had three bands each, including a smoothed, formula-based central band for South Africa.
  - iii. Category 3. Our three examples ranged from 7 (Nevada) to 12 (Chile) to 17 (Peru).
4. Set rates for each band. One way to approach this is to set rates based on what is commonly seen elsewhere in the world (i.e., from 2% to 10%, with some exceptions in some countries/commodities). Ideally, the rates should be set based on an economic model<sup>19</sup> to create the desired effective tax rate and flexibility for volatile prices.

For profit-based royalties in categories 2 and 3, the calibration should be based on a range of realistic profit margin ratios, typically between 0% and 60%. Rates can be more progressive than for category 1 royalties and will not need any adjustment. To adjust the rates to each band of profit margin ratios, it is recommended to use an economic model and determine an appropriate relationship between profit pre-tax and post-tax profit.

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<sup>19</sup> See Natural Resource Governance Institute for economic models: <https://resourcegovernance.org/economic-models>



## Conclusion

Some governments already use variable royalties, but others might benefit from levying one. Many variable royalties add progressivity to a fiscal regime while keeping the tax base relatively simple to verify. They could be a key fiscal instrument for countries that already rely on royalties for mining revenue collection. And, if properly calibrated, they can be attractive to companies by providing a visible upside to governments during high prices, protecting cash flows during low prices, and creating more stability overall by reducing the pressure to renegotiate fiscal terms along commodity price cycles.

In designing a variable royalty, governments can choose among three types with varying degrees of progressivity but also complexity. We propose a four-step design process: tax base category (gross or net revenue), tax rate application category (marginal, aggregate, or sliding scale), future adjustments, and calibration.

However, variable royalties all require thinking about the economics of mining in the design phase. Several variable royalties surveyed were poorly calibrated to the price cycle of a metal market or did not sufficiently account for cost changes. Applying variable royalties to by-product metals, many of which are critical minerals for clean energy industries, might be easier and more successful than applying them to major metals because the price of a by-product generally does not follow the general cost cycle of the mining industry.



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