Worked Examples – Trade in Metal Ores and Products

Version – 15th January 2024

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Instructions

It is important that you watch the tutorial videos on trade in metal ores and products before using this workbook. You should then try to complete the example tasks using what you have learned there, before checking against the solutions provided. These examples are intended as reinforcement learning rather than the primary instruction tool.

For the following exercises, use any or all the data provided to try attempt to calculate the trade account elements you can derive from the information given. The solutions provided are not necessarily prescriptive, but illustrate a reasonable way to proceed.

Situations where you have access to data suited for use in the Metals_Exports_Tool or Metals_Imports_Tool are adequately covered in the first of the main tutorial videos and won't be revisited here. The following examples concentrate on situations where data availability is more limited and disparate, but still sufficient to at least attempt to make estimates. The importance of assembling and structuring disparate data from multiple sources, then exercising your judgement, is emphasised.

Example – Ores, concentrates, near primary metals

Here we will go through the process of using similar data to the type encountered in the tutorial video on using fallback methods for compiling metal ores and products trade data.

The compilation process there emphasises the need to flexibly assemble the various data inputs you do find, then use your judgement to establish a hierarchy of data. Some will be directly useful, some can be used provisionally to refine calculations, and some is largely irrelevant or unreliable.

A key element here will be engaging with the process of thinking through what extra data you would search for at each stage to move your calculations and compilation forward.

Also, know that the solution provided is not necessarily exclusive of others, and that the approach you have reached independently may also work and be valid. Indeed, using the data to reach a similar outcome independently will probably prepare you better than simply replicating the prepared solution.

Your initial search to find data for exports of items which are likely to involve large tonnages metal ores and products has found that a national statistical office or other agency is already publishing some data on exports of major metals products commodities, and at least two major mining companies are publishing annual reports which contain data on their sales of commodities. Comtrade also has some relevant data, but not much (i.e. no mention of the iron exports)

These sources have enabled you to assemble an initial table shown as in Table 1.

Initial data and targeting subsequent searching.

Table 1 Ad hoc compilation of data from initial searching

Source	Year	Description	Tonnes	Comments
Mine_Operator_A	2021	Iron ore ROM	2,200,000	Sales data from company annual report
Mine_Operator_A	2021	Iron ore fines	26,600,000	"
Mine_Operator_A	2021	HBI iron briquettes	3,200,000	"
Mine_Operator_B	2021	Iron ore and fines	59,000,000	"
National statistics office	2021	Iron ore and concentrates	125,000,000	Data from NSO commodity exports "fact sheet"
National statistics office	2021	Iron and steel inc. semi-finished products	2,200,000	"
National statistics office	2021	Ferro-nickel and stainless steel	300,000	"
Mine_Operator_A	2021	Zinc concentrate	800,000	Sales data from company annual report
Mine_Operator_A	2021	Copper concentrate	500,000	"
National statistics office	2021	Base metal ores and concentrates	2,000,000	Data from NSO commodity exports "fact sheet"
Comtrade	2021	2617 - Ores and concentrates nec	2,000,000	Comtrade exports data using HS system
Comtrade	2021	7401 - Copper mattes, cement copper	60,000	"
Comtrade	2021	750110 - Nickel, nickel mattes	20,000	"

The following question are to help you reflect on what this data tells us, how the different entries relate to other entries, and what data we would look for next to advance our compilation task.

Question 1:

Which, if any, of the metal ores and products exports categories (e.g. C.2.Fe, C.2.Cu, C.2.nec,…) do we have direct information for an initial estimate of exported tonnage?

Question 2:

Which, if any, of the exported metal content memo item (e.g. C.2.m.Fe, C.2.m.Cu….) do we have adequate information for an initial estimate of exported tonnage?

Question 3:

What data would we look for next?

For Question 1, the NSO figures for Iron ore and concentrates, plus Iron and steel inc. semi-finished products, should give a reasonable initial figure for C.2.Fe.

The concordance on the compiler from HS to MFA categories currently indicates that ferro-nickel goes also goes into the C.2.Fe. category, however by far the most valuable metal component is its nickel. This highlights why estimating the individual metal content memo items should always be done where practicable.

For Question 2, we have no data specified at this point for the metal content of any of these products, so we can't estimate any of the memo items yet.

For Question 3, we know that we should search for data on metal content for all of the products listed.

Beyond that, we notice that both Comtrade and the NSO data for the non-ferrous base metals (NSO - Base metal ores and concentrates, Comtrade - 2617 - Ores and concentrates nec.), at 2 million tonnes, suggest that the total of from Mine_Operator_A on Zinc and Copper concentrates (1.3 million tonnes) isn't enough to cover all exports in this category. This means we should look for concentrate exports from additional operations.

Also we can't simply assume that all, or even any sales of the zinc and copper concentrates are exports. They may be sales to a domestic refiner, so we should look for information on that as well.

To proceed, we would expand our initial table as shown in Table 2, and begin searching for data to address the gaps we've identified.

Table 2 Initial targeted expansion of ad hoc table to focus subsequent searches

Source	Year	Description	Tonnes	Metal content (grade, ppm)	Metal content (total, tonnes)	Comments
Mine_Operator_A	2021	Iron ore ROM	2,200,000			Sales data from company annual report
Mine_Operator_A	2021	Iron ore fines	26,600,000			"
Mine_Operator_A	2021	HBI iron briquettes	3,200,000			"
Mine_Operator_B	2021	Iron ore and fines	59,000,000			"
National statistics office	2021	Iron ore and concentrates	125,000,000			Data from NSO commodity exports "fact sheet"
National statistics office	2021	Iron and steel inc. semi finished products	2,200,000			"
National statistics office	2021	Ferro-nickel and stainless steel	810,000			"
Mine_Operator_A	2021	Zinc concentrate	750,000			Sales data from company annual report
Mine_Operator_A	2021	Copper concentrate	500,000			"
National statistics office	2021	Base metal ores and concentrates	2,000,000			Data from NSO commodity exports "fact sheet"
Comtrade	2021	2617 - Ores and concentrates nec	2,000,000			Comtrade exports data using HS system
Comtrade	2021	7401 - Copper mattes, cement copper	60,000			"
Comtrade	2021	750110 - Nickel, nickel mattes	20,000			"

Data synthesis and final selection

In this section we'll step through a hypothetical example of the process of integrating further data, by the end of which we might have a table assembled which looks similar to Table 3.

First we look at the ferrous ores and products. Mine_Operator_A's annual reports had considerable detail, including the metal content (grade) of the two main ore streams (ROM and fines).

They didn't provide data on the metal content of the hot briquetted iron production, however, so we looked for more general data on this product, and find that it seems to be a fairly standardised product with a reasonably narrow range of iron content, with 92% being mid-range.

Mine_Operator_B doesn't provide grade data, but does provide data on total contained metal directly. Either quantity (contained metal or grade) coupled with tonnage data, can be directly and easily converted into the other i.e.

Grade = total contained metal / tonnage

Note: Values in blue text in Table 3 have been calculated by combining other data in the table.

Next we have the NSO data indicating that the total tonnage of Iron ore and concentrates exported is 125 million tonnes. The direct data from mine operators only accounts for 91 million tonnes, but further searching online indicates that there is at least one other significant iron ore exporter operating. For whatever reason (perhaps it is a private company, with no shareholder reporting obligations), there is no separate data on tonnages or grade from this operation.

In this situation, you could estimate an average grade for iron ores and concentrate exports for the whole country, using the volume weighted average of exports from the two operations which do provide detailed data i.e.

Average grade = Total metal content / total ores and concentrates tonnage

= (1,438,800 + 16,758,000 + 2,944,000 + 37,760,000) / (2,200,000 + 26,600,000 + 3,200,000 + 59,000,000)

= 0.647262

You would then use the larger NSO tonnage as the relevant tonnage for iron ores and concentrates, and calculate total contained iron by applying the calculated average grade. This has been done in Table 3. This single row would now serve as the one line from the first five rows to be used for further compilation.

The next row, for Iron and steel inc. semi-finished products, is also likely to go through to the final compilation. It has been differentiated from stainless steels, so in the absence of more information, we'll assume that it is dominated by low alloy steels, and so perhaps 98% iron.

The Ferro-nickel and stainless steel row presents a challenge and should be investigated further. While ferro-nickel's main component by weight is iron, as mentioned in the tutorial videos, we should pay attention where other contained metals likely to be more significant in terms of both value, and in global flows for those metals.

In this case we'll assume that we couldn't find any further direct local data, except that it is heavily dominated by ferro-nickel rather than stainless steel. This helps, as it is easy to search and ascertain that stainless steel has a very wide range of common compositions (e.g. https://eagletube.com/resources/chemical-compositions/), ranging from zero nickel and 10% chromium content to > 20% chromium plus > 20% nickel, as well as significant other alloying metals such as molybdenum and copper.

While ferro-nickel also has considerable variation, it is very likely to be > 20% and < 40% nickel, with iron dominating the balance. So we can reasonably use the lower boundary to find the minimum nickel metal contained in this export, and later add that to the C.2.m.Ni memo item.

This allows us to break the ferro-nickel out into two rows, one to calculate iron content, and the other for nickel. Apply the 20% (200,000ppm) minimum grade to the nickel content, and assume the remaining 80% is iron.

The end result is significant here. While the 80% iron content in ferro-nickel exports won't add significantly to total C.2.m.Fe, the contained nickel will dominate the country's export flows of nickel, at over ten times the C.2.m.Ni contained in its nickel and nickel mattes exports.

It would also be much more significant in global terms, at 5-10% of global annual nickel production, as compared to far less than 0.1% of iron production. This last is the strongest reason why ferro-nickel should be concorded to C.2.Ni rather than C.2.Fe.

Table 3 Form of compilation table prior to final data comparison and selection

Source	Year	Description	Tonnes	Metal content (grade, ppm)	Metal content (total, tonnes)	Comments
Mine_Operator_A	2021	Iron ore ROM	2,200,000	654,000	1,438,800	Tonnage (sales) and grade data from company annual report.
Mine_Operator_A	2021	Iron ore fines	26,600,000	630,000	16,758,000	"

Mine_Operator_A	2021	HBI iron briquettes	3,200,000	920,000	2,944,000	Tonnage (sales) from company annual report, metal content from https://www.metallics.org/hbi.html
Mine_Operator_B	2021	Iron ore and fines	59,000,000	640,000	37,760,000	Tonnage (sales) and contained metal from annual report. Same source indicates most/all exported
National statistics office	2021	Iron ore and concentrates	125,000,000	647,262	80,907,750	Tonnage from NSO commodity exports "fact sheet", grade derived volume weighted average from other mines above
National statistics office	2021	Iron and steel inc. semi-finished products	2,200,000	980,000	2,156,000	Tonnage from NSO commodity exports "fact sheet", Steel assumed to be 98% Iron
National statistics office	2021	Ferro-nickel and stainless steel (Fe)	810,000	800,000	648,000	Tonnage from NSO, survey of online sources indicate 20% conservative estimate for Ni content.
		Ferro-nickel and stainless steel (Ni)	810,000	200,000	162,000	"
Mine_Operator_A	2021	Zinc concentrate (Zn)	780,000	550,000	412,500	Tonnage (sales) and grade data from company annual report. Same indicates most/all exported
		Zinc concentrate (Pb)	780,000	43,000	32,250	"
		Zinc concentrate (Ag)	780,000	300	225	"
Mine_Operator_A	2021	Copper concentrate (Cu)	500,000	310,000	155,000	Tonnage (sales) and grade data from company annual report. Same source indicates most/all exported
		Copper concentrate (Au)	500,000	25	13	"
National statistics office	2021	Base metal ores and concentrates	2,000,000			
Comtrade	2021	2617 - Ores and concentrates nec	2,000,000			
Comtrade	2021	7401 - Copper mattes, cement copper	60,000	500,000	30,000	Grade of 50% chosen as conservative estimate from ranges encountered in web searching (approx. 40-80% Cu in matte, > 75% in cement)
Comtrade	2021	750110 - Nickel, nickel mattes	20,000	400,000	8,000	Grade of 40% conservative estimate (approx. 30 – 60% for matte, > 80% for "Nickel")

Moving on to the other metal ores and concentrates, Mine_Operator_A has reported similarly detailed data on tonnage and grade for its other mining operations as it did for iron. This makes calculating both ore and concentrates, and the contained metal memo item components from that source, straight forward, i.e.

$$total\ contained\ metal\ =\ tonnage\ x\ Grade$$

This has been done in Table 3.

Other data we have includes a figure of two million tonnes of metal ores and concentrates from both a national statistical office, and Comtrade, some additional tonnages of more concentrated forms of copper and nickel from Comtrade, and some deliberately conservative grades for these products surmised from web-searching.

The agreement between the Comtrade and NSO figure of two million tonnes, and the fact that only 1,280kt of than can be accounted for by Mine_Operator_A's zinc and copper concentrates, indicates that we could reasonably infer the difference (720kt) as an additional export of non-specific (but non-ferrous) metal ores and concentrates. In the absence of further information, however, we would not try to convert that to an additional contained metal memo item.

At the end of the process above, you could manually add the individual tonnages of products, and any associated metal content memo items, to the relevant categories on the Compiler's "Table C".

An easier option in this case, however, would be to go via the Metals_Exports_Tool, in a similar way to that detailed for situations where you have more detailed operator data (in the "Metal Ores and Products Trade – Practical compilation using preferred method" tutorial).

Table 4 Selected data as transferred to "Metals_Exports_Tool" on the Compiler.

Product Batch Label	Year	tonnes	Compilation category	Metal	Concentration (ppm)
NSO_Fe_OreAndConc	2021	125,000,000	C.2.Fe	C.2.m.Fe	640,000
NSO_IronAndSteel	2021	2,200,000	C.2.Fe	C.2.m.Fe	980,000
NSO_FerroNickel	2021	810,000	C.2.Ni	C.2.m.Fe	800,000
NSO_FerroNickel	2021	810,000	C.2.Ni	C.2.m.Ni	200,000
MineOp_A_ZnConc	2021	750,000	C.2.Zn	C.2.m.Zn	550,000
MineOp_A_ZnConc	2021	750,000	C.2.Zn	C.2.m.Pb	43,000
MineOp_A_ZnConc	2021	750,000	C.2.Zn	C.2.m.Ag	300
MineOp_A_CuConc	2021	500,000	C.2.Cu	C.2.m.Cu	310,000
MineOp_A_CuConc	2021	500,000	C.2.Cu	C.2.m.Au	25
NSO_BaseOresAndConc_Unattributable	2021	720,000	C.2.compound		
Comtrade_MatteAndCemCu	2021	60,000	C.2.Cu	C.2.m.Cu	500,000
Comtrade_MatteNi	2021	20,000	C.2.Ni	C.2.m.Ni	400,000

The data you would enter in the latter approach would be as shown in Table 4. Key things to check that you understand in this final table for this exercise are:

1. Why the original iron ore and briquette tonnages data from Mine_Operator_A were not transferred.
2. Where the concentration used for iron for NSO_Fe_OreAndConc came from.
3. Why the Ferro-nickel has been classified as a nickel product rather than and iron product.
4. How the tonnage for NSO_BaseOresAndConc_Unattributable was derived.