IGF-OECD PROGRAM TO ADDRESS BEPS IN MINING

MONITORING THE VALUE OF MINERAL EXPORTS:

POLICY OPTIONS FOR GOVERNMENTS

IGF

INTERGOVERNMENTAL FORUM
on Mining, Minerals, Metals and
Sustainable Development

OECD

BETTER POLICIES FOR BETTER LIVES

Published by the International Institute for Sustainable Development

MONITORING THE VALUE OF MINERAL EXPORTS: POLICY OPTIONS FOR GOVERNMENTS

Author: Alexandra Readhead

This practice note has been prepared under a programme of cooperation between the Organisation for Economic Co-operation and Development (OECD) Centre for Tax Policy and Administration Secretariat and the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF), as part of a wider effort to address some of the challenges developing countries are facing in raising revenue from their mining sectors.

It complements action by the Platform for Collaboration on Tax and others to produce practice notes on top priority tax issues facing developing countries.

It reflects a broad consensus between the OECD and IGF, but should not be regarded as the officially endorsed view of either organization or of their member countries.

This programme builds on the OECD BEPS Actions to include other causes of revenue loss in the mining sector.

The programme will cover the following issues:

1. Excessive Interest Deductions
2. Abusive Transfer Pricing
3. Undervaluation of Mineral Exports
4. Tax Incentives
5. Tax Stabilisation
6. International Tax Treaties
7. Offshore Indirect Transfers of Mining Assets
8. Metals Streaming
9. Abusive Hedging Arrangements
10. Inadequate Ring-Fencing

OECD: http://www.oecd.org/tax/beps/
IGF: http://igfmining.org/tax-avoidance-guidance-document/

About the Author

Alexandra Readhead is Technical Advisor, Tax and Extractive Industries at IGF,

Acknowledgements

The author would like to acknowledge the contributions made by IGF member governments, in particular, Sierra Leone, Guinea, Canada and Tanzania, as well as Cotecna, the University of the Witwatersrand, Adam Smith International, the International Council for Mining and Metals, Oxfam America, the Natural Resource Governance Institute, the Colombia Centre for Sustainable Investment, the United Nations Conference on Trade and Development and the International Centre for Tax and Development.

IGF Secretariat hosted by:

IGF Secretariat funded by:

The OECD contribution to this publication has been provided with the assistance of the European Union. The contents of this publication are the sole responsibility of the IGF and OECD and can in no way be taken to reflect the views of the European Union.

Co-funded by the European Union

IISD HEAD OFFICE

111 Lombard Avenue
Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

IISD.org
@IISD_news

IISD
International Institute for Sustainable Development

IGF/IISD OTTAWA OFFICE

220 Laurier Avenue W.
Suite 1100
Ottawa, Ontario
Canada K1P 5Z9

IGFMining.org
@IGFMining

IGF
INTERGOVERNMENTAL FORUM on Mining, Minerals, Metals and Sustainable Development

OECD HEAD OFFICE

2, rue André Pascal
75775 Paris Cedex 16
France

OECD.org
@OECD

OECD
BETTER POLICIES FOR BETTER LIVES

Table of Contents

Figures

Tables

Boxes

Acronyms and Abbreviations

AAS	Atomic Absorption Spectrometry
ASA	Alex Stewart Assayers
BEPS	Base Erosion and Profit Shifting
CBG	Compagnie des Bauxite de Guinee
CBK	Compagnie des Bauxites de Kindia
CIL	Coal India Ltd
CIMFR	Central Institute of Mining and Fuel Research
CSIR	Council of Scientific and Industrial Research
ICP	inductively coupled plasma
IGF	Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development
ISO	International Organization for Standardization
JORC	Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves
MEM	Ministry of Energy and Minerals (Tanzania)
MMG	Ministry of Mines and Geology (Guinea)
NMA	National Minerals Agency (Sierra Leone)
NI	National Instrument
NRCan	Natural Resources Canada
OECD	Organisation for Economic Co-operation and Development
OGV	ocean-going vessels
PCT	Platform for Collaboration on Tax
PPP	public–private partnership
PTP-MAL	Proficiency Testing Program for Mineral Analysis Laboratories
SAMREC	South African Code for the Reporting of Exploration Results, Mineral Resources and Reserves
SMB	Société Minière de Boké
SMHL	Vimetco Limited
SOP	standard operating procedures
SRL	Sierra Rutile Limited
TIO	Tonkolili Iron Ore Limited
TMAA	Tanzania Mineral Audit Agency
XRF	X-ray fluorescence

INTRODUCTION

1.0 Introduction

In the mining sector, royalties and income taxes are usually levied on the price of the mineral, multiplied by the volume. The price might be the actual sale price received or the relevant quoted price, if there is one. Consequently, government revenue depends on mineral products being priced and measured accurately.

However, pricing is not always straightforward. It may be complicated by the different stages of mineral beneficiation, the lack of publicly quoted prices for some minerals, and any adjustments based on the quality or grade of the product, as well as deductions for transport and insurance costs. These factors are further complicated in the case of related party sales, where there is an incentive to set artificially low prices to reduce taxable income in the mining country and shift profits offshore.

Mineral prices are primarily a function of the value or quality of the mineral. Therefore, government must be able to determine the value before they can verify the price. For example, the quoted price for iron ore is based on the material containing a certain percentage of iron. If the percentage is below or above, or there are impurities, the price will need to be adjusted, minus any costs.

Many governments are worried they don't know the value of their exported minerals and are losing much-needed revenue as a result. An African country has reported that, in 2014, the average value of one company's bauxite exports to its affiliate refinery in Europe was nearly three times lower than the value of its bauxite exports to other trading partners. The local tax and regulatory authorities lack the technical expertise and facilities to determine if the discrepancy is justified by differences in the quality of the ore or if the company is deliberately understating the value to pay less tax. Similar reports from other countries reveal a widespread belief that companies are under-reporting the value of their mineral exports.

While the possibility of undervaluation is real, the response must always be linked to the actual level of risk attached. In most cases, companies are already valuing their own mineral exports according to internationally accredited sampling and testing procedures, in which case it may be sufficient to simply monitor companies' compliance with these standards rather than directly measure the value of mineral exports. Notwithstanding, unless governments are confident that the values declared by companies are accurate, suspicion and doubt will continue to erode trust between government and industry, which in turn affects companies' social licence to operate.

About this practice note

The practice note aims to increase policy-makers' knowledge of the process of determining the value of exported minerals. The focus is determining the value (or quality) of mineral exports, not the quantity. While there is a risk that companies may underestimate both, verifying the value of minerals is more complex and requires more technical expertise. Additionally, most governments have some measures in place to verify quantity—for example, draft surveys to calculate the weight of a ship carrying minerals for export—whereas the skills, expertise and facilities to monitor mineral value are lacking.

Having laid the foundation, the practice note sets out three main policy options for improving government oversight of mineral product export valuation (hereinafter referred to as "export valuation"). These are: direct measurement of mineral value, monitoring companies' own mineral export valuation processes and a hybrid approach. The goal is that policy-makers will be equipped to make informed, risk-based decisions on how best to monitor the value of mineral exports.

Who is this practice note for?

The practice note is intended for use by policy-makers to determine the appropriate policy response to the risk of companies deliberately, or accidently, undervaluing their mineral exports. The practice note should be used in combination with the mineral product pricing case studies published by the Platform for Collaboration on Tax (PCT, 2017a), which provide practical guidance to government on how different mineral products (e.g., gold, copper, iron ore and thermal coal) are priced. Before government can verify the price of a mineral, it must first be able to confirm its value; hence, this practice note is intended to bolster government implementation of the PCT guidance on mineral pricing.

How is it structured?

The practice note is divided into five sections:

1. **A high-level overview of the export valuation process**, including mineral sampling, sample preparation and analytical testing for common commodities. This is not intended to be exhaustive, but a summary of key concepts and practices.
2. **A guide to selecting the appropriate policy option for export valuation**. There are numerous policy options available to government to improve its oversight of the grade and quality of mineral exports. The option most favoured by developing country governments is to set up a mineral laboratory to do direct testing of mineral exports. An alternative is to monitor companies' own mineral export valuation processes to check whether they comply with international sampling and testing standards or a hybrid approach, depending on risk.

3. **A description of the various mechanisms for policy implementation**. Once the appropriate policy option has been chosen, government must decide whether to implement directly, outsource to a private mineral inspection firm, or pursue a hybrid model. There are pros and cons to each approach.
4. **A list of ways for government to finance export valuation activities**.
5. **An overview of mineral sampling and testing reporting standards** from Canada, South Africa and Australia. Such standards provide a clear baseline against which shareholders and government can assess mining companies' internal quality controls.

There is one annex. It contains two case studies on export valuation done by governments in Sierra Leone and Guinea. These were developed in close collaboration with the National Minerals Agency in Sierra Leone and the Ministry of Mines and Geology in Guinea. The aim is to highlight some of the factors that government should consider when deciding which policy option to choose.

MINERAL PRODUCT EXPORT VALUATION

2.0 Mineral Product Export Valuation

Minerals are valued at various stages of the mine life cycle: during exploration, to estimate the value of the resource and to determine if it is worth developing, as well as throughout the mining process (see Figure 1). However, it is the value of the mineral product export (imagine a stockpile of iron ore at the harbour or copper concentrate in raffia bags on the wharf) that taxes and royalties are based on. Any undervaluation at this point will have a big impact on government revenues; hence, the focus of this practice note is export valuation.

Figure 1. Mining life cycle and mineral analyses

	Exploration	Feasibility	Mining	Trading, Marketing & Sales
Type of mineral analysis	Exploration-grade	Ore-grade	Control-grade	Export-grade
Purpose	Preliminary prospecting of a mineral	Estimate the value of the resource (i.e., what a mine is worth)	Monitor or control the refining or mining process	Determine the sale value, and later taxes and royalties

2.1 Point of Export Valuation

The precise point at which export valuation should take place will depend on when taxes and royalties are levied. For example, if royalties are imposed on mine production, then valuation may need to be done at the mine gate. Alternatively, if royalties and taxes are imposed at the point of export, then valuation should be done at the last point at which the country sees the mineral product.

Box 1 describes the different export valuation points for rough diamonds, which are generally applicable for gemstones and precious metals. High-value precious stones and metals are more susceptible to leakage—for example, smuggling—hence, valuation should be done as close to production as possible. However, for base metals, bulk commodities, and intermediate products, export valuation will almost always be done at the point of sale, which usually coincides with the point of export (e.g., port or land border crossing point).

It may be prudent to have multiple export valuation points to crosscheck results at different stages of the value chain. One African country reported cases of smaller companies requesting export permits based on analytical work and valuations done on lower-grade ore, but the actual exports contained higher-grade material. The problem was that royalties were

based on the low values generated for export permits. The government has sought to resolve this issue by comparing the value of actual exports at the border with the stated value in the export permit.

Box 1. Export valuation points for rough diamonds

Government bodies may need to value the production of diamonds at several points in the upstream value chain to impose taxes, royalties and/or customs duties, as well as for Kimberly Process certificates. These export valuation points include:

- **At the mine gate**: For those countries that impose royalties on mine production, there is an initial need to value the run of mine. This is often done before the stones leave the mine site as an integrity measure but could also feasibly done at another location if the transport of diamonds is trusted (that is, there is no "leakage" of stones).
- **Point of domestic sale or transfer**: For those countries levying corporate income taxes, the point that diamonds are sold commonly forms the basis of calculations of income (and thereby profits) for corporate income tax purposes. This will be of importance to countries with artisanal sectors also, where diggers sell their stones to local dealers or intermediaries, who in turn export the stones for resale.
- **Point of export**: This is often the last point at which producing countries see their mined diamonds. For those imposing export duties, or using the point of export for royalty purposes, the estimated value at the point of export is key for revenue collection. At this stage, many stones will not have been sold, but may have been mixed with stones from other mines.

Adapted from: Organisation for Economic Co-operation and Development, 2017; Guj et al., 2013

2.2 Export Valuation Process

There are three stages in the export valuation process:

- Sampling: extracting a representative sample of material contained in a carrier (e.g., a ship or train) for delivery to the customer
- Sample preparation: crushing and pulverising the sample for analytical testing
- Analytical testing: determining the quality and composition of mineral exports

a) Sampling

Sampling is the process of selecting a part (i.e., sample) of a whole, for example, a shipment of ore, such that the measured value for that sample is an unbiased estimate of the value of the entire shipment. Mining companies will undertake mineral sampling at various stages throughout the mining value chain: exploration, mining, beneficiation, shipment, delivery to and from intermediary storage, or delivery to users' facilities.

From the perspective of government, sampling should be done at the point when royalties and taxes are levied, for example, at the point of export in the case of bulk commodities.

A sample is only correct if each fragment in the lot (e.g., the shipment of ore) has the same statistical chance as every other fragment of being in the sample. However, there are many errors that can occur during the process, both random and systematic, that prevent the sample from being representative—for example, faulty sampling equipment and untrained samplers (Box 2 provides an overview of sampling training). A lack of safe access to the goods in movement may also generate errors. For instance, where there is no conveyor belt used, meaning the samplers must work on stockpiles, which typically produce less reliable samples. Once the sample is collected, it is sent for sample preparation.

Box 2. Training on mineral sampling

Training on mineral sampling should cover the following topics:

- Underlying statistical issues around sampling
- Grade and fragment size
- Sampling errors and sampling bias in the theory of sampling (classification of errors, how the errors occur and measurement of errors)
- Calibration of sampling parameters
- Sampling protocol
- Measures to overcome and mitigate sampling errors

Source: Outline of course on The Theory and Practice of Sampling provided by Professor Richard Minnitt, School of Mining Engineering, University of Witwatersrand.

b) Sample Preparation

Sample preparation is the process by which a sample is readied for analysis. Once a large bulk sample is delivered to the mineral laboratory, it should be ground to a homogeneous consistency to ensure representative testing of the whole sample as submitted. The grain size of the prepared sample must be so fine that the target mineral elements (e.g., iron) can be effectively released from the rock and distributed into a mixture of finely ground ore and water ("pulp") for further analysis. See Table 1 for a baseline approach to sample size.

Table 1. Rock sample size

Grain Size	Sample Size
Fine grained (<1mm-1mm)	100–500 grams
Medium grained (1mm-1cm)	1kg
Coarse grained (1cm-1decimeter)	2–10kg
Porphyritic (rocks containing crystals) (1-3mm)	500g–1kg
Porphyritic (306mm)	2–10kg

Source: Adapted from SGS Mineral Services, 2015

There are five steps in sample preparation: drying, crushing, splitting, pulverising and screening (SGS Mineral Services, 2015, pp. 29–56). The required steps will depend on the type and size of the sample submitted to the laboratory and the mineralogy, as well as analytical and budgetary requirements. More than one step may be used, for example, rock samples will need to be dried, crushed and pulverised. It is important the sub-sample is sufficiently representative.

Table 2. Sample preparation procedures

	Rocks	Ores	Heavy Minerals
Sample preparation	a) Drying b) Primary crushing c) Secondary crushing	a) Drying b) Primary crushing c) Secondary crushing	a) Drying b) Sieving c) Mechanical concentration and/or liquid preparation
Sample selection	d) Splitting*	d) Splitting	d) Splitting (not always advisable)
Sample preparation	e) Pulverising f) Homogenisation**	e) Pulverising f) Homogenisation	e) Pulverising (not always) f) Homogenisation
Finished product	Pulp or bulk sample ready for analysis		

Source: Adapted from SGS, 2015, p. 28.

** "Splitting" refers to dividing the bulk material into representative samples. For example, when using a chute or riffle splitter, the material is poured into the top of the splitter, flows through the chutes and is randomly divided into two equal sizes. The procedure can be repeated until a sample of the desired size is obtained.*

*** "Homogenisation" is any action on a sample (e.g., mixing, splitting-and-recombining, blending) that will reduce the heterogeneity of the sample. The aim is to achieve a more uniform distribution of the chemical substances and particles throughout the sample.*

The main risk during this stage of the export valuation process is that the sample becomes contaminated and produces inaccurate results in the next phase. There are many ways in which contamination may occur during sample preparation. In the sample area, for example, the laboratory should have physically separated sample processing areas for each type of mineral, as well as separate crushers and pulverisers.

c) Analytical Testing

The purpose of analytical testing is to determine the quality and composition of mineral exports; it is the final stage of the export valuation process. Mineral testing should determine the proportion of "payable metals" in the sample, as well as any impurities that might reduce the final sale price. For example, the percentage of copper present in the concentrate and the level of arsenic. There are many analytical methods and instruments to choose from; the next section describes three of the more commonly used methods in developing countries. Each method is distinct, although some may be used in combination.

Fire Assay

Fire assay is the most common analytical method for precious metals (e.g., gold, silver, platinum group metals). The approximate cost per gold fire assay was USD 20 in 2018 (ALS, n.d.).

Table 3. Stages of fire assay

	Description
Stage 1	A chemical solution is added to the sample (this is called a "flux"). The flux will include lead in the case of gold or silver, or nickel sulphide for platinum group metals.
Stage 2	The sample, including the flux, is put in a very hot furnace.
Stage 3	Once in the furnace: - The flux breaks down the finer-grained mass of rock material to release the precious elements. - These elements combine with the lead or nickel sulphide element in the flux to form a solid material that collects at the bottom of the vessel. This process is called "fusion." - When the fusion is complete, the molten liquid is poured into a conical mould; the lead or nickel sulphide "button" sinks to the bottom and is subsequently removed from the waste material.
Stage 2	The final stage is the separation of any remaining lead or nickel sulphide from the precious metals, via a process called "cupellation." - The sample is heated up again so the elemental lead or nickel sulphide becomes molten and is absorbed into the cup-like vessel containing the sample. - This leaves a precious metal alloy on the surface. - There is a range of ways to finish the analysis of precious metals. The most common is atomic absorption spectrometry (AAS) (see below for more information).

X-Ray Fluorescence Spectroscopy

X-Ray Fluorescence (XRF) analysis is the most common analytical method for routine determination of major elements that define the material in question (e.g., aluminium, manganese, iron, etc.) and base metals (e.g., copper, cobalt, nickel, etc.). The sample is exposed to a beam of X-rays. The atoms of the sample absorb energy from the X-ray. They then emit secondary X-rays specific to each element in the sample. The intensity of the energy emitted from the secondary X-rays is proportional to the concentration of the element in the sample.

Table 4. XRF analysis

Advantages	Disadvantages
- It provides rapid analysis. - Handheld XRF units are relatively cheap to buy and operate compared to other methods. - It can take solid samples as opposed to a liquid form, which reduces sample preparation. - It can analyse a large range of elements.	- Less accurate, often used to confirm that the material matches a more precise determination done on an earlier sample. - The machines must be carefully calibrated, requiring regular maintenance, and staff must be instructed on how to use the machines to get reliable results.

Atomic Absorption Spectrometry

AAS is an analytical technique that determines the presence of metals in a liquid sample. It is commonly used for a range of base metals (e.g., copper, lead, zinc, cobalt, nickel). The sample is introduced in liquid form into a flame burner, which atomises the sample. Light is then shone through the flame. The amount of light absorbed determines the number of absorbing atoms and thus the concentration of that metal in the sample.

Table 5. AAS analysis

Advantages	Disadvantages
- More reliable and accurate than XRF.	- AAS is more expensive than XRF, and it also requires a range of consumables (e.g., reagents). - The sample must be in a solution, which means some elements may be lost or not dissolved thoroughly during the "digestion process."

An alternative to AAS is inductively coupled plasma (ICP) mass spectrometry. ICP is less common in mineral laboratories in developing countries, because it is more expensive than AAS and is better suited to large volumes, hence it is not covered in detail here.

However, it is worth noting that the main advantages of ICP are that it can analyse up to 70 elements, compared to AAS which can only analyse 13 elements, in a very short time (1–2 minutes).

DETERMINING THE APPROPRIATE POLICY FOR EXPORT VALUATION

3.0 Determining the Appropriate Policy for Export Valuation

3.1 A Step-by-Step Guide

Step 1. The risk of undervaluation of mineral exports

Step 1(a) What is the mineral product being exported?

Some mineral products are more likely to be undervalued than others, and hence require closer monitoring. Relevant factors include:

i) The form the mineral product is sold in and the level of commoditisation:

- Intermediate/ early value chain products are less likely to have transparent pricing. For example, bauxite is more vulnerable to undervaluation than the refined product (alumina), due to a lack of quoted bauxite prices, and limited spot sales (i.e. buying or selling a commodity for immediate settlement – see related bauxite case study example);
- Large variations in grade make it harder to determine the value of the mineral product. Government monitoring should be more frequent If the mine can vary the quality of its output from month-to-month;
- Spot sales increase the transparency of mineral values.

ii) Tax benefit from undervaluation:

- The value of the mineral is the basis for determining how much tax should be paid. There is a greater incentive to undervalue higher value mineral products (e.g. rough diamonds) to get a large tax benefit, than in the case of lower value mineral products (e.g.sand, gravel).

Based on the factors above, Table 6 categorises mineral products according to their likelihood of being undervalued (next page).

Table 6. Opportunity to understate mineral values

Low	Medium	High
Refined base/precious metals Gold, copper, lead, zinc, nickel, cobalt, tin, aluminium, platinum, silver **Bulk commodities** Iron ore, coking and steam coal, manganese ore and phosphate rock **Metallurgical products and specialty metals** Alumina **Gemstones** Industrial diamonds	**Physical concentrates** Copper silver, zinc silver, lead silver, zinc lead, cobalt nickel **Metallurgical products and specialty metals** Blister copper, nickel matte, alumina, gold doré **Gemstones** Industrial diamonds	**Non-metallic industrial minerals** Barite, fluorite, graphite, beryl **Gemstones** Rough diamonds and other gems

Adapted from Guj et al., 2017, p. 37.

Step 1(b) Is it sold mainly via related party transactions?

- If the majority of mineral production is sold to foreign related parties, the risk of undervaluation is higher than if sold to third parties;
- If the mine and its related parties are part of a private, or state-owned group, rather than a publicly listed company, the risk level increases due to the lack of public reporting and compliance requirements, which might otherwise discourage companies from deliberately undervaluing mineral exports;
- If the industry is highly integrated (e.g., most bauxite sales are to related party refineries where the bauxite is transformed into alumina) it is likely to be less transparent with respect to price.

Step 1(c) What quality controls do mining companies have?

- For mining companies that comply with international mineral sampling and testing standards, it may be more cost effective for government to monitor these export valuation processes, rather than duplicate them wholesale.
    - South Africa, Australia, and Canada do not do any physical testing of mineral exports, instead they require companies to report their mineral sampling and testing processes against international standards, and, in some cases, use private laboratories certified by government.

- Does the company have its own in-house mineral testing facilities? Do these facilities comply with ISO/EN 17025:2017? (general requirement for competence in testing)[1]
- Does the company contract a private mineral inspection firm (e.g. SGS, Cotecna, Bureau Veritas) to sample, and/or test the value of its mineral exports?
    - A private mineral inspection firm may add an additional level of assurance, rather than if the company does all export valuation activities in-house.
- Does the company comply with international sampling and testing standards?
    - Companies that are listed on stock exchanges in Canada, South Africa, and Australia must disclose their sampling methods, sample preparation, analyses, and quality assurance measures, in accordance with the relevant standard (i.e. NR43-101, SAMREC, and JORC respectively).
    - Compliance with international standards should provide some level of assurance with respect to companies' export valuation practices.

Step 1(d) How does government calculate sales revenue for taxes and royalties?

- Does the government use benchmark prices (e.g., London Metals Exchange, or Platts) to calculate sales revenue for income tax purposes?
    - Undervaluation is less of a risk if sales are calculated according to a publicly quoted price, rather than the reported sale price (i.e. a "sixth method"). However, adjustments for differences in quality may still leave some scope for manipulation. Some of the countries using the sixth method include Zambia, Ecuador, and Argentina.[2]
- There may also be distinct export valuation arrangements in mining contracts.

[1] The International Organization for Standardization (ISO) is an international standard-setting body composed of representatives from various national standards organizations. ISO/IEC 17025:2005 is the standard that specifies the general requirements for the competence to carry out tests, including sampling. For more information https://www.iso.org/standard/39883.html

[2] For more information on the sixth method, see Readhead, A. (2016). *Special rules for commodity sales: Zambia's use of the 'Sixth Method.'* NRGI. Retrieved from https://resourcegovernance.org/sites/default/files/documents/special-rules-for-commodity-sales-zambia-sixth-method.pdf

Step 1(e) What is the appropriate policy response based on risk?

There are three main policy options for export valuation. The most appropriate option will depend on the country context, in particular, the risk of undervaluation of mineral exports. Table 7 suggests which policy option is most appropriate depending on the risk. Each policy option is described in detail in the next section.

Table 7. Risk-based policy responses

Risk of Undervaluation	Corresponding Policy Response
HIGH	**Direct measurement of mineral exports**, including sampling, sample preparation and testing.
MEDIUM	**A hybrid option** that combines monitoring of companies' own export valuation processes, with direct measurement in high-risk cases.
LOW	**Monitoring mining companies' own internal export valuation processes**, to ensure the reliability of their results.

Step 2. Other practical considerations

Risk should be the main consideration when determining the appropriate policy response. However, there may be other factors such as production and export volumes, government budget, and previous policy commitments, that need to be taken into account. These issues are examined below.

Step 2(a) What is the quantity of minerals produced and exported?

- Smaller production and export volumes may make it harder for government to justify investing in a laboratory, instead it may be more strategic to focus on monitoring companies' export valuation process, and send samples to testing facilities abroad in the case of heightened risk.

Step 2(b) What are government's existing controls on mineral quality?

- Is there a government mineral testing facility? Does it comply with ISO/IEC 17025:2017?
    - Historical preferences, for example, to set up a mineral laboratory, may influence government's determination of the most appropriate export valuation approach.
- Are government officials trained in mineral sampling and analytical testing?

- Does the government undertake any mineral sampling activities?
    - Four to 9 per cent of all errors leading to inaccurate export valuation arise during analytical testing (personal communication, Richard Minnitt, School of Mining and Engineering, 2018). The lion's share of the risk of undervaluation is during the sampling phase. On that basis, governments should invest at least as much, if not more, resources in training staff on sampling and sample systems management, than in improving mineral testing.
- Does the government have documented processes for mineral sampling and testing (i.e. Standard Operating Procedures)?

Step 2(c) What is the government's budget for export valuation activities?

- Setting up a mineral laboratory from scratch costs between EUR 2 million and EUR 5 million (depending on pre-existing capacity and equipment). Ongoing running costs are likely to be between EUR 300,000 and EUR 500,000 per year for a medium-sized laboratory (personal communication, Cotecna, October 12, 2017);
- It is unlikely that government can generate sufficient revenue from commercial testing services to cover the cost of a laboratory (e.g., the cost of running the Tanzanian government's mineral laboratory is twice the amount of revenue it gets from commercial mineral testing services).

3.2 Direct Measurement of Mineral Quality

Building a mineral laboratory

To undertake direct measurement of mineral quality, governments need to set up laboratories. For the results to be reliable, the laboratory should confirm to ISO/IEC 17025:2017; this is necessary to ensure the government's position is defensible in the face of conflicting analyses. Experience suggests that if the government's analyses differ from the company's, and the disagreement goes to court, the decision will almost automatically favour the side with ISO-accredited analysis.

There are three things to consider before setting up an ISO-accredited laboratory:

- **Economic viability:** Whether a mineral laboratory is economically viable depends hugely on the mineral type, stage of beneficiation, production volume, means of transport, the logistics of trade flow and the risk to revenue. Investing in a laboratory may not be warranted if production volumes are relatively small or if most mineral exports are sold to independent customers, reducing the risk of undervaluation. These factors must be carefully considered to determine whether a laboratory makes economic sense.

- **Time frame**: Setting up an ISO-accredited laboratory from start to finish takes roughly two years, at a minimum (personal communication, Ron Smit, Mining Sector Governance Consultant, May 7, 2018). It involves learning specific testing methods for each commodity—for example, fire assay for precious metals—getting certified and then learning another method for another commodity.
- **National accreditation**: National laboratories must be accredited by the national accreditation body (e.g., a mineral laboratory in Sierra Leone would need to be accredited by the Sierra Leone Standards Bureau). However, the national accreditation body can only pronounce the local laboratory ISO compliant if it is an ISO member body, which is not the case for most developing countries.[3] Alternative ways for the laboratory to achieve compliance is to be accredited by a private mineral inspection firm that is recognised by the ISO or to request a foreign accreditation body to do the certification process (e.g., the the Southern African Development Community Accreditation Services). Regardless, the capabilities and credibility of the national accreditation body is an important factor in establishing a laboratory's reputation.

Budget, including for ongoing maintenance

Accredited ISO laboratories are expensive to have. The establishment and fit-out of a laboratory is a large, one-off capital expense. As stated earlier, depending on the level of pre-existing expertise and equipment, the approximate cost of setting up a laboratory from scratch is between EUR 2 million and EUR 5 million.

While donors may be willing to finance the initial outlay, ongoing running costs are not insignificant. Staffing, consumables and maintenance may cost approximately EUR 300,000–500,000 per year for a medium-sized laboratory. In addition, it costs money to maintain accreditation of the laboratory. In Tanzania, it costs the government mineral laboratory approximately USD 45,000 annually to maintain its ISO accreditation. The money is spent on staff training, paperwork, procurement, testing and calibration of equipment, participating in proficiency testing twice a year, sample testing, registration and accreditation fees.

Qualified and experienced personnel

The cornerstone of a successful accredited mineral laboratory is well trained staff. Laboratory staff should be appropriately qualified for the positions they hold, as well as fully trained to conduct their duties and be provided with continuous training to keep abreast of new methods and technologies. Staff should declare any interests outside the laboratory and its activities, be as independent as is possible and be free from any conflicts of interest.

[3] See a full list of ISO member bodies here https://www.iso.org/members.html

Robust and transparent procedures

To achieve ISO accreditation, the laboratory team must prepare the management system documentation and accumulate a testing track record. To maintain accreditation, which is subject to annual maintenance audits, all laboratory activities must be traceable and transparent. In practice, this means there must be written SOPs for collecting and analysing mineral samples. SOPs could be developed jointly by the relevant government institutions and industry so that companies know what to expect. There should be an SOP for each mineral product.

Having a laboratory is only useful if mineral samples are collected and prepared independently, rather than relying on companies. In one African country that has a government laboratory, companies submit a sample of what they intend to export for the next three months, and the laboratory accepts it despite the contents not being the same for future exports and not knowing if it was collected according to standard sampling procedures. If a government is going to invest in setting up a laboratory, it should also ensure there are personnel trained to collect and prepare mineral samples independently.

3.3 Monitoring Companies' Own Export Valuation Processes

There exists considerable variation in countries' approaches to export valuation. Some insist on direct government measurement of all production, which requires considerable expertise in mineralogy and sampling techniques, as well as expensive measuring equipment. Others exercise limited oversight and rely on the accuracy of company measurements and documentation (Calder, 2014, p. 45). Established mining countries such as Australia, South Africa and Canada do not undertake any direct mineral testing; instead, they leave this responsibility to companies (see Box 3).

Rather than government taking on all responsibilities for export valuation, particularly in the case of large multinational enterprises where the risk may be lower, an alternative would be to monitor companies' performance of their own export valuation obligations. Many companies undertake sampling and testing in-house or contract private inspection firms to do this on their behalf. Governments could regularly review companies' export valuation systems and controls, including sampling processes, as well as physically monitoring and testing measuring equipment. These tests should be carried out at unpredictable intervals to prevent companies from interfering. Other data sources, such as production plans and feasibility studies, should also be used to test the veracity of company declarations.

Governments should allocate sufficient resources for officials to conduct mine site visits to avoid having to seek funding from the companies themselves. It is not uncommon to find that the expenses involving officials' travels to mine sites are paid for by the mining companies themselves. The budget allocated to the ministry may be sufficient to

cover staff salaries, but it may have to rely on the mining companies to assist with transport and other logistical support. These constraints may compromise officials' independence, as well as undermine government's ability to effectively monitor activities in the sector.

Box 3. Export valuation processes in Canada

The Government of Canada, specifically Natural Resources Canada (NRCan), does not do any physical sampling or testing of mineral exports, with the exception of rough diamonds. Rough diamonds are valued by third-party evaluators that are contracted by the relevant provinces and territories. For all other commodities, securities regulators in Canada require disclosure of mineral sampling and testing processes under National Instrument (NI) 43-101. These processes must be reviewed by a qualified professional appointed by the company who will recommend that analyses be done by a reputable and preferably accredited laboratory. Since most laboratories at mine sites are not accredited, they use outside laboratories that are accredited, usually to ISO 17025.

Accreditation of mineral analysis laboratories is made possible by proficiency testing (PT) programs, one of which is the Proficiency Testing Program for Mineral Analysis Laboratories (PTP-MAL) managed by NRCan. All mineral analysis laboratories seeking accreditation to ISO 17025 by the Standards Council of Canada must successfully participate in a PT program. There is also an option for laboratories outside of Canada to apply. Currently, 80 laboratories participate in PTP-MAL; roughly 50 per cent are based in countries outside of Canada. Laboratories that wish to participate in the PT program must submit analyses for test samples that are prepared by PTP-MAL. Each year they must successfully participate in two cycles of testing in which they are compared against the performance of other participating laboratories. There are two staff that run the PTP-MAL , and at least one is qualified in analytical chemistry. The program generates around CAD 200,000 in revenue per year.

The Government of Canada does not do any physical testing of mineral exports. However, it uses other measures to build layers of confidence that companies are reporting the true values of their mineral exports. Developing country governments could adopt a similar approach whereby they require companies to use a certified laboratory. Although they may not be able to establish their own PT program, they could, for example, require companies to use laboratories accredited through the Standards Council of Canada.

Source: personal communication. NRCan official, December 10, 2017

3.4 Hybrid, Risk-Based Approach

Monitoring companies' own export valuation processes (see section 3.3) works best if they accord with global standards, or use an accredited inspection firm, in which case there is strong credence given to the results. A major reason why governments in Australia, South Africa and Canada are confident of the accuracy of companies' declarations is because they require them to comply with a standard for mineral sampling and analyses.

However, some companies may be high risk, including not implementing internationally accredited standards, in which case government could reserve the right to conduct direct measurement in limited circumstances. Table 8 summarises the risk factors set out earlier in the practice note in selecting the appropriate policy response for valuing mineral exports.

Table 8. Factors determining direct measurement

	Risk Factor	Explanation
1	Type of commodity	Unfinished or intermediate mineral products may be higher risk due to a lack of index prices, and hence the need for adjustments (e.g., netting back the price of bauxite from the London Metals Exchange price for alumina) creating opportunities for manipulation. See Table 6 for ranking of mineral products.
2	Customer	Related party sales are higher risk than independent sales.
	Type of company	Privately held or state-owned companies are not subject to the same standards and disclosure requirements as publicly listed companies, hence they may be higher risk.
3	Internal quality controls	Companies that lack robust internal quality controls are high risk. Those that have in-house mineral testing facilities that comply with international standards are lower risk. The least risky setup are companies that use internationally accredited third parties.
4	Impact on government revenue	Smaller mining companies may not have the means to set up their own testing facilities or to engage a private inspection firm. However, the impact of any potential undervaluation on government revenue is lower than in the case of companies with a larger turnover.

In such cases, government could contract a private mineral inspection firm to do sampling and testing on its behalf. This is common in many resource-rich countries in the case of export valuation disputes. It would be a more cost-effective, targeted solution than paying to retain a private firm or setting up a government laboratory. The cost could be borne by either party depending on the outcome or by the mining company automatically, assuming there is a reasonable basis for the higher-risk level as determined by government.

MECHANISMS FOR POLICY IMPLEMENTATION

4.0 Mechanisms for Policy Implementation

Once the appropriate policy option has been chosen, government must decide whether to implement directly, outsource to a private mineral inspection firm or pursue a hybrid model. There are pros and cons to each approach. By government taking the lead, it develops internal capacity to conduct independent analyses of mineral exports. The downside may be that government has less expertise to start with, taking longer to operationalise oversight mechanisms than compared with a private mineral inspection firm that has years of experience. An alternative might be for government to contract a private firm to undertake aspects of export valuation on its behalf, building the capacity of local officials simultaneously, so they can take over these responsibilities after a period of time. This next section provides an overview of the mechanisms for policy implementation, their advantages and their disadvantages.

4.1 Government Led

Government would assume all responsibilities for export valuation activities, whether these are direct measurement of mineral exports or monitoring companies' own export valuation processes. The main consideration with respect to this approach is which government institution should be in charge (questions of financing will be discussed later in the note).

a) Institutional Arrangements

Despite the implications for tax revenue, the responsibility for export valuation usually falls to a government department other than the tax authority, for example, the ministry in charge of mines or customs. However, this varies from country to country and may depend on how responsibilities for assessment and collection of value-based taxes are allocated among government agencies. For example, in Colombia, the responsibility for mineral testing falls to the National Directorate of Taxes and Customs, whereas in Sierra Leone it is the National Mineral Agency, which reports to the Ministry of Mines.

There is no right or wrong approach, provided that the agency that oversees export valuation routinely shares the results with other government agencies involved in mining revenue administration. Ideally, this exchange should be done automatically via an online platform. If the exchange is delayed or sporadic, it may lead to government agencies issuing conflicting accounts of mineral quality and quantity. For example, in the past, major coordination challenges in the mining sector in Zambia have led to contradictory copper production and export volumes being reported by the Ministry of Mines, the Central Bank of Zambia and the Central Statistical Office. This has led to allegations of missing copper

and has complicated the tax authority's assessment of tax and non-tax revenues (Readhead, 2016, p. 21).

b) Knowledge and Expertise

For both policy options, government would need to be competent in mineral sampling and testing. To equip itself with the necessary expertise, government could contract a private inspection firm to train officials. This could include a package of ongoing training and remote support. Training should cover sampling, sampling systems management, inspection processes (ISO 17020), and testing and laboratory management if relevant.

Box 4. Mineral testing facilities in Tanzania

In 2003, the Government of Tanzania contracted a private firm, Alex Stewart Assayers (ASA), to build and operate a mineral laboratory on behalf of government. The government took the decision to outsource the laboratory to the private sector because it lacked the relevant technical expertise. ASA took six months to set up the laboratory, which focused solely on gold assay. The government paid ASA in advance, and the cost was later offset against ASA's bills for running the laboratory. ASA recruited and trained 12 mineral analysts.

2009 – government replaces private firm with the Tanzania Mineral Audit Agency

In 2009, government replaced ASA with the Tanzania Mineral Audit Agency (TMAA) (now called the Minerals Commission), a semi-autonomous government institution that took over running the laboratory. The reason was the high cost: in return for operating the laboratory, ASA charged 1.9 per cent of the market value of exported gold, equivalent to 64 per cent of royalties payable to the Ministry of Energy and Minerals (MEM). TMAA's mandate extended beyond gold to cover all mineral exports, as well as other functions including financial and environmental audits, and monitoring smuggling of minerals. TMAA reported to the permanent secretary of MEM.

2015 – TMAA laboratory achieves ISO accreditation

TMAA inherited the laboratory, as well as the staff, from ASA. In 2010, TMAA began working toward achieving ISO accreditation. The process included staff training, improving documentation, equipment, procurement, maintenance, calibration and proficiency testing. Finally, in 2015 the laboratory was accredited by the Southern Africa Development Community Accreditation Services. TMAA does not do any sampling; it simply prepares the sample and does the testing.

- **Laboratory services**: TMAA staff were trained by ASA to undertake mineral sampling, which they do in relation to the large-scale mines. Testing services include fire assay; XRF analysis; atomic absorption analysis; and valuation of gemstones, diamonds and coloured stones. Based on its findings, TMAA issues mining companies with a provisional royalty payable to MEM before exports leave the country. Although gold has traditionally dominated the sector, TMAA also monitors copper, silver, sulphur, iron ore, diamonds and tanzanite.
- **Operating cost**: TMAA spends approximately USD 155,000 per year, around three per cent of its annual operating budget, on mineral analyses, inspections of minerals at exit border posts and export valuation. That figure does not include procurement of laboratory equipment. In addition, TMAA spends approximately USD 45,000 annually to maintain its ISO accreditation. The money is spent on staff

training, paperwork, procurement, testing and calibration of equipment, participating in proficiency testing twice a year, sample testing, registration and accreditation fees.

- **Revenue from commercial services**: TMAA conducts mineral analyses on behalf of government, as well as offering commercial services to the private sector. On average, the revenue from the commercially operated part of the laboratory is USD 45,000. Most of the large-scale miners do not use the service either, because they have their own in-house laboratory or they have a contract with a private mineral inspection firm. TMAA has no other independent source of income; its USD 4.8 million annual budget is paid for by government.
- **Impact**: According to TMAA, being able to detect undervaluation of mineral exports increased voluntary compliance by companies, significantly limiting undervaluation. Recently, it identified a transfer pricing issue involving a mining company selling tanzanite at low prices to a related marketing entity in Mauritius, which then on-sold the gems to India and Hong Kong for a higher price. The mine in Tanzania declared a sales revenue half of that declared by the marketing hub in Mauritius. TMAA found it difficult to determine the arm's length sale price for tanzanite due to the lack of reference prices. However, with the help of its gemologists, it could determine an appropriate price, which, combined with an analysis of the marketing hubs functions, assets and risks, was used by the Tanzania Revenue Authority as the basis for issuing a tax adjustment.

Source: Readhead, n.d.; personal communication, former TMAA staff, August, 25 2017.

4.2 Independent, Third-Party Assessor

Government could contract a third party to undertake all aspects of export valuation on its behalf. In the case of direct measurement, one of the advantages of contracting a third party—for example, Cotecna, SGS, or Bureau Veritas—is that they have decades of experience and expertise running mineral laboratories, as well as operating sampling, sample preparation and chain-of-custody management. This should mean that they can set up an international standard laboratory in less time than a developing country government starting from scratch and to a higher standard. Government may perceive a potential conflict of interest if mining companies are using the same third-party assessors. They should retain a reference sample at the standards bureau in the event there is a dispute with the firm.

Alternatively, government could outsource discrete activities to a third-party assessor while retaining control over some aspects of the export valuation process. Sampling is the most challenging part of the process to get right, compared to mineral testing, which is much more mechanical. In the case of sampling, there may be heterogeneous products of different sizes and purity, in which case a good sampling mechanism requires significant expertise. For governments that have begun building their own laboratories, it may be strategic to focus on strengthening mineral testing and contracting a private mineral inspection firm to collect, prepare and

transport samples to the laboratory. Some transfer of knowledge and technical expertise could be built into the contract with the third-party. Another option is for the third-party to monitor companies' compliance with accredited mineral sampling and testing standards. The monitoring could be done as little as once a year or as often as for each shipment.

Box 5. Mineral export valuation processes in India

India is a significant producer and user of coal. There is a monopoly on coal production by state-owned company Coal India Ltd (CIL), which sells its coal to a predominantly state-owned power producer, NTPC. The determination of the quality of coal shipments from CIL to NTPC has been the subject of frequent disputes between the entities.

There are two key features of the mechanism set up by government to monitor flows of coal from CIL to NTPC. First, a government laboratory, the Central Institute of Mining and Fuel Research (CIMFR), which is accountable to the Council of Scientific and Industrial Research (CSIR), tests the quality of the coal. CSIR-CIFMR was selected as an independent, third-party assessor by CIL and NTPC. Second, in 2016, CSIR-CIMFR selected Cotecna to carry out the sampling and sample preparation at railway/truck loading sidings in mines, as well as power plants across India, following a global tender process.

Cotecna collects the coal samples, which are then delivered to CSIR-CIMFR laboratories in four locations for testing. Cotecna samples every consignment (usually trains) of coal and manages labelling, storage and handling of samples all the way to the laboratory. The whole operation involves 2,300 people in 180 locations. About 20 million tonnes of coal is sampled every month. The arrangement has significantly improved transparency and thermal generation supply-chain efficiencies and has been publicly hailed as a major success by both the government and NTPC units.

Source: Coal Insights Bureau, 2017.

Government should be careful to avoid remuneration structures based on the value of the export and instead aim for a service contract system. As noted in Box 4, previously, the Ministry of Finance in Tanzania contracted a private firm, ASA, to audit four large gold mines. The firm charged 1.9 per cent of the market value of exported gold, equivalent to 64 per cent of royalties payable to the MEM. For 2003 alone, the firm charged Tanzania more than USD 10 million (Readhead, 2017).

Ideally, government should contract a private firm on the basis that it will perform export valuation services in exchange for an agreed service fee, paid either by government or industry users (more on this in the section on financing). However, if it is difficult to attract firms on this basis, government could offer a moderate commission on total royalties, but avoid a commission based on market value, which, depending on how the royalty is calculated, is likely to be more than government receives after allowable deductions and discounts. Government should consider the risk that firms may overstate the value of the mineral if their remuneration is linked to this.

4.3 Public–Private Partnership

Under a public–private partnership (PPP) agreement, the government would select a private company to finance and build a mineral laboratory and/or export valuation system and operate it on behalf of government for a period of time. There are different ways a PPP could be set up; however, the most likely is a build-operate-transfer scheme, at the end of which the facility ownership is eventually transferred to government. PPP arrangements are used when governments need to build infrastructure or systems.

In the case of a build-operate-transfer scheme for a mineral testing facility, an allocation of functions may be:

- The private company finances/acquires/builds the testing facility at its own expense.
- The private company operates the laboratory (including full service and maintenance) and submits the testing results to government.
- In return for its services, the private company receives a fee that covers its financial (equipment depreciation, debt service, etc.) and operating costs. Different models can be devised for determining the fee.
- At the end of the concession period, the ownership of the facility is transferred to government.

4.4 Shared Regional Testing Facilities

It may be more economical for smaller mineral-producing countries to set up shared regional mineral testing facilities, rather than duplicating. Mineral laboratories take considerable time and resources to set up. Also, there is a significant margin for error, which means a laboratory must be well equipped and adequately staffed to avoid the test results being unenforceable in the face of conflicting analyses. Rather than governments in the same region setting up their own mineral testing facilities, which may not be economical for small export volumes, and risk repeating the same errors, they should set up a state-of-the-art shared laboratory. Regional infrastructure plans already exist in many of the high-level political strategies in Africa, for example, the African Mining Vision and the Comprehensive Africa Agriculture Development Program.

Establishing regional testing facilities is also a model employed by commercial mineral inspection firms and large countries such as India, because it makes economic sense. Rather than setting up a commercial analytical mineral laboratory in every West African country where SGS has clients, for example, it has three laboratories, in Ghana, Burkina Faso and Mali. These laboratories are strategically located to service SGS activities

throughout the region.[4] Similarly, the Bureau of Mines in India has its main mineral laboratory in Nagpur in central India and two regional mineral processing laboratories, one in the north in Rajasthan and one in the south in Bangalore, to service local mining areas.[5]

There is significant donor investment going into building mineral laboratories in many African countries. It is not obvious that government will be able to financially sustain these laboratories once operational. If it turns out that they cannot, and, as a result, equipment falls into disrepair, inaccurate results will be produced, potentially leading to costly disputes with mining companies. It would be more efficient for donors to finance a shared facility, which governments could pool resources to fund and second national experts to increase the available talent.

For a shared regional mineral testing facility to get support from governments, it would need to guarantee timeliness and accuracy. Regarding the first point, governments may be reluctant to rely on a shared facility for fear of experiencing delays in receiving the results. This concern could be overcome by the laboratory having comprehensive data of mineral export volumes and flows from each country, to be able to equip the laboratory with enough testing lines as well as staff to deal with demand. It could also be alleviated by government collecting samples as a preventative measure (i.e., at regular intervals during the year), rather than just when companies export, thus reducing the time pressure on getting results.

[4] For more information, see the SGS website: https://www.sgs.com/en/news/2015/07/three-sgs-laboratories-in-west-africa-recognised-by-sanas-for-iso-iec-17025-conformity

[5] For more information, see: http://ibm.nic.in/index.php?c=pages&m=index&id=102

FINANCING MODELS

5.0 Financing Models

Implementation of either policy option requires resources. An appropriate financing structure could consist of one or more of the models below, for example, through a combination of tax revenue and charging for commercial laboratory services.

In many forms of industry regulation, a workable financial model is preferably one where the cost of independent export valuation by government is borne by the mining companies themselves. However, in this case, government may need to offer companies the opportunity to prove that their sampling and testing processes accord with international standards before requiring them to pay for a second, or, in some cases third, opinion on the value of their mineral exports.

The options contemplated, however, should also be placed in the institutional context of each country and be adapted to the relative strengths of budget systems to ensure they will work (and not create the wrong incentives for government officials).

5.1 Fixed Annual Fee

There may be an option to introduce a fixed annual fee that mining companies are required to pay to cover the cost of government verifying the value of mineral exports (e.g., an inspection fee). One risk with this approach is that the government finds another use for the revenue raised and the actual verification is not adequately funded, leading to a breakdown in the system. Another challenge may be that, in many countries, fiscal regimes are stabilised for mining (i.e., no additional taxes or charges can be levied), in which case it may not be feasible to introduce a new levy.

5.2 Commercial Services

Some governments choose to provide commercial laboratory services to the private sector as a means of raising funds to cover the running costs of a government laboratory. For example, the TMAA charges approximately USD 97 for sample preparation and USD 433 for analytical testing, depending on the commodity (see Box 4). The Government of Zambia also intends to raise funds by charging the private sector for the use of its mineral laboratory.

One challenge with this approach may be a potential for conflict of interest if the laboratory is involved in analysis on behalf of government in a supervisory role over private industry, as well as doing contract work for that industry. It may also lead to less time spent on government work. Consequently, an alternative means of financing may be advisable to avoid potential conflicts of interest.

5.3 Donor Funds

Another possibility is that international development partners provide funds. These funds could be given to government, used to directly procure a laboratory on government's behalf or used to pay an independent, third-party assessor of the government's choosing. This option might be feasible at the beginning to overcome high upfront costs that will be difficult for resource-constrained countries to manage and demonstrate the importance of export valuation. However, a more sustainable arrangement would be needed in the longer term. It may also be difficult to engage donors on a project of this kind if it is outside of their usual priority areas for assistance (e.g., health, education).

5.4 Fee for Service

Under this option, an independent, third-party assessor would carry out measurement and/or monitoring activities on government's behalf, and companies would pay a fee for service direct to the assessor. A similar approach is adopted for other sectors. For example, in Cameroon, the government has appointed SGS to determine the value of certain imports. Companies are required to pay SGS a fee for service. The government then uses the information collected by SGS as a basis to levy taxes on imported goods. While companies have complied so far in Cameroon, other countries may wish to consider enforcement mechanisms to ensure that companies meet the payment terms, for example, they could block companies' mining licences temporarily.

One challenge is that mining companies may be reluctant to pay for a service they already contract another private mineral inspection firm to provide, which they regard as providing credible results. To overcome this challenge, government could give companies a choice: comply with the country's mineral sampling and testing standards, subject to regular monitoring and validation by government, or submit to sampling and testing by an independent, third-party assessor selected by government and pay the cost. This is a common approach to resolving export valuation disputes, particularly in oil and gas.

5.5 Public-Private Partnership

A PPP may be a faster, easier way for a government to begin direct measurement of mineral exports. It is also less costly for government than investing public funds in public procurement. The service is guaranteed by the private sector, and it is in the interest of the service provider to make sure that the goals of the service are met. It would also allow for a gradual buildup of local competences, allowing a smooth transfer of responsibilities to government at the end of the arrangement. Remuneration could be structured according to any of the options above, for example, by government directly through additional revenue or by requiring companies to pay a fee for service.

Box 6. Laboratory-specific PPPs

PPPs for mineral laboratories are rare in Africa and elsewhere. However, laboratory-specific PPPs have been common in the heath sector. A study by the World Bank identified approximately 36 PPPs in Kenya, Uganda, Rwanda and Tanzania.

Placement of privately owned laboratory equipment in public facilities is the most commonly used form of PPP. In this model, a private manufacturer or distributor makes equipment available at no cost, trains staff to operate it and provides free maintenance services. In exchange, the public sector provider commits to the regular purchase of an agreed minimum volume of specific reagents from the same company.

Alternatively, in some cases, for example the District Hospital Laboratory in Voi, Kenya, the private partners split the user fees with the hospital.

Source: Ravishankar & Lehmann, 2015.

MINERAL SAMPLING, TESTING STANDARDS AND REPORTING REQUIREMENTS

6.0 Mineral Sampling, Testing Standards and Reporting Requirements

For government to effectively monitor companies' export valuation processes, there must be a clear standard for mineral sampling and testing, as well as corresponding disclosure requirements. Canada, South Africa and Australia all have reporting codes that require mining companies to disclose their sampling methods, sample preparation, analyses and quality assurance measures. These are:

- The National Instrument 43-101 (NI) (Canada)
- The South African Code for the Reporting of Exploration Results, Mineral Resources and Reserves (SAMREC)
- The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC)[6]

Box 7. Disclosure requirements for sampling and mineral testing

JORC, SAMREC and NI 43-101 all require companies to disclose some combination of the following information:

- The precise location of the sample
- Unique number of each sample
- Measures taken to ensure the sample is representative
- Nature, quality, size and appropriateness of sample preparation techniques
- List of sampling equipment (including date of purchase)
- The laboratory used for testing and its accreditation
- Any refusal of accreditation
- Nature, quality and appropriateness of the assaying and laboratory procedures
- Nature of quality control procedures (e.g., standards, blanks, duplicates, external laboratory checks) including whether acceptable levels of accuracy (i.e., lack of bias) and precision have been established
- Results of internal and external audits of export valuation processes
- Employees capable of export valuation, especially sampling, including recent trainings
- Company code of practice for sampling procedures

[6] NI 43-101 can be viewed here: http://web.cim.org/standards/documents/Block484_Doc111.pdf; SAMREC can be viewed here: https://www.samcode.co.za/codes/category/8-reporting-codes?download=120:samrec; and JORC can be viewed here: http://www.jorc.org/docs/JORC_code_2012.pdf

The intention is not to set up rules with respect to mineral sampling and testing, but rather to create self-regulation among international and local companies who are looking for credibility with investors. The codes provide guidelines for what companies should do, rather than what must be done. Each company, specifically, the "qualified person," is left to decide the standard and methodologies and should be able to defend their decisions before a panel of peers. According to NI 43-101, "the qualified person should be clearly satisfied that they could face their peers and demonstrate competence and relevant experience in the commodity, type of deposit and situation under consideration. If doubt exists, the person must either seek or obtain opinions from other colleagues or demonstrate that he or she has obtained assistance from experts in areas where he or she lacked the necessary expertise."

Enforcing reporting requirements can be a challenge for developing countries due to the power imbalance between investors and government. For countries that have a stock exchange, it may be possible to improve compliance of listed companies by linking disclosure of export valuation processes to stock exchange requirements. In South Africa, mining companies seeking listing on the Johannesburg Stock Exchange for the first time, as well as presently listed companies, must comply with the SAMREC. For countries that do not have a stock exchange, the next best option would be to require companies with foreign affiliates subject to similar requirements in other countries to share their disclosures with local authorities. Beyond requiring disclosure, government could use a code of practice as a basis for monitoring companies' sampling and testing processes.

In addition, government could require that all mining contracts include a standard clause regarding sampling procedures and protocols. A standard clause might state that companies will follow the ISO standards for bulk commodities. Precious metals and concentrates would require a more detailed description of the protocol. The reporting codes could be used as a basis for developing a standard clause for contracts. Box 8 is an example of a clause where the export valuation process is highly ambiguous.

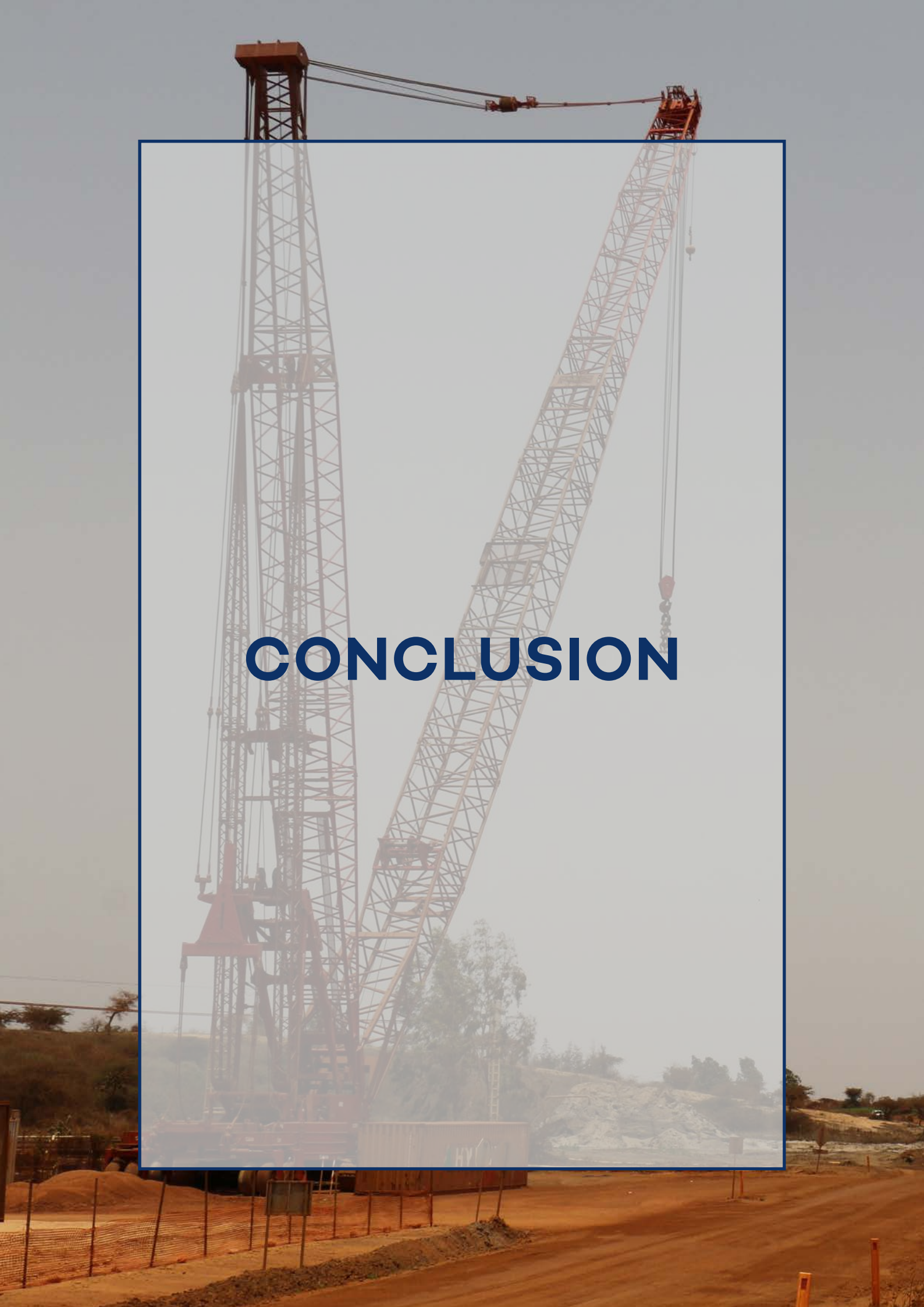
Box 8. Export valuation and sales contracts

15. Sampling and Analysis

Sampling and Analysis at Buyer's Warehouse in Manzanillo, Mexico

Buyer and Seller shall appoint AHK on a joint basis to analyse each lot of 2,500 (two thousand five hundred) wet metric tons from the samples taken by AHK during sampling operations at Buyer's warehouse at Manzanillo, Mexico *in the usual technical manner in accordance with standard international practices*. (emphasis added)

Source: Iron Mining Group Inc & IMG Iron Ore Trading, 2011



CONCLUSION

7.0 Conclusion

Many governments are searching for ways to strengthen their capacity to determine the value of mineral exports. They are understandably concerned about accepting company declarations at "face value" due to their lack of technical expertise and facilities. However, there is a risk that, in rushing to find solutions, governments may make decisions that are inappropriately calibrated to risk and, in doing so, waste limited resources.

Governments understand they need the knowledge and skills to monitor the quality of their minerals, but a key question is how to build that in an efficient and timely way. In some cases, they may also require testing facilities to enable direct measurement of minerals either via a government laboratory or an independent, third-party assessor. The lesson is that there is no one-size-fits-all approach. The most appropriate option will depend on the risk of undervaluation and the available resources, as well as historical preferences or previous commitments.

It may be more practical for governments to aim for effective deterrence of undervaluation than try to determine the precise value of every mineral that is exported. One such deterrence measure is requiring companies to comply with international standards for mineral sampling and testing. Another is insisting they use accredited third parties. A combination of such measures should make undervaluation less likely, leaving government to focus its limited resources on higher-risk transactions.

The following conclusions are intended to help governments of resource-rich developing countries choose the most appropriate policy response to the risk of undervaluation.

1. **The first step for concerned governments is to investigate the risk of companies deliberately undervaluing their mineral exports before deciding on the appropriate policy response**. The likelihood of companies under-reporting the value of their mineral exports will depend on a number of factors (e.g., the type of commodity, how it is sold, etc). Governments need to know these nuances before investing potentially significant resources.
2. **Focusing on mineral testing without addressing sampling is likely to be ineffective**. More errors occur during sampling than testing, hence sampling must be done correctly in order to determine the accurate value of the material. Investing significant resources setting up a laboratory in response to the risk of undervaluation, and yet accepting mineral samples from companies, would almost certainly not decrease risks. Governments need to invest at least as much, if not more, resources in training staff on sampling and sample systems management as improving mineral testing.

3. **It may be more cost-effective for governments to monitor companies' own internal export valuation processes rather than duplicate them**. If the risk is low and companies have quality controls that comply with international standards, it may be sufficient for government to monitor these processes rather than undertake direct measurement. Where the risk of undervaluation is elevated, government could arrange for a sample to be taken and sent for testing at a laboratory.
4. **The cost of contracting an independent assessor should be paid by the company, unless it can prove that its sampling and mineral testing accord with international standards**. If the risk of undervaluation is high, it may be fair for government to pass the cost of independent verification on to the company. But the company should have the option to demonstrate the reliability of its internal quality controls before costs are imposed.
5. **Whichever option government selects, the result should stand up to legal scrutiny**. If the government's determination of the value of mineral exports differs from the company's and the disagreement goes to court, it would be reasonable to assume the ultimate decision would be very likely to favour the side with internationally accredited analyses. There is little use establishing a government mineral laboratory if it does not comply with international standards.
6. **Governments should explore opportunities for cross-country collaboration on export valuation**. Rather than setting up their own mineral testing facilities, which may not be economical for small export volumes, governments in the same region should set up a state-of-the-art shared mineral laboratory. Alternatively, if there are countries in the region that already have the relevant facilities, others could consider using these.

References

ALS. (n.d.). 2018 fee schedules. Retrieved from http://www.alsglobal.com/services-and-products/geochemistry/geochemistry-downloads

Calder, J. (2014). *Administering fiscal regimes for extractive industries: A handbook*. Paris: International Monetary Fund.

Coal Insights Bureau. (2017, August 20). Cotecna handling 30mt of coal sampling per month. *Coal Insights, 12*(1). Retrieved from https://www.magzter.com/IN/mjunction-services-ltd/Coal-Insights/Business/243378

Guj, P., Bocoum, B., Limerick, J., Meaton, M. & Maybee, B. (2013, April). *Chapter 3: Mineral royalties. In How to improve mining tax administration and collection frameworks: A sourcebook*. World Bank. Retrieved from http://documents.worldbank.org/curated/en/576391468330004326/pdf/818080WP0P122250Box0379844B00PUBLIC0.pdf

Guj, P., Martin, S., Maybee, B., Cawood, F., Bocoum, B., Gosai, N., & Huibregtse, S. (2017, January). *Transfer pricing in mining with a focus on Africa: A reference guide for practitioners*. Retrieved from http://documents.worldbank.org/curated/en/801771485941579048/pdf/112346-REVISED-Dated-Transfer-pricing-in-mining-with-a-focus-on-Africa-a-reference-guide-for-practitioners-Web.pdf

Gy, P. (1982). *Sampling of particulate materials: Theory and practice* (2nd ed.). Amsterdam: Elsevier.

Iron Mining Group Inc & IMG Iron Ore Trading. (2011). *Purchase Contract*. U.S. Securities and Exchange Commission. Retrieved from https://www.sec.gov/Archives/edgar/data/1416712/000114420411049185/v233030_ex10-1.htm

Organisation for Economic Co-operation and Development. (2017). *The challenges faced by developing countries in valuing rough diamonds*. Discussion draft provided to Kimberley Process participants.

Platform for Collaboration on Tax. (2017). Supplementary report on Addressing the information gaps on prices of minerals sold in an intermediate form. In *A toolkit for addressing difficulties in accessing comparables data for transfer pricing analysis* (pp. 155-236). Retrieved from http://www.oecd.org/tax/toolkit-on-comparability-and-mineral-pricing.pdf

Ravishankar, r. & Lehmann, J. (2015). *Opportunities abound: Public private partnerships for laboratory services in East Africa*. New York: World Bank.

Readhead, A. (n.d.). *Improving mining revenue collection: Tanzania's Mineral Audit Agency*. New York: Natural Resources Governance Institute. Retrieved from https://resourcegovernance.org/sites/default/files/documents/improving-mining-revenue-collection-tanzania-mineral-audit-agency.pdf

Readhead, A. (2016). *Preventing tax base erosion in Africa: A regional study of transfer pricing challenges in the mining sector*. Natural Resource Governance Institute

SGS Mineral Services. (2015). *Rocks to results: A practical guide to laboratory operations*. (5th ed.). Retrieved from https://www.sgs.com/-/media/global/documents/brochures/sgs-rocks-to-results-brochure-en.pdf

SGS Mineral Services. (2016). *Analytical services*. Geneva, Switzerland: SGS.

Annex: Country Case Studies

A1 Republic of Sierra Leone

Government Controls on Export Valuation for Bulk Commodities

Sierra Leone currently mines and exports ilmenite, zircon, iron ore, bauxite and rutile. There is also artisanal and small-scale production of tantalite ores taking place. The sector is monitored by the National Minerals Agency (NMA), a semi-autonomous agency set up in 2012. The NMA reports to the Ministry of Mines, and its responsibilities include assessing the quantity and quality of mineral exports to levy royalties, which are ultimately collected by the National Revenue Authority.

There are three mining companies exporting bulk commodities from Sierra Leone, these include: Sierra Rutile Limited (SRL), Sierra Mineral Holdings Limited (SMHL) and Tonkolili Iron Ore Limited (TIO).

Table A1. Mineral production and export volumes, Sierra Leone (2016)

Bulk Minerals	Production Vol.	Export Vol.
Iron Ore	6,175,958.00	5,157,254.48
Bauxite	1,429,589.45	1,465,531.37
Rutile	148,541.00	155,150.35
Ilmenite	28,102.00	29,356.42
Zircon	1,329.00	5,054.70

Source: NMA data.

There is no systematic monitoring of mineral quality. The NMA does have its own laboratory (not ISO accredited) that has some equipment. The laboratory is staffed with an experienced laboratory manager, one chemist and four geologists who have received technical training on the equipment. The laboratory is already being used to test some samples from exploration companies. The main obstacles have been the lack of a suitable XRF machine and a transformer to protect the equipment from power surges.

a) Overview of production and export information submitted to the NMA

All companies are legally obliged to submit a monthly production report to the NMA. The NMA also conducts an economic prospect assessment twice a year, visiting every mine to discuss production performance, projections and targets. However, when it comes to exports, the information submitted by the companies varies widely. The NMA recently assessed TIO's royalty payments and found a lack of information regarding exports; it had only received the internal sales contract with the related party marketing company and sporadic sales invoices. This has since been rectified and the company submits the following additional information:

- Freight invoice from carrier
- Draft survey report
- Third-party sales agreement
- Copy of certified laboratory report for each shipment
- Customs certificate at the port of delivery (e.g., Qingdao)
- Supporting documents that can explain all differences between the Platts price and the

quoted "base price" and its exact and costed origins (e.g., metal and other elements content, size of the particles, moisture, etc.) (new requirement)

For SMHL and SRL, the NMA only receives the bill of lading and a copy of the freight invoice from the carrier. The NMA is planning to enforce stricter documentation rules like the ones applied to TIO.

b) The NMA's Export Valuation Objectives

The NMA is concerned about the potential for undervaluation of mineral exports. It had previously thought there was abusive transfer pricing going on in relation to TIO's sales to a related party in China. However, a comparison of the third-party sales agreement and offtake agreement showed that the low sale price was due to poor quality ore. However, for bauxite, 100 per cent is sold to a related party in Romania. Due to the highly integrated nature of the bauxite industry and lack of benchmark prices, the NMA considers there to be a big risk of undervaluation.

The NMA is working hard to improve its export valuation capacity. In future, it plans to collect representative samples of all bulk mineral exports leaving the country and either analyse them in the NMA laboratory or use an outside laboratory for independent quality assessment. The director of geological survey is doubtful there is enough demand to warrant the investment required to get the laboratory ISO certified. The NMA's priority is to establish a sustainable structure for export valuation that works for the medium to long term.

Mining Industry in Sierra Leone

Table A2. Mining and export processes, Sierra Leone

Activities	Summary
Type of mining method	All three mines are open cast; SRL does some dredging.
Mineral product	• TIO: an all-in-32 large particle product, high in clay, moisture and alumina. • SRL: extracted ore is approx. 2 per cent, processed to 95 per cent titanium dioxide. • SMHL: no information provided.
Beneficiation process	• Bauxite: ore is washed and dried. • Rutile: processing includes washing of ore, screening, gravity concentration on spirals and separation of heavy minerals using electrostatic and magnetic separation techniques. • Iron ore: no processing, an unwashed all-in-32 product is being exported.
Handling and transport to point of export	Road: haulage trucks to port; then barge to ocean-going vessels (OGV). TIO also operates its own rail; then transhipment shuttle vessels to OGV.
Intermediary storage	No storage in Sierra Leone.
Loading process	From port storage facility via conveyor belt onto barge/or transhipment shuttle vessels.
Location of sales/ customers	• 15 per cent of TIO's iron ore is sold to related party, Shandong Group in China; the rest is sold on the spot market. • 90 per cent of SMHL's bauxite is sold to parent company Alum in Romania (Alum is an aluminium producer). • SRL sells most of its product to an unrelated company, Kronos, in Europe, it also sells to customers in Mexico and the United States.

Mining companies' own export valuation controls

All three mining companies in Sierra Leone that are exporting bulk commodities carry out their own export valuation.

- TIO contracts private mineral inspection firm, SGS, to do all sampling and mineral analysis—onsite and at the port.
- SRL has an in-house laboratory that does all sampling and testing at the mine and the port.
- SMHL does all sampling itself. 100 per cent of samples taken at the port are sent to external laboratories for cross-checking and testing. For shipment samples, they are mostly using the Rio Tinto Alcan lab in Canada. For moisture analysis, they are using a British lab. For XRF analyses, they usually use an SGS laboratory in Australia.

Assessment of Options

For reasons outlined below, Sierra Leone might be best choosing the hybrid, risk-based approach:

Potential Policy Options	
Direct measurement of mineral exports, including sampling, sample preparation and testing.	X
Monitoring mining companies' own internal export valuation processes, to ensure the reliability of their results.	X
A hybrid option which combines monitoring of companies' own export valuation processes, with direct measurement in high-risk cases.	✓

Table A3. Justification for policy proposal, Sierra Leone

	Activities	Summary
1	The risk of undervaluation is lower in the case of iron ore (Sierra Leone's main mineral export)	- Sierra Leone currently exports nearly five times more iron ore than bauxite. There are publicly quoted prices for iron ore, which can be used to benchmark related party sales. - Most of the iron ore and rutile is sold to independent customers.
2	The mines have internal quality controls	- All three exporting companies either have their own mineral testing laboratory onsite or contract a private mineral inspection firm, for example, SGS in the case of TIO.
3	Direct measurement would be less economic	- Export volumes are small, making it harder to justify the cost of setting up an ISO-accredited laboratory. - The three large mines either have existing contracts with private mineral inspection firms or their own laboratories, in which case they may be reluctant to pay to use a government lab.
4	Bauxite is higher risk, making monitoring companies' own valuation processes less appropriate	- There are limited price indices for bauxite. - 90 per cent of the bauxite produced in Sierra Leone is sold to a related party. - Hence, some direct measurement may be required: the NMA could send samples abroad for testing. The requirement for independent testing could be factored into the mining development agreement, and the cost borne by the company, unless it can satisfy the NMA of the veracity of its internal assay results.

To introduce further layers of confidence, the NMA could adopt a mineral testing and sampling reporting code, like the JORC or SAMREC, as well as require companies to use accredited mineral laboratories certified by the NMA.

A2 Republic of Guinea

Government Controls on Export Valuation for Bulk Commodities

Guinea is endowed with the world's largest deposits of bauxite; it accounts for more than one third of the world's known reserves. The sector is monitored by the Ministry of Mines and Geology (MMG). The MMG's responsibilities include verifying the quantity and quality of mineral exports to levy royalties and taxes, which are collected by the Customs Directorate of the Ministry of Budget and the Direction Nationale des Impôts, respectively.

There are three mining companies currently exporting bauxite from Guinea: Compagnie des Bauxites de Kindia (Rusal/CBK), Société Minière de Boké (SMB), and Compagnie des Bauxite de Guinee (CBG). The Government of Guinea owns 10 per cent of SMB and 49 per cent of CBG. SMB is predicting considerable future growth, up to 35 million tonnes of bauxite per year.

Table A4. Mineral production and export volumes, Guinea (2015/16)

N°	Mining companies	Production 2015, Mt	Production 2016, Mt	Exportation 2015, Mt	Exportation 2016, Mt
1	CBG	16,440,040	15,850,000	15,328,128	14,950,000
2	CBK	3,400,000	3,500,000	3,400,000	3,250,000
3	SMB	866,929	6,653,770	796,109.62	6,141,883.05
4	**TOTAL**	**20,706,969**	**26,003,770**	**19,524,238**	**24,341,883**

MMG does not do any independent monitoring of the quality of mineral exports. Instead, it bases its assessment of royalties on the companies' self-declarations. In a Memorandum of Understanding with SMB, the government requires SMB to have each shipment valued by an internationally reputable verification firm (in practice, it has been VERITAS). SMB, not the MMG, is paying for the independent, third-party assessor. The same requirement has been included in a regulation on royalty assessment, which is about to be signed into an "arrete."

There is a National Laboratory for Geology and Mining, but the equipment is outdated; thus, it was not functional at the time of writing. However, with the support of the World Bank, the laboratory diagnosis has been done, and the modernisation process is ongoing. The MMG is currently renovating the laboratory and installing a tabletop XRF spectrometer. The laboratory will also be equipped to perform moisture content analyses. Russian cooperation is helping to build another Laboratory at Kamsar (Boké) for bauxite.

The Customs Directorate, the General Inspectorate, the National Laboratory of Geology and Mines and the National Mines Department have also begun to train staff to conduct independent draft surveys. Two trainings were conducted in June and October 2017 by INROS LACKNER, a German engineering firm, with the help of the German Society for International Cooperation (GIZ). Also in 2017, the MMG conducted a mission at CBG and CBK to assess their mineral assessment procedures. The purpose is to establish government control procedures in alignment with the processes already put in place by the companies.

a) Overview of production and export information submitted to MMG

To date, only CBG provides regular (monthly) production and export information to the MMG. Other companies provide information only at the request of the ministry.

b) MMG's export valuation objectives

According to Article 163 of the Mines Act (Code Minier 2011), export taxes (royalties) for bauxite are calculated based on the three-month London Metals Exchange selling price for aluminium. The standard rate for the formula is that one tonne of bauxite will contain 40 per cent aluminium oxide (e.g., the price of one tonne of aluminium x 0.4). The tax rate is 0.075 per cent for production and the same for export, so in practice it is 0.15 per cent for all bauxite exports. Having a fixed pricing formula that takes into account the London Metals Exchange price for the period reduces the risk of underpricing of bauxite exports.

However, the MMG remains concerned that it lacks the facilities, as well as the capacity, to monitor the quality of bauxite exports (i.e., the alumina content). Hence, its objective is to improve its capacity to perform checks on the quality of exported minerals to ensure accuracy in calculating royalties and taxes.

Mining Industry in Guinea

Table A5. Mining and export processes, Guinea

Activities	Summary
Type of mining method	• CBG: open pit, blasting. • CBK: drilling and blasting. • SMB: open pit, blasting.
Mineral product	• CBG: average 51 per cent Al_2O_3. • CBK: no information received. • SMB: no information received.
Beneficiation process	• CBG: crushed (100mm) and dried from an average of 12.5 per cent moisture to 6.7 per cent for shipping. • CBK: no information received. • SMB: crushed (200mm) by surface miner from an average of 10 per cent moisture for shipping.
Handling and transport to point of export	• CBG: loaded onto haul trucks for transport to the mine stockpiles, then transported by rail to the port. • CBK: similar to CBG. • SMB: transported by land by the company member of the consortium UMS International Ltd, to the ports of Katougouma and Dapilon, then by barge to the deep sea before being transferred onto cape size vessels provided by Winning Shipping Ltd to China (also a consortium member).
Intermediary storage	• No storage in Guinea.
Loading process	• CBG: loaded onto OGVs by conveyor belt. • SMB: uses both conveyor belt and direct through shovel. • CBK: no information received.
Location of sales/ customers	• CBG: the non-government shareholders of HALCO (51 per cent owned by Rio Tinto, Alcoa and DADCO) are the main buyers, with long-term sales contracts for 20 years. • CBK: owned by Russian aluminium giant, RUSAL, primarily exports to Russia and the Ukraine; 65 per cent goes to the Nikolaev alumina refinery in Ukraine. • SMB: 100 per cent to Shandong Weiqiao in China (alumina refinery), a member of the consortium.

Mining companies' own export valuation controls

As mentioned above, the MMG requires SMB to contract an independent, third-party assessor.

Assessment of Options

For reasons outlined below, Guinea might be best choosing direct measurement of mineral exports:

Potential Policy Options	
Direct measurement of mineral exports, including sampling, sample preparation and testing.	✓
Monitoring mining companies' own internal export valuation processes, to ensure the reliability of their results.	X
A hybrid option that combines monitoring of companies' own export valuation processes, with direct measurement in high-risk cases.	X

Table A6. Justification for policy proposal, Guinea

	Activities	Summary
1	The risk of undervaluation is higher in the case of bauxite.	- Bauxite is Guinea's major mineral export. - Pricing of bauxite is significantly more opaque than in the case of iron ore.
2	Direct measurement would be relatively economic.	- Guinea's large production and export volumes, and projections for future growth, make a government laboratory more economic.

Guinea should consider direct measurement of mineral exports and upgrading its laboratory accordingly. Equally important to testing are reliable sampling processes. Bauxite is a highly heterogeneous mineral substance that exhibits wide variability with respect to size and chemical composition particles, making careful sampling especially critical to export valuation.

The MMG could consider contracting a mineral inspection firm under a standard service agreement to train government officials on mineral sampling for a period of six to 12 months. The firm could provide theoretical as well as on-the-job training, enabling the MMG to gradually build up the necessary expertise to perform all the quality controls required to determine the grade and quality of bauxite exports.

In addition to sampling at the point of export, the MMG could deploy staff to monitor companies' own sampling operations. The basis for monitoring should be the companies' SOPs, provided that they comply with international norms. The MMG could use these SOPs to develop a testing and sampling reporting code for Guinea or, alternatively, adopt one of the international standards (e.g., JORC, SAMREC, etc).

IGF

INTERGOVERNMENTAL FORUM
on Mining, Minerals, Metals and
Sustainable Development