



MINERAL PRODUCT PRICING STUDY

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BACKGROUND



Background

- Challenges in raising revenue from extractives are pressing, diverse, international
 - Across spectrum of policy, law design, administration, corruption, capacity, accountabilities, resourcing (and so on)
- Where to begin?
 - Countries, the G8, and G20 told us to focus on significant asymmetries in information between companies, revenue authorities

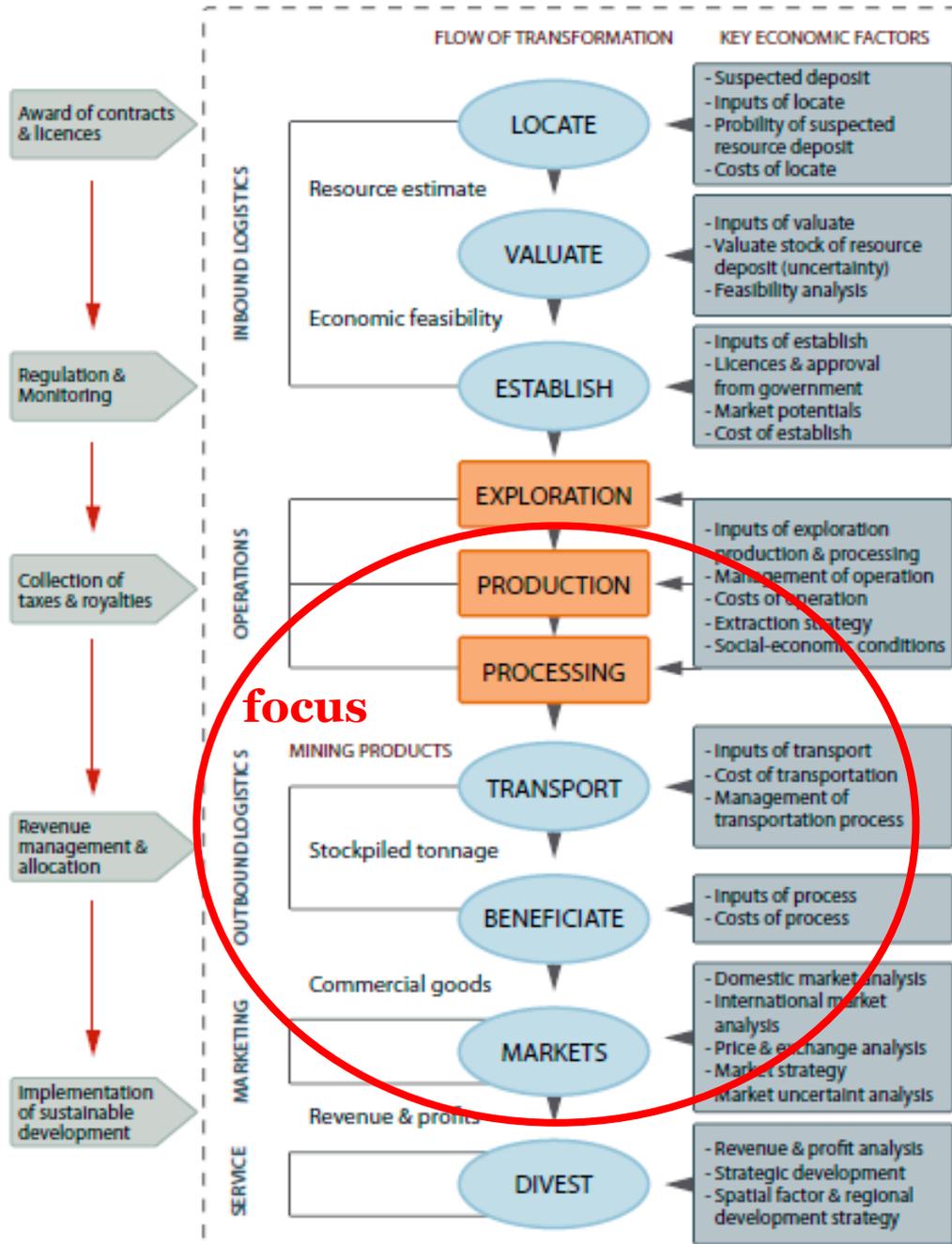


Background

- Developing countries expressed concerns about the availability and quality of financial data on comparable transactions
- Financial data about transactions between unrelated parties that are similar to the related party transactions (“comparable transactions”) vital to enforce TP rules
 - (CIT and also royalties)
 - Mitigate against price manipulation (underpricing)

AUTHORITY SUPPORTS

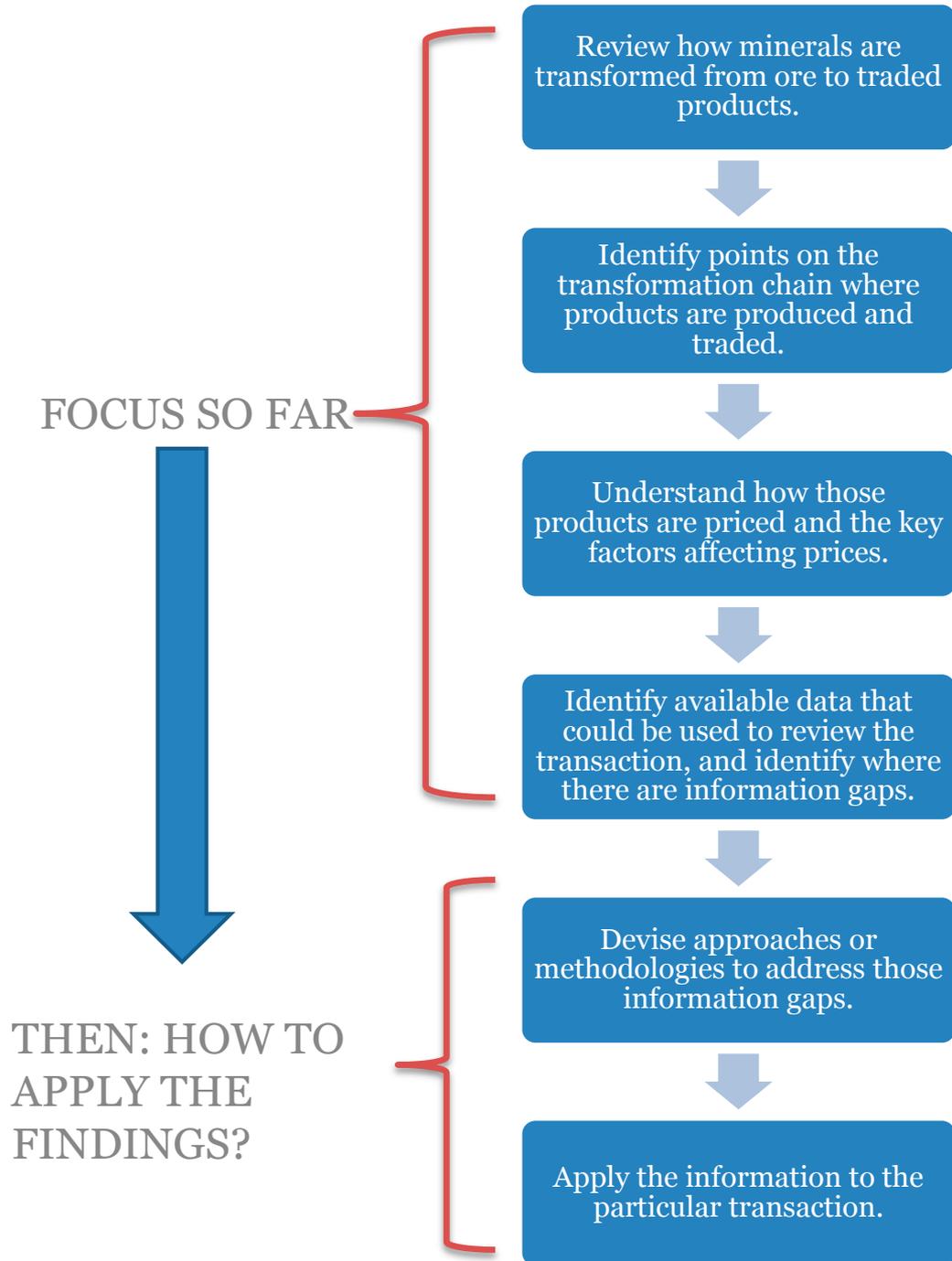
MINING OPERATION PROCESS





Study on Mineral Pricing

- Aim: provide information to help dev countries assess whether transactions within corporate groups are equivalent to arm's length transactions.
 - Examine how mineral products are priced when they are sold at arm's length
 - Build a stock of knowledge, but more importantly, a **methodology** others could apply





Study /2

- Initial undertaking: copper, iron ore, gold
 - Also thermal coal (underway)
- Your participation important:
 - As a potential customer of the work
 - As experts to improve the study



CASE STUDY – COPPER



Copper

- **Oxide-based** ores and **sulphide-based** ores.
 - *Which do you have? Determines the products you'll be pricing.*
- Oxide-based: leaching, solvent extraction, electrowinning: **cathodes**
- Sulphide-based: concentration, smelting, refining: **concentrates, matte, blister/anode, cathodes**

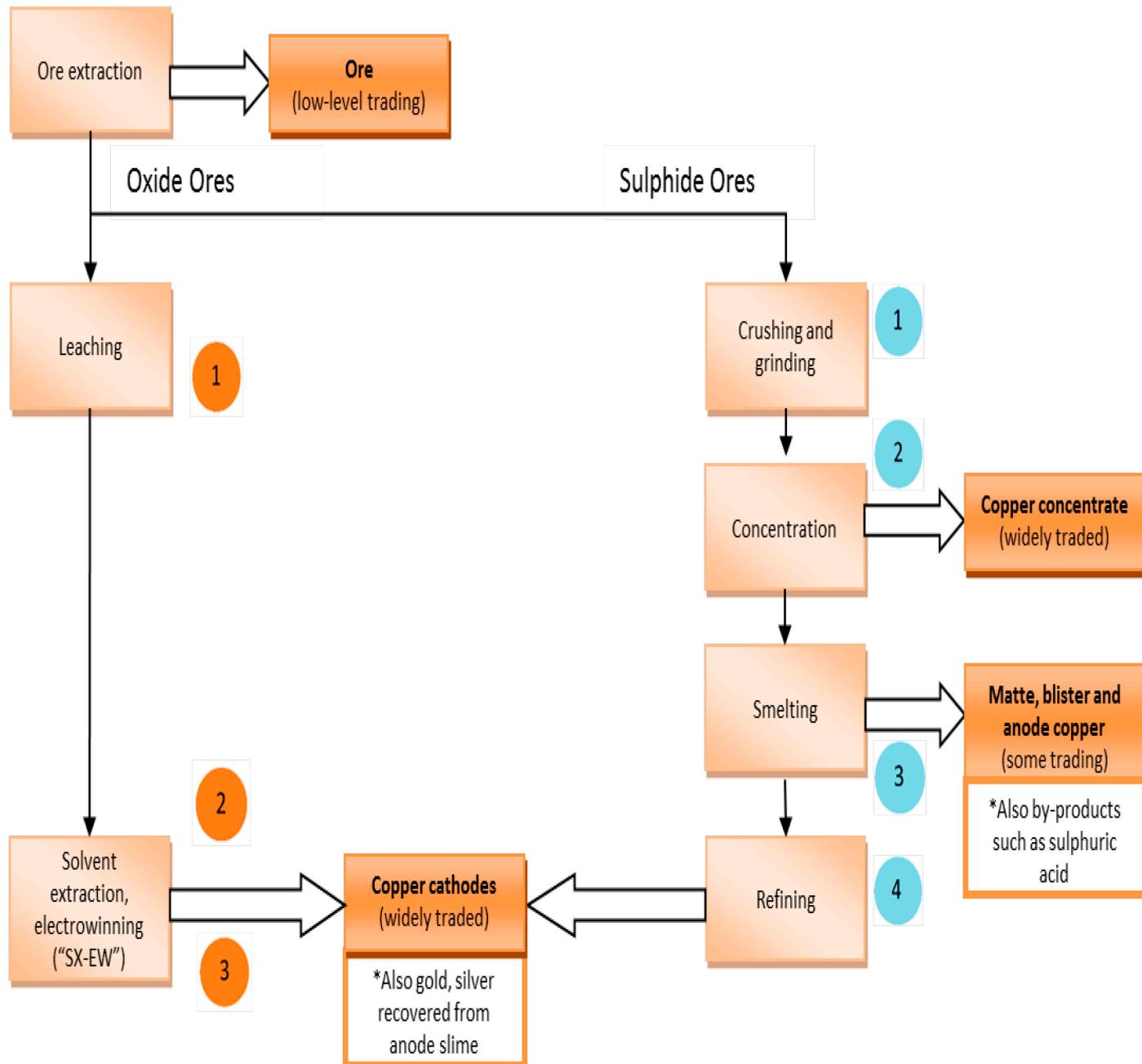
COPPER ORES

To separate the copper ore from the surrounding rock, drilling and blasting processes are used. The broken ore is then conveyed to a stockpile for further processing. At this point, the copper content is typically 1-2 per cent by mass or less. Other valuable metals may also be present, such as gold, silver, nickel and cobalt – indeed many mines are considered as ‘multi-mineral’.

The ore may be of consistent grade or, if not, be separated by grade into different piles. It is then taken to be broken down into smaller pieces of roughly uniform size at a mill that is located at the mine site, or transported to an off-site mill by road or rail.

Crushing and screening are the first steps of transformation. For sulphide-based ores, the ore will be ground down further in preparation for concentration processes.

For oxide ores, the rocks will be heaped in preparation for leaching processes.





Cu (sulphide) – Early in Value Chain



Copper ore (1-2% copper)

Source: Sikal



Source: Freeport McMoran

Copper concentrate (20-30% copper, 30% iron, 30% sulphur, gold, silver, and unwanted elements eg arsenic, mercury)

IRON OXIDE ORE

- 1 Iron oxide ores usually follow a processing path where the copper is leached from the surrounding rock. The ore is first heaped into piles in special leaching areas, and a sulphuric acid solution is sprayed over the heap to gradually dissolve the copper, separating it from the surrounding gangue. The copper-rich liquid is collected in pools and pumped into a plant for refining.
- 2 An organic solvent is added to the solution, which binds with the copper. The copper-rich electrolyte floats to the top of the liquid, separated off and pumped through to the next stage of the process. This is known as “solvent extraction”.
- 3 An acidic solution is then added to increase the concentration of copper and allow the liquid to conduct electricity. The liquid is then moved to tanks containing thin sheets of either copper (“starter sheets”) or stainless steel (“blanks”). Similar to the sulphide ore refining process, an electrical charge is applied to the liquid, causing the copper to attach to the sheets. Over approximately 10 days, the starter sheets fatten to a width of 2.5 centimetres, forming 99.9 percent copper cathodes. This process is known as “electro winning”.

SULPHIDE ORES

- 1 Sulphide-based ores are firstly ground to the consistency of sand, then mixed with water and chemicals to coat the copper sulphide particles, along with a frothing substance.
- 2 This slurry is moved to flotation tanks, where air is pumped through the mixture, forming bubbles which attract the chemically coated copper sulphide. The bubbles float to the surface and overflow or are skimmed off, filtered, and then dried to form a powder (copper concentrate). This process is usually able to recover 85 to 95 percent of the copper in the ore. The dried concentrate contains approximately 20-30 percent copper by mass, 30 per cent iron, 30 per cent sulphur, with the remainder including small amounts of gold, silver, and unwanted elements such as arsenic and mercury. Exported copper concentrates are transported by sea as a bulk commodity, either in drums or packages, or as loose powder.
- 3 Smelters are key purchasers of concentrate for physical delivery. Smelting removes most of the iron, sulphur and other unwanted materials from the concentrate. The concentrate may be initially roasted to remove sulphur and moisture. Concentrates are combined with silica sand and limestone and transferred to a furnace to melt them. Melting separates the materials with the heavier copper sinking to the bottom of the furnace, while the silica, which draws away impurities, floats and is poured off as slag.

Following this furnace process, the copper is in ‘matte’ stage with copper concentration between 50 and 70 percent. In most instances the matte is transferred directly as a molten liquid to a converter, but it may also be poured into ingots, cooled, and moved to a separate facility. In the converter, more silica is added to the matte and air is blown through the furnace to again melt the materials and separate the copper from another slag containing the iron. Following this process, the copper is known as “blister” copper, and is typically around 99 percent copper. Small impurities including oxygen, sulphur and iron are still present, requiring further treatment to remove. Depending again on the type of smelter, the blister copper may be cooled and shaped into ingots for transportation to another facility, or carried directly to an anode furnace for casting. During the casting process, natural gas is blown into the melt to burn off excess oxygen. At end of the process, molten copper of approximately 99.4 percent purity is poured into moulds and cooled to form ‘anodes’.

- 4 Refining is the final step. Anodes are placed in tanks with a sulphuric acid solution along with fine “starter” sheets of pure copper. An electrical current is applied to the solution causing the anodes to dissolve and copper to attach to the starter sheets, eventually forming 99.9 percent pure copper cathodes. Precious metals do not dissolve in the solution, instead dropping to the base of the refining cell and forming ‘anode slime’. This slime is collected and the precious metals recovered through a leaching process.



Copper – Transferred to Smelters

- Concentrates widely traded, using reasonably standard trading terms:
- Payment to mine = (payable metals – TC – RC – penalties, +/- shipping/insurance)



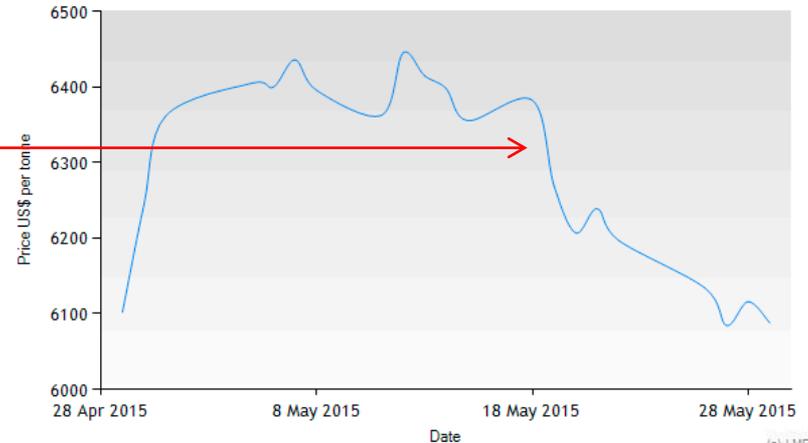
Example: Copper Concentrate Reference Price



Copper concentrate (powder)

Copper Concentrate A: 28% copper, 30% iron, 30% sulphur, gold, silver

LME spot price



Price = (% **copper** * reference price) + (value of gold, silver) - (charges, penalties) +/- delivery terms



Copper – later in the chain



Blister – 99% copper

Source: Jiangxi XinJinye



Anode – 99.4% copper

Source: EPS McGill



Copper cathode – 99.9965% cu

Source: Boliden



WRAPPING UP AND KEY FOCUS QUESTIONS



Some Issues Raised

- Needless to say, understanding the mining industry is essential.
- Each mineral has unique characteristics and market structure.
- Pricing data is not available for every transaction, and some components of a price are more difficult to verify.
 - Eg products with opaque markets
- Other transactions may be embedded in prices (eg project financing, service fees), making TP analysis more difficult.
- This work has limits – elements of price that will be unique to the facts and circumstances of the transaction.
- Verifying prices best if timely.

Broader issues

- Product testing is fundamental
- Wider efforts to obtain information can greatly assist in revenue protection
- Broader revenue policies may be undermining goals



Toolkit on Comparability Data

What is being developed?

- Two part toolkit...

- to assist developing countries address difficulties in accessing comparables data
- presenting approaches to apply internationally accepted principles in the absence of comparables



- Supplementary Work on determining Appropriate Prices for Mineral Commodities

- Helping to understand the value chain of three minerals





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