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Export controls and competitiveness in African mining and minerals processing industries

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EXPORT CONTROLS AND COMPETITIVENESS IN AFRICAN MINING AND MINERALS PROCESSING INDUSTRIES

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Governments may decide to control the export of unprocessed raw materials hoping that this will promote local downstream industries. There is scant empirical examination of the actual outcomes of such policies put in place. This paper describes use of export control measures by four minerals-rich African countries and looks for effects on activities downstream from the extractive sector that may be attributed to these measures. The measures studied are export taxes, non-automatic export licensing requirements and outright export bans. The industries are manganese in Gabon, lead in South Africa, copper in Zambia and chromite in Zimbabwe.

For the empirical analysis the Revealed Comparative Advantage (RCA) index is calculated tracking over 20 years the relative global performance of the local mining and processing industries, for the specific minerals studied. The effect of the restrictive measures is investigated by way of identifying structural breaks in the level of the RCA index, for both the raw mineral and related processed products.

The results suggest that use of export restrictions as a tool for stimulating local mineral processing does not pay off. There was no improvement in the revealed comparative advantage of processed products presumed to benefit from export controls on the raw material. Moreover, the measures may have undermined the overall performance of the industries in some of the cases studied because the relative export performance of the mined minerals deteriorated.

JEL codes: F1, F2, L7, O1.

Key words: Export restrictions; export control measures; export tax; export licence; export ban; Africa; minerals; mining; minerals processing; value chain of mining; revealed comparative advantage; RCA; structural break; international trade.

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EXECUTIVE SUMMARY

The minerals and metal sector in Africa is heavily affected by export control measures of raw materials. Export control measures are amongst the tools which governments employ with the aim to encourage local processing and capture more of the value flowing from minerals extraction. By putting restraints on the export of raw materials, governments hope to divert these materials to the domestic market, thereby supporting local activities to process these materials and employment. But export restrictions can also have costs for countries employing them; in particular, they can lower the returns on raw materials production and entail efficiency costs for the economy overall.

The four case studies selected for the analysis concern the manganese sector in Gabon, the primary and secondary lead sector in South Africa, the copper sector in Zambia and the chromium sector in Zimbabwe. These cases cover a variety of conditions: they concern different types of minerals (base metals, minor and technology minerals), employ different kinds of export control policies, and the number of potential downstream activities differ significantly.

The report describes developments in the industries over a 20-year time span from 1992 through 2013. It examines the revealed comparative advantage and uses structural break methods to determine whether changes have occurred in the relative competitiveness of raw and related processed products and whether these could be attributed to export control measures. The focus of the analysis is on the processing at the early stages of the value chains of these industries.

The selected countries differ in the level of vertical diversification achieved in the course of the twenty years studied. All of them have a revealed comparative advantage in the mined metal, but their export performance in processed products is weak or at best very narrow. This report finds that export control measures on raw materials have not promoted downstream processing activities in any of these countries, and in some cases have led to substantially negative effects on the primary sector.

In the minerals and metal sector the availability and price of the primary (and secondary) raw materials are key determinants of production at subsequent stages of the value chain. However, availability and price alone are not sufficient conditions for processing to take place on a globally competitive basis. Minerals processing industries typically consume large amounts of energy and water and employ a high skilled labour force. Proximity of sales markets and the state of infrastructure influence transport costs, another important co-determinant of global competitiveness.

A growth and jobs strategy founded on export restrictions on raw materials risks to overlook other domestic factors that are equally important to achieve global competitiveness on a sustainable basis. A systematic stocktaking and comparative analysis of the overall enabling environment seems well advised.

I. Introduction

Many African countries have significant mineral and metal deposits but limited processing capacity. For these countries, the exploitation of raw materials in general and minerals and metals in particular provides a crucial link to global markets and value chains. To develop industry and to capture more value from minerals and metals, many African countries have employed policies that restrict their exportation. This paper explores the empirical consequences of such export control measures.

For producer countries, such measures may bring local industries using the restricted raw material some economic and social benefits, but export restrictions also lower the returns on production of raw materials and generate efficiency costs. Export controls also have adverse effects for consumer countries, including higher prices.

The study finds no evidence that export restrictions have in practice influenced the economic activity downstream from the extractive sector in specific minerals industries. This finding emerges from an analysis of developments in the mining and processing segments of the local value chains of industries in four African countries, Gabon, South Africa, Zambia and Zimbabwe, reported here. These countries all produce and export mineral ores, have used export control measures and made efforts to expand the benefit they derive from these resources through more local processing. The industries studied are copper, chromite, lead and manganese.

The paper describes development in these four industries from 1992 to 2013 and examines detailed export data using the Revealed Comparative Advantage (RCA) index and structural break analysis to determine whether changes have occurred in the relative competitiveness of raw and processed products belonging to the same metals industries that may be attributed to export control measures which the countries have applied. The analysis uses mirror statistics as reported by the importing countries, as these tend to be more reliable and to some extend rectify the large observed discrepancies between nationally reported export data and import data.

The study is timely because attempts to stimulate processing industries are contributing to the proliferation in recent years of export control measures worldwide. The next section reviews the incidence of these measures and how activities downstream from mining may benefit from policies that restrict the export of inputs, among other effects predicted by trade theory. Section III provides a stylised description of the industries and restrictive policies studied. Section IV explains the RCA and structural break methods used for exploring the direct and indirect effects of export restrictions on the relative competitive position of metals in their raw and processed form and presents the results of the empirical assessment of detailed trade data. Section V summarises the findings and concludes.

II. Do export restrictions promote downstream processing?

To promote downstream industries in the minerals sector is one of the reasons why governments resort to export control measures. Use of export restrictions has become more frequent in recent years, both in terms of countries applying export restrictions and the number of products affected. The minerals sector is a favourite target. This development has prompted the OECD (2010, 2014) to analyse the use of restrictive measures and their economic effects.

Incidence of export control measures

A stock-taking by Solleder (2013) of export taxes across all sectors finds that the majority of products affected by export restrictions are from the extractive industries, and that within those industries minerals and metals dominate. Forty-two African countries imposed export taxes on at least one product at least once in the period 2007-12.

The OECD's Inventory of Restrictions on the Export of Raw Materials tracks, since 2009, a broad range of export restrictions applied to some 80 different industrial raw materials in their raw (ore), secondary (waste and scrap) and semi-processed forms. The survey covers some 100 countries, including 26 African countries.[1] Of these, 21 had at least one active export restriction in place during 2009-12, the period for which Inventory data were reviewed for this study. These countries accounted for 18% of all export restriction entries recorded at the HS6 product level for 2012. The dataset shows that national approaches vary in the choice of policy tool. Some countries have used export taxes, others quantitative measures (export quotas or prohibitions) or export licensing schemes or various other types of policy interventions. Sometimes countries apply export controls simultaneously to several minerals at the mining stage. For example, in South Africa export licensing requirements apply for a long list of minerals, and exported diamonds are taxed. Where information about the rationales or policy objectives is available in the OECD dataset, a recurrent theme is that governments, including ten African governments, wish to promote or protect the local industry or safeguard domestic supply.

Gabon, South Africa, Zambia and Zimbabwe, the countries selected for study, are among the African countries for which export control measures on unprocessed minerals at the mining stage are recorded.

The economic effects of export restrictions

The theory of trade policy helps understand why governments wishing to promote local transformation of raw materials into higher value products find export taxes or other export control measures attractive.

When *export taxes* are applied, this raises the price of raw material for foreign buyers and reduces supply of mined raw materials from going abroad. More of the raw material becomes available for local use, at below world market price. This can lead processors and other industries using the raw material as input to expand and sell their output at a lower price. The effect is similar for *quantitative restrictions* (if the level of demand increases over time, the price effect of quantitative restrictions will be greater). In the extreme case of an *export ban*, exports of the mined raw material will cease altogether and this may cause its domestic price to fall steeply if a large amount of the commodity previously sold abroad swamps a small domestic user market.[2] In the case of a *non-automatic export licensing requirement*, firms that wish to sell abroad have to go through the process of obtaining prior approval, in the form of a license or permit, before they are able to ship the product. By deciding, on a case-by-case basis, who can export and how much, government authorities can control the quantity of export. Uncertainty and the extra costs in time and sometimes payments (license fees) for obtaining an export license are likely to discourage at least some supplier firms from looking for sales opportunities abroad and importers abroad from placing orders.

If industries that are located downstream from the extractive sector can source the restricted raw material at a lower price, they can sell their products at a cheaper price than would be otherwise be possible. In other words, export restrictions act as an indirect subsidy to the production costs of these industries, enabling a country to export these products at a relatively cheaper price that therefore may get a larger share of the export market. In the vertical structure of the minerals industries, metal smelting, refining and the manufacture of semi-fabricated metal products are activities sufficiently close to the extractive sector in the value chain to benefit when more and cheaper raw material becomes available, among other factors of production. These activities may expand and export more if the cost or supply advantages conferred indirectly by export restrictions are large enough to make expansion profitable. Profitability implies that the higher-value products are able to compete successfully in the domestic or international market (Piermartini, 2004). If this is the case, one would expect to see export activity at the industry level diversify away from the mined raw material and the share of (indirectly subsidised) processed products in the country's overall export activity rise relative to that of the rest of the world, ceteris paribus. Economies can benefit from downstream production in many

1. The OECD Inventory of Restrictions on the Export of Raw Materials can be accessed at http://qdd.oecd.org/subject.aspx?Subject=ExportRestrictions_IndustrialRawMaterials. The analysis is based on records in the OECD Inventory of Restrictions on Exports of Raw Materials accessed in April 2015.

2. For a detailed exposition of the trade and welfare effects of export taxes and quantitative restrictions: Fung and Korinek (2013).

ways, including through higher and more stable export earnings resulting from a more diversified export offer, more employment, the acquisition of skills and more advanced technology and linkages to other sectors.[3]

While in theory domestic industries operating downstream from the extractive sector may benefit from these measures, they have also negative effects, which governments seldom acknowledge. There are costs borne by producers of the primary raw material. Their returns, profits and welfare will diminish and this may lead them to cut back existing mining operations or new investments. Export control measures therefore should affect the export competitiveness of unprocessed minerals, i.e. ores and concentrates, negatively. If the country supplies a significant share of world exports of a raw material, a policy of controlling exports may also have negative spill-over effects on the international market. It may raise the world price and hurt other countries that buy the raw material.

Few empirical studies of the economic and welfare effects of export restrictions focus on the linkage between the intended policy objectives of these measures and actual outcomes, at the country and product level (for an overview of existing literature, see Solleder, 2013). Some other work has scrutinised the use of export restrictions for environmental protection purposes etc. (e.g., Korinek and Kim, 2010), but studies examining the role that export restrictions has played in the development of downstream industries are notably scarce, especially in minerals sector.[4] This is motivating the question explored by this study: what, in practice, have been the effects of export control measures on the downstream activities in Gabon, South Africa, Zambia and Zimbabwe?

Detailed production statistics for individual raw minerals are limited and show quite some discrepancies between different data sources. Furthermore, country-level time series on production within the downstream segments of the mineral value chain is spotty, and production and export figures are not necessarily comparable because expressed in different units (e.g. metal content for production but not for exports and imports). Nor is information on domestic prices and production costs of the companies that mine and process in a country, which would provide a direct measure of competitiveness, readily available. Therefore, the question of the effect of export restrictions on domestic production and prices is investigated by examining countries' relative competitiveness of mining and processing activities as expressed though indices of revealed comparative advantage (RCA) computed from trade statistics, and looking for shifts occurring in the level of competitiveness that possibly can be attributed to export restrictions. The RCA index is a revealed measure and thus does not captures the underlying sources of international competitiveness like for instance production cost, factor endowments and government support.

III. The African industries and export control measures

The industries selected for study are manganese in Gabon, lead in South Africa, copper in Zambia, and chromite in Zimbabwe. The availability of trade data at the HS 6 level of product classification for the mineral products was an important criterion for selecting the countries and products studied, as was the year in which the export control measures studied were introduced and how long they were left in place.

The study period is 1992 through 2013, some 20 years. Considering that it may take time for the effects of some of the export control measures to show up in trade (e.g. processing facilities will have to expand or be built), this is sufficiently long to explore the impact of the selected export control policies using structural

3. For discussion of how raw materials processing may contribute to economies' growth and development and what enabling conditions must be present for local processing industries to be viable: Economic Commission for Africa (2004); Republic of Zambia (2006); Government of Canada (1998); Commonwealth of Australia (1991).

4. The effects of export tariffs or other export restrictions on downstream industries have been the subject of study in the forestry sector. Log export restrictions of various countries have been investigated. A common finding of these studies is that export restrictions reduce harvest and export revenues, whereas the increase in downstream production of forest products is modest (Solberg et al., 2010).

break analysis. Still, for some cases the number of observable *ex post* years is relatively short - four to five years.

Per World Bank income classification, Zimbabwe is a low-income country, Zambia is a lower middle income country and Gabon and South Africa are upper middle income countries. The minerals sector is the dominant sector in all four economies, with exports depending on a few specific minerals (e.g. Zambia - copper and cobalt; Gabon – oil and manganese). All countries have for many years pursued the goal of increasing the benefits from their mineral resource base. National programmes have stressed the need and determination to diversify the economic base and national exports downstream from mineral extraction (vertical export diversification).

The countries, industries, and export control measures are shown in Table 1. Gabon, Zambia, and Zimbabwe have employed ad valorem export taxes that ranged from 3.5% to 20%. Zimbabwe banned chromite exports in 2007, switched to an export tax in 2010 and then back to the ban in 2011. In South Africa firms have had to obtain export licenses. In Gabon and Zimbabwe the measures apply to ores and concentrates, whereas in Zambia and South Africa processed products are also affected. In their original or in some modified form all of these export control measures were still in effect in 2013.

Table 1. The selected country cases

Country	Mineral ore and concentrate	Export control measure	Year of introduction	Relative rank in global ore production (2013)	Relative rank in global ore exports (2013)
Gabon	Manganese	Export tax (3-3.5%)	1999	4th	3rd
South Africa	Lead	Non-automatic export license	2008	16th	10th
Zambia	Copper	Export tax (15%) Export tax suspended, then reinstituted	2008 2013	7th	46th
Zimbabwe	Chromite	Export ban Export tax (15-20%) Export ban	2007 2010 2011	14th	44th

Note: * Data is for 2012.
Sources: OECD Inventory of Restriction on Export of Raw Materials (as of April 2015) and other sources cited for a measure in Part III of this paper. Production and exports: own calculations based on data from the British Geological Survey (2014) and UN Comtrade (2014).

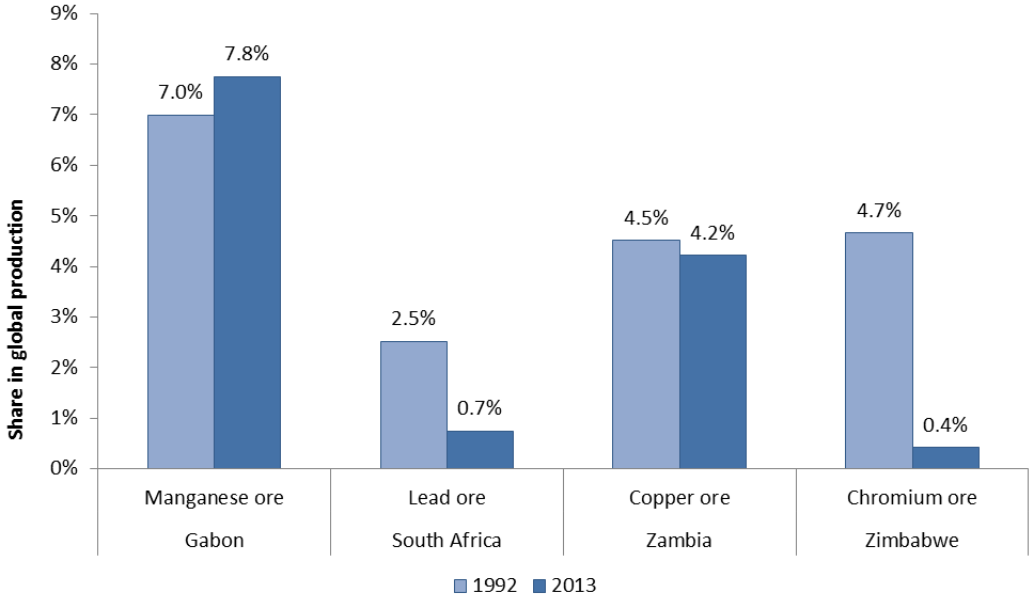
The last two columns of Table 1 show the countries' respective ranks in global production and exports. Only Gabon and Zambia are relatively large global players in their respective mining sectors (manganese, copper), and only Gabon holds a strong position as a leading exporter on the world market.

Given how fast world supply of the minerals has grown over the last two decades these are weak scores. As can be seen from Figure 1, with the exception of Gabon the countries have not sustained their shares in global production.

Figure 2 shows the share in global exports of each of the selected countries. Gabon is a major player in the international market for manganese ores and concentrates. Almost all countries experienced deterioration in their position in global trade.

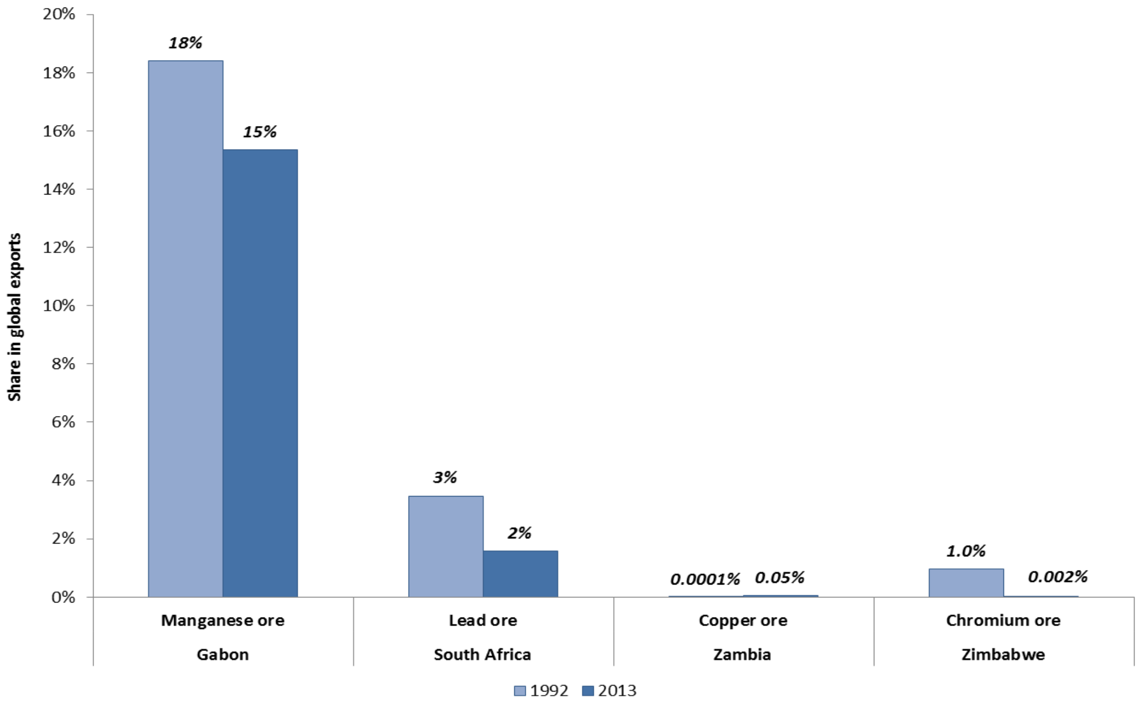
When it comes to processing mineral ores into more finished products, the picture blurs because forward linkages are complex, differ across minerals industries and statistics are limited. According to the ITC (2012), in 2010 34% of all non-oil exports of sub-Saharan Africa consisted of raw products that did not involve any transformation. The share was 23% for other developing regions like Latin America and only 5% in developed regions like the European Union, indicating that Africa has been lagging other regions of the world in value-adding processing downstream from mining and other natural resources. At the country level, according to figures compiled by the US Geological Survey (2013), in 2007 none of the four countries were among the ‘top three processors’ of the respective minerals selected for study. South Africa, Zambia and Zimbabwe seemed to produce metal products at a more advanced stage of transformation than Gabon.

Figure 1. Share in global production of ore and concentrate (1992/2013)



Note: Based on volume figures.
Source: Own calculations based on British Geological Survey data (2015). Figures refer to quantity of ore and concentrate output.

Figure 2. Share in global exports of ore and concentrate (1992/2013)



Note: Based on volume figures. For Zambia data are 1994.
Source: Own calculations based on data from UN Comtrade (2015).

A more detailed picture of the four countries' processing sectors is provided in the following sections, which gives information about industry characteristics and performance since 1992 and sets the stage for the subsequent empirical analysis. More information is also provided about the export control measures. The information is derived from a review of available official, industry and other secondary sources.

Manganese mining in Gabon

Africa is well represented among the world's leading production sites for manganese ore. Nine African countries produce this ore and jointly accounted for some 30% of global output in 2012. Among them, South Africa, followed at some distance by Gabon and Ghana are the leading producers of the continent and are also among the world's top-10 producers. South Africa has the world's largest reserves of the metal (80%) and ranked second in production behind the People's Republic of China (hereafter "China"), producing approximately 9 million MT annually or 18% of global manganese. Gabon ranked fourth, after Australia (BGS, 2014:74).

Over the period of 1960 and 2000, Gabon saw capital flowing primarily to the oil sector, which resulted in the so-called "Dutch disease" leading to the marginalization of the non-oil sectors, including manganese mining. As of 2014, oil accounted for 81.2% of the country's exports. Manganese was the second largest export item (8.4%) followed by wood products (3.4%) (ITC, 2016).

In 1999, Gabon imposed an export duty ('droit de sortie') of 3% on manganese ore exports. This export tax remained in effect in 2013, at a slightly higher rate (3.5%).[5] No official document explaining what motivated the government to take this action was found. At the time when the measure was introduced, the government was becoming concerned about the economy's dependence on its diminishing oil resource and volatile world oil prices (which declined between 1996 and 2000 and brought Gabon in economic difficulties), and was looking to exploit more vigorously and diversify the country's other main export sectors – manganese in the mining sector and timber.[6] The high-grade (metal content of 48%–52%) deposits in Gabon are reputed to be among the world's richest.[7] Among mining companies and policymakers interest in tapping the potential of this resource increased when global demand for manganese, used primarily in steelmaking, soared in the early 2000s.

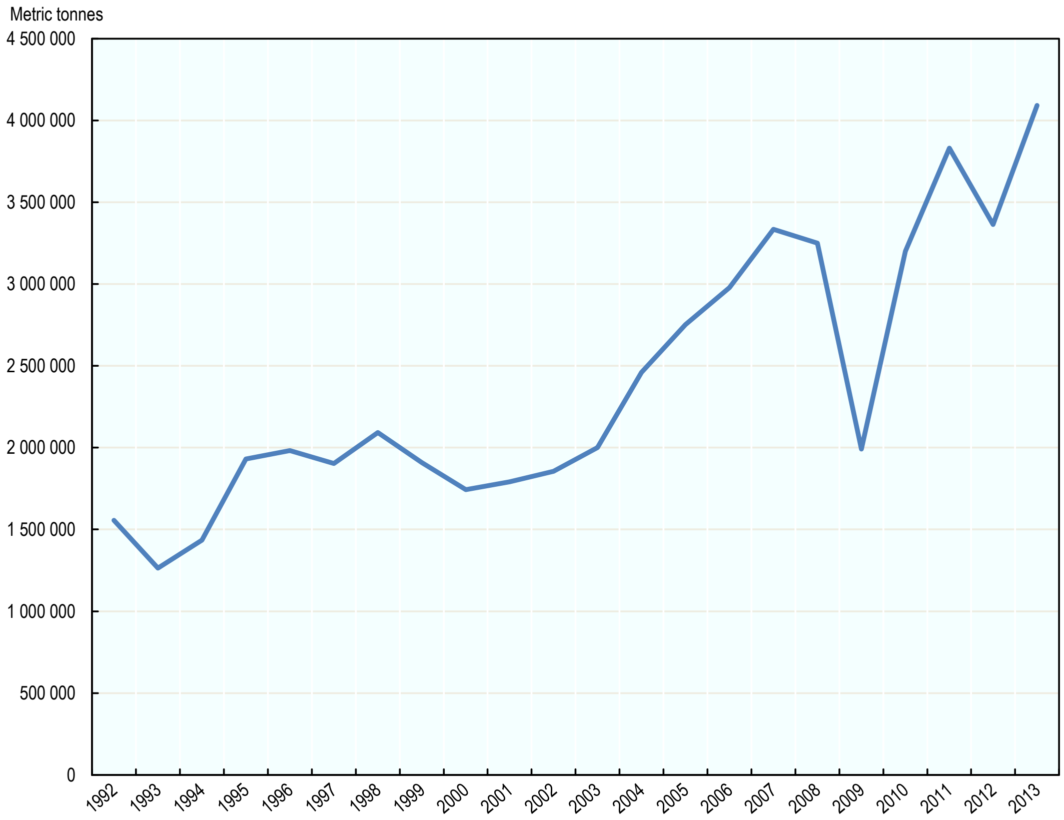
Gabon's production of manganese ore has expanded significantly, as shown in Figure 3. Historically growth of mining was limited by the capacity of the cableway—at 76 km, Africa's longest overhead cable—which transported the mineral to the Congo border, from where it was carried by rail to the port of Pointe Noire. The cableway could transport up to 2.8 million tons of manganese ore a year. With the completion of the Trans-Gabon-Railway in 1987, an alternate export outlet for manganese (and uranium) through the Gabonese port of Owendo became available. The railroad cut shipping costs significantly (Zafar, 2004). Annual production of manganese rose 156% from 1992 until 2013, from 1.56 million MT to 4 million MT. Most of this growth has taken place after 2000, when ore production expanded every year except in 2009, when the world economy went into recession, and in 2012.

5. Confirmation that the export tax was still in effect was received from the government of Gabon during the WTO Trade Policy Reviews of the country conducted in 2001, 2007 and 2013. The 2007 and 2013 Reviews report the rate of the export tax to be 3.5%.

6. In the case of timber, the export of which in unprocessed form the government has regulated for many years using export taxes and other types of export control measures, the stated goal has been to a domestic wood processing industry enabling the country to export wood products of higher value, WTO (2007a:16).

7. Manganese has been exploited at the Moanda Mine by L'Ougoué, which belongs to COMILOG, an international consortium and the second largest manganese producer of the world.

Figure 3. Gabon's production of manganese ore



Note: Mine production is expressed in terms of metal content.
Source: British Geological Survey, World Mineral Production, various issues.

Around 90% of the manganese consumed in the world is used to produce manganese ferroalloys, consisting of various grades of ferromanganese and silico-manganese, and ferro-metals for use in iron and steel making (Corathers, 2002). Hence, the trend of global demand for manganese closely follows that of the steel industry. Manganese also is a component of certain aluminum alloys and, in oxide form, dry cell batteries. Non-metallurgical applications include animal feed and fertiliser (ibid).

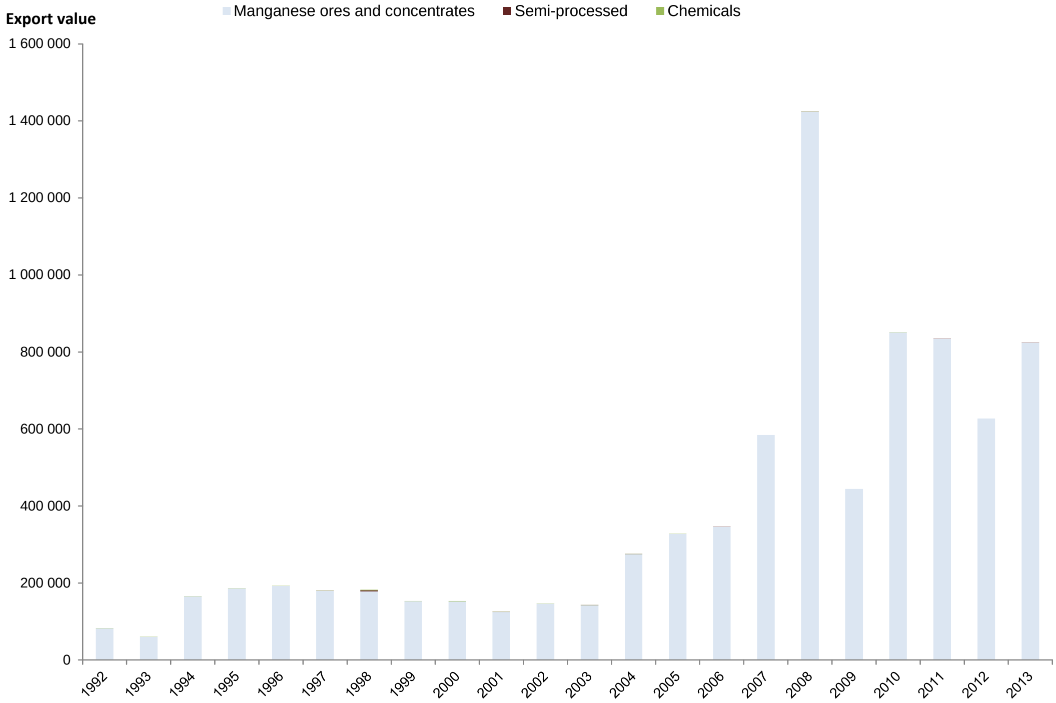
Gabon has no significant forward linkages into production downstream. Most processing takes place abroad. This is illustrated in Annex 4 for ERAMET, one of the top five manganese producers worldwide. ERAMET mines manganese through Compagnie Minière de l'Ogooué (COMILOG), which it owns jointly with the Gabon government, and then processes the raw material abroad to obtain manganese metal and silico-manganese, which is a crude alloy of silicon, manganese and some iron used especially in the manufacture of alloy steel.

Gabon inaugurated its first domestic processing plant, the so-called Moanda Metallurgical Complex (Complexe Métallurgique de Moanda) only in early 2015. Owned by COMILOG, the Complex is expected to produce 65 000 MT silico-manganese and 20 000 MT manganese metal annually and create some 500 direct jobs.[8] Some other processing facilities are reported being under construction or planned.

8. Inauguration of Moanda Metallurgical Complex in Gabon on June 12th by Ali Bongo Ondimba, President of the Gabonese Republic, and Patrick Buffet, Chairman and CEO of the ERAMET Group, Press release by ERAMET of 15 June, 2015.

Gabon's exports have consisted almost exclusively of manganese ore and concentrate. Semi-processed products barely show up in the composition of the country's exports of manganese products in Figure 4. Gabon's imports of manganese products are not shown but have been marginal over the last two decades and consisted predominantly of occasional imports of manganese ore and concentrate from the region.

Figure 4. Gabon's exports of manganese products



Note: Export value is in USD.
Source: Own calculations based on data from UN Comtrade (2015).

The new government coming to power in 2009 has made diversification its highest priority. The promotion of local processing of primary materials and export of high value-added products ("Gabon Industriel") is one of three pillars of an ambitious plan for turning Gabon into an emerging economy (see Annex 4). It is the vision of the government that by 2025 no raw material extracted from the country's soil should be exported without having been transformed locally.[9] Gabon also wants to become part of a regional metallurgy hub in the Central African Economic and Monetary Community producing and exporting iron-based products to the whole sub-region and beyond. In line with this vision, the government wants to raise the country's manganese production to 5.7 million MT a year and also increase the production of ferromanganese.[10] A new mining code entering in effect in early 2015 includes strong incentives for mining companies to set up processing operations. It requires that future mining concessions have a local processing component (EY's Global Mining & Metals Center, 2015).

Development of downstream activities requires significant investment in supporting infrastructure. The supply of electricity, for example, appears to have reached its limits in Gabon and cannot support more manganese processing plants.[11] Observers familiar with the country's minerals sector cite various other factors

9. *Le Gabon dit stop à l'exportation des matières premières brutes*, www.gabon-industriel.com/l-actualite/toute-l-actualite/26802/le-gabon-dit-stop-l-exportation-des-matieres-premieres-brutes.

10. Nyagah (2014), and a speech by the President available at www.mines.gouv.ga/object.getObject.do?id=730.

11. The electricity consumed by the Moanda Metallurgical Complex is generated by a hydroelectric dam that was built specifically for that project.

- high labour costs (driven by high salaries in the oil sector) and a high cost of services, and governance issues such as transparency and control of corruption - that have hampered the exploitation and management of the country's mineral resources. Another constraint is the small size of the domestic market. Gabon's GDP per capita (USD 4 000) makes it one of the richest countries in Sub-Saharan Africa, but the country's population and local industrial base is small. There is no steel industry or other significant industrial use of manganese (Zafar, 2004). The country has significant iron ore reserves (the second largest in Africa) in the remote northeast, but development will require important investment in transport and other infrastructure, environmental concerns have been raised, and by late 2013 the government had yet to sign major deals with foreign mining companies.

Lead mining in South Africa

More than 40 countries around the world, including South Africa, are currently producing lead. World mine production was estimated to amount to 4.1 million MT (lead content) in 2010, with China, Australia, the United States, and Peru leading the list of producers of lead ore. Along with Morocco, South Africa is the leading producer of lead in Africa but a small player in the world market. In 2007, the year before the government put an export licensing system into effect, the country ranked number seven in world lead reserves and thirteenth in world production of mined lead (primary production).

In addition to mined lead, lead waste and scrap is being recycled and this secondary material accounts for a growing and significant share of global lead supply – around 50% in 2011/12 according to the International Lead and Zinc Study Group (2014).

Lead is a widely used non-ferrous metal, after aluminium and copper. It is consumed in the form of metals as well as in the form of compounds and oxides. According to ILZSG, lead's principal use (around 80%) is for lead-acid batteries used in automobiles and other applications, industrial batteries found in computers and fork lift trucks and for back-up power generation in emergency systems (e.g. in hospitals). Other applications are pigments and compounds, rolled and extruded products, alloys and sheathing material used in cables for use by the construction, glass and plastics industries and for radiation shielding. When used as metal in batteries, cable sheeting and similar products, lead is fully recyclable. Parallel to the production of lead from ore by smelting and refining, there is a thriving industry of lead scrap recycling in South Africa and many other countries.

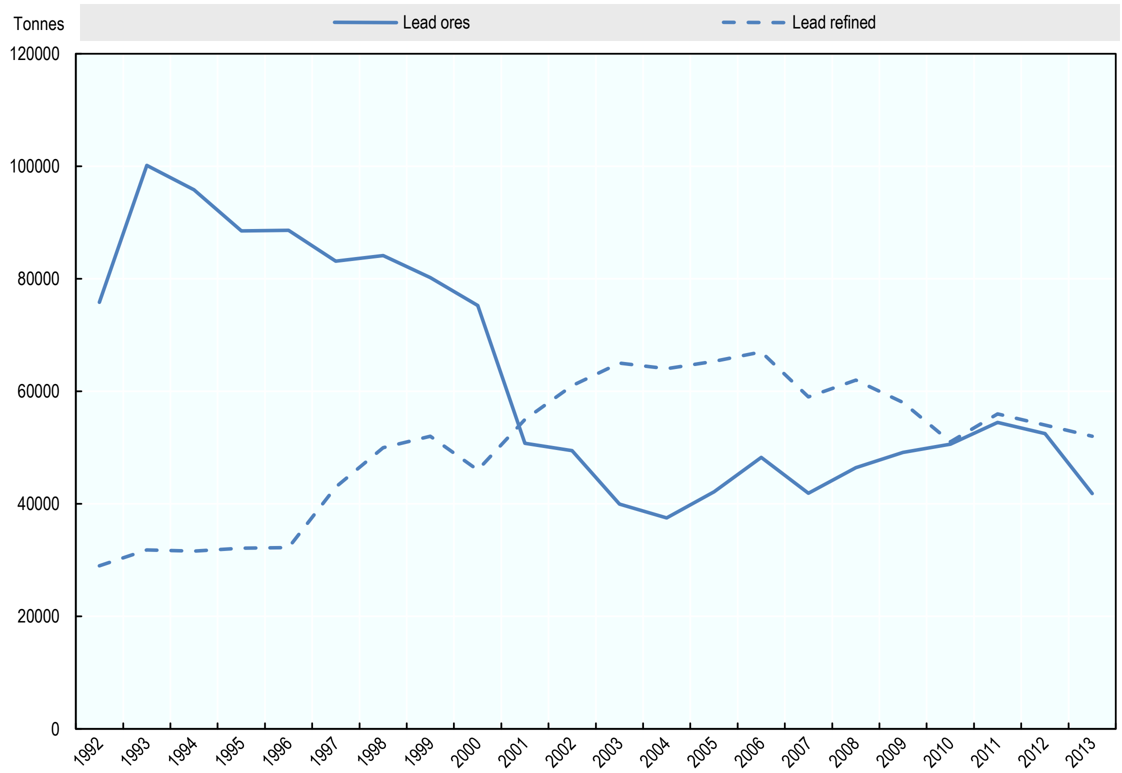
Demand for lead worldwide has been growing and this is expected to continue because of the growing automobile and electric bicycle markets in China and elsewhere (Kropschot and Doebrich, 2011). World consumption of refined lead was 9.2 million MT (lead content) in 2009 and rose to 10.5 million MT in 2012 (ILZSG). The leading countries consuming refined lead are China, the United States, and Germany.

As can be seen from Figure 5, South African lead mining has been in long-term decline. Production declined after 1993, then gradually rose again from 2005 onward. Closure in 2002 of the Pering Mine located in the Northern Cape Province left one lead producing mine in South Africa, the Black Mountain mine located in the same region. This three-decade old mine, which produces also zinc, copper and silver, was taken over in 2010 from Anglo Base Metals by Vedanta Resources of India, the world's largest integrated zinc-lead producer. All of the primary lead ore and concentrate derived from the mine is exported for further treatment to mainly China, South Korea and Europe (ITC, 2016 and DMR, 2014). Vedanta Resources acquired in 2012 another zinc-lead mining project in the region (the Gamsberg Project) which by 2013 had not yet reached its operational stage. Since 2008, the closed-down Pering Mine, too, has been under discussion for the resumption of mining zinc and lead deposits there under new ownership.

When it comes to refined lead produced from mined ore and concentrate (primary refined lead), African output originates mostly from Morocco. South Africa is not a player, having no primary lead smelters or refineries (Van der Merwe, 2008). However, it has established a local industry that recycles lead waste and scrap (e.g., from used automotive and other types of batteries) and according to Yager et al (2007) is the leading producer on the African continent of refined lead derived from secondary material (a share of 86% in 2005, with Kenya, Morocco, and Nigeria accounting for the remainder). Some of the scrap is exported and this activity gained momentum from 2009 onward, but most of this secondary raw material goes to local smelting facilities (which might be able to receive also primary mine concentrates if these are in the form of lead oxides). There are several processors turning scrap into secondary lead and some lead-using manufacturers recycle internally.

Figure 5 shows that, in contrast with declining ore output, production of refined lead has steadily risen from 29 000 MT in 1992 to 67 2000 MT in 2006, after which production of refined lead, too, has slowly declined. Production of refined lead apparently is unable to meet domestic demand, as South Africa has been importing refined lead and the trade balance shows a deficit. World production of refined lead, too, has struggled to keep up with world demand since the early 2000s, the international market being in deficit in most years.

Figure 5. South African production of lead ore and refined lead

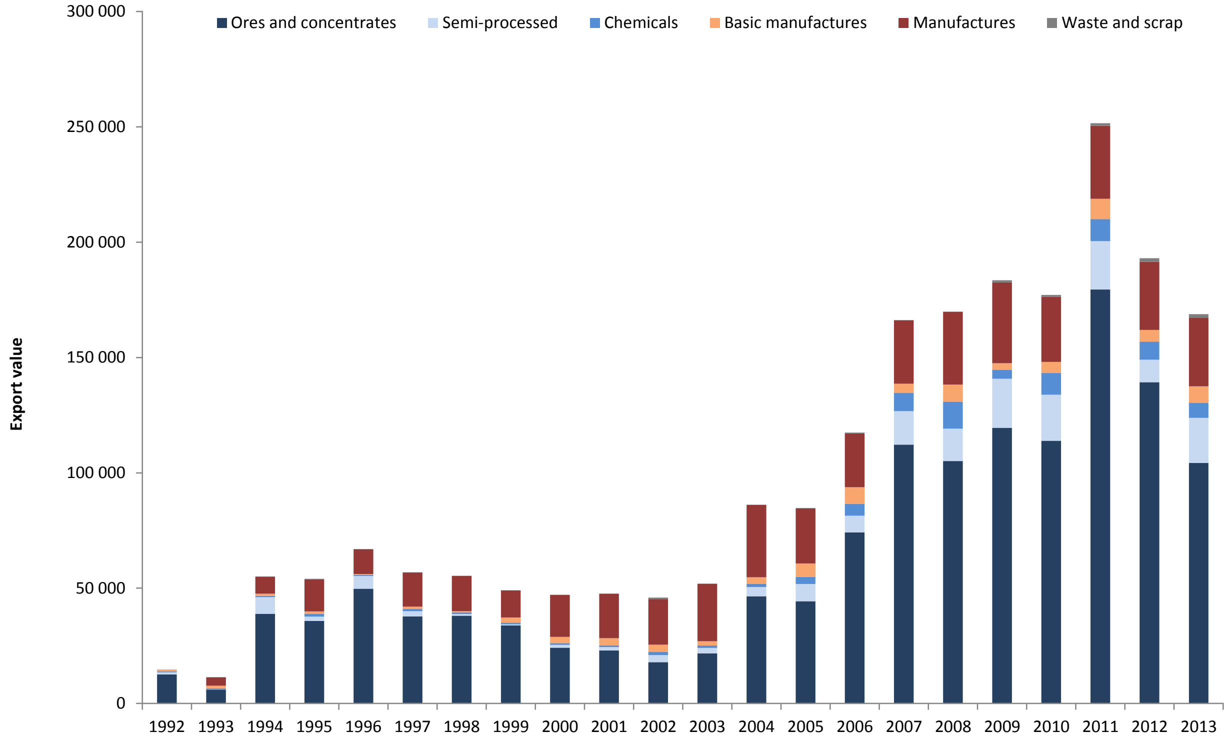


Note: Lead metal content. The refined lead figures shown are for primary and secondary refined lead and include the lead content of antimonial lead. Metal recovered from materials by re-melting alone is excluded.
Source: British Geological Survey, World Mineral Production, various issues.

At the domestic level, the lead industry is very small compared to South Africa's other minerals industries. Still, it is an important supplier of inputs for certain local industries. This is true especially for the automotive industry, which the government has targeted to become one of the strategic sectors of industrial growth. Local manufacturers depending on lead turn out products such as glassware, but especially batteries used in automobiles. Smaller amounts of intermediate lead products are used to produce cable, pigments and ammunition.

As can be seen from Figure 6, the South African lead industry exports a diverse range of products. In value terms, lead ore and concentrate is the dominant export item. Due mostly to the significant rise in dollar lead prices (London Metal Exchange) after 2004 rather than production volume increases (see Figure 5), the share of the extractive sector in total exports has been rising.

Figure 6. South Africa's exports of lead product



Note: Export value is in USD.

Source: Own calculations based on data from UN Comtrade (2015).

Not shown here, South Africa's imports of lead products since 1992 mainly consist of unwrought refined lead. These imports gained momentum during the 2000s and have given rise to a large trade deficit. Imports of some other semi-processed lead products are relatively large and also increasing. Farther downstream, the lead acid battery and glass industries have come under pressure and show a growing deficit in their respective trade balances since 2004.

South Africa shows also a negative trade balance for lead waste and scrap; importing almost four times more than it exported in 2013. Hence, for recycling purposes locally sourced lead waste and scrap is complemented with imported material. As mentioned, all of South African lead mine production is exported and local lead manufactures are made from recycled lead.

In June 2008, the government of South Africa implemented an export permit scheme for a range of metals, including lead. The export permits are issued by the International Trade Administration Commission (ITAC). This export control measure is not confined to mined lead. Besides for primary and secondary lead raw material (ore and scrap), an export permit is required also for exportation of selected lead-based basic manufactures (refined metal).[12] The export control measure is meant to help getting local transformation under way and secure local supply of the raw material.[13] It seems that encouragement of local first-stage

12. On the list of controlled products is unwrought refined lead (ingots); lead bars, rods, profiles and wire (for construction); lead plates, sheets, strip & foil used in the area of radiation shielding and construction; lead powders & flakes, lead tubes and pipes and related fittings, lead waste and scrap, and Other articles of lead. Certain lead products (lead monoxide, lead oxides, and specialty unwrought lead containing antimony) are not listed (Republic of South Africa, 2008).

13. OECD Inventory of Restrictions on the Trade of Raw Materials, http://qdd.oecd.org/subject.aspx?Subject=ExportRestrictions_IndustrialRawMaterials

processing of mined lead ore or scrap material was only one motive. The list of controlled lead products namely includes semi-finished lead products, which suggests that the government wants to make sure that if more processing takes place, the automotive industry and other local users of lead can take advantage of the greater supply rather than it going abroad. As public records of licence applications and denials are not available, one cannot say how restrictively or liberally the licensing system has been applied during the months and years from 2008 onward.

There is evidence of export licences becoming harder to obtain for some products as of 2013. In that year, the government issued Guidelines setting forth conditions that dealers of ferrous and nonferrous scrap metal, must meet before they obtain an export permit. According to these Guidelines, which entered into effect in September 2013, metal scrap could no longer be exported unless it had been offered first to potential domestic buyers, such as foundries, mills or secondary scrap processors, for thirty days at a substantial (20%) discount from the international spot prices. If a domestic sale was made, the volume in the original export permit application would be reduced by the volume purchased by the domestic consumer. If the opportunity was not taken, the application would be processed and an export permit would be issued. This price preference system entered into force in August 2013. It was complemented by other measures that subjected permit applicants and the material they wished to export to more rigorous verification by the authorities.

The move resulted from the government's concern about a growing volume of scrap metal leaving the country to the perceived detriment of local users, notably mills, secondary smelters and foundries manufacturing steel and other products used in the local mining, automotive, construction and agricultural sectors. With prices for scrap rising on the international market, South African foundries and other users reported increasing difficulty to stay in business. The government's action focused on steel and copper scrap but the Guidelines applied also to lead and other scrap metals.

The new policy has been highly controversial. It was amended in 2014 and subsequently has undergone further changes.[14]

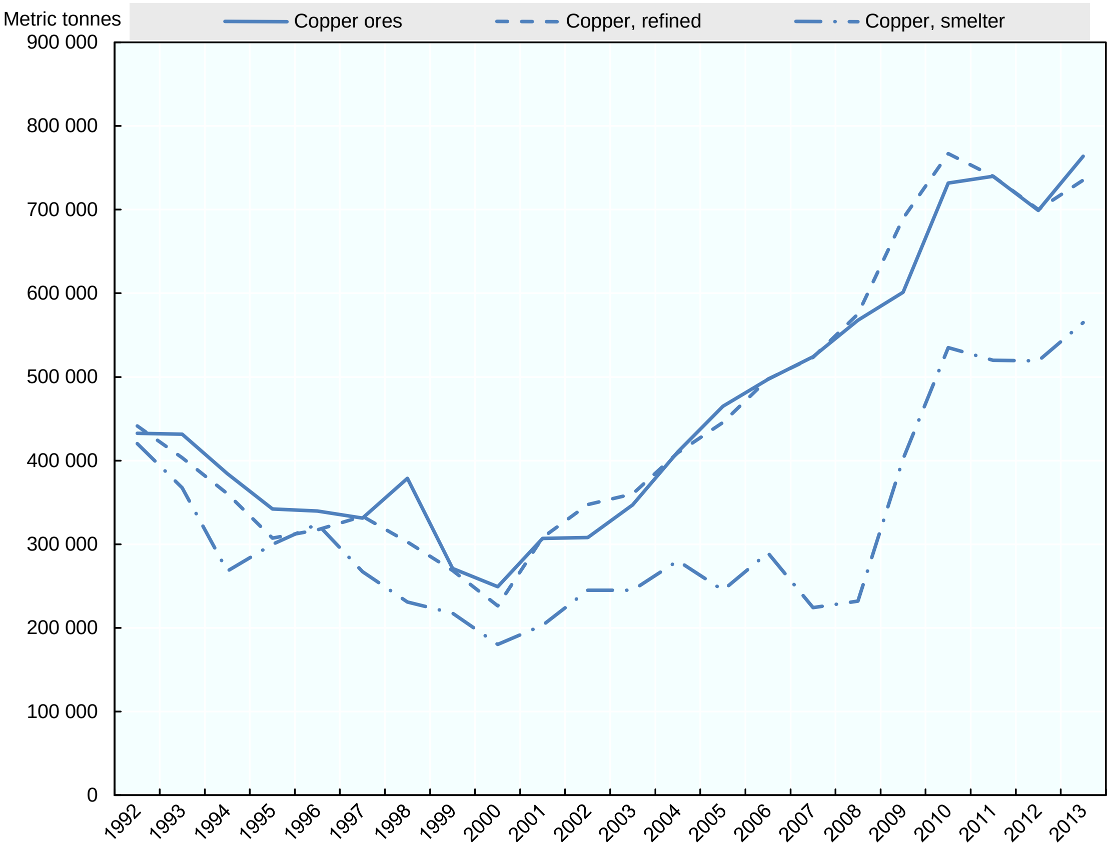
Copper mining in Zambia

Copper is mined in a large number of countries around the world. However, world mine production has traditionally has been concentrated in a small number of countries, essentially Chile, the United States and Australia. China has caught up over recent times and joined this group of major players. Zambia was the 7th largest copper mine producer worldwide in 2013. In Africa, nine countries produce copper; Zambia is leading here, followed by the Democratic Republic of Congo.

Copper is the main mineral resource in Zambia and accounts for the lion share of the country's total export earnings. In the early 1970s, copper mine output in Zambia peaked (700 000 MT in 1972). According to the World Bank (2011a), nationalisation of parts of the mining industry following Zambia's independence in 1964 and volatile copper metal prices discouraged new investment capable of sustaining high levels of output into the future Rising world demand and prices for the metal and the government's privatisation policy and economic reforms have since then improved the sector's overall performance. From Figure 7**,** which traces the evolution of Zambian mining as well as smelter and refinery production, by the end of the 1990s the country produced merely 250 000 MT of ore and concentrate. Since then, production has grown steadily, reaching 760 000 MT in 2013.

14. Republic of South Africa (2014). For reaction from the scrap dealers, see Lisa Steyn, "Local scrap industry feels the squeeze", Mail & Guardian, 17 January 2014. On 13 February 2015, South Africa increased the domestic price preference on aluminum scrap to 25% and steel and stainless steel scrap to 30% from originally 20%. In October 2013, the Metals Recycling Association of South Africa challenged the Guidelines in court. See Metal Recyclers Association of South Africa v. Minister of Economic Development + Others (51410/13)v[2013] ZA CPPHC 311 (28 October 2013) www.saflii.org/za/cases/ZAGPPHC/2013/311.html

Figure 7. Zambia's mine, smelter and refined copper production



Note: Mine production is expressed in terms of metal content of ore. Smelter production is primarily blister and anode produced from concentrate, including leach cathodes. Refined copper figures include both primary and secondary refined copper (electrolytic or fire refined). They include metal recovered from domestic or imported materials, whether primary or secondary, but exclude re-melted materials.

Source: British Geological Survey, World Mineral Production, various *issues*.

After rocks of copper ore have been concentrated, blister and anodes are a more usable but still impure form of melted and cast copper. Their production is an intermediate stage of copper refining; pure copper in the form of cathodes is obtained through another step of (electrolytic) refining where less pure copper anodes are dissolved. Cathodes are used for the fabrication of wire, tubes, cables and other copper and copper alloy products for final use in construction, transport and many manufacturing industries. Zambia has a refinery industry that produces and exports cathodes and other refined products and chemicals and which generates over 60% of the country's total export earnings (Zambia Development Agency, 2013). The country has abundant water resources, which is a favourable condition for processing using a Solvent Extraction-Electro-Winning (SX-EW) method. As can be seen from Figure 7, production of both smelter copper (anodes and alike) and refined copper have followed more or less a similar growth path as the mined ore and concentrate. Smelter production saw growth take off after a time lag, but then expanded sharply between 2008 and 2010. Annual production of refined material has closely followed the evolution of copper mine production, at times curiously exceeding the level of the mine output. This could be explained by material being imported for processing being counted toward the output of refined products. It may also reflect a lag time in copper metal production resulting from the processing cycles involved, which can be long, or simply errors in the reporting of statistics.

As can be seen from Figure 8, Zambia's exports of copper products have performed rather well since the early 2000s, with second-stage semi-processed material (cathodes and chemicals) leading the way. Basic manufactured products like copper cable and rods are minor exports, an indication that the domestic value chain does not run deep. More recently, exports have however included also ore and concentrate and, starting in 2006, copper anodes (first-stage semi-processed products). The share of anodes in total exports of copper products has grown since 2008.

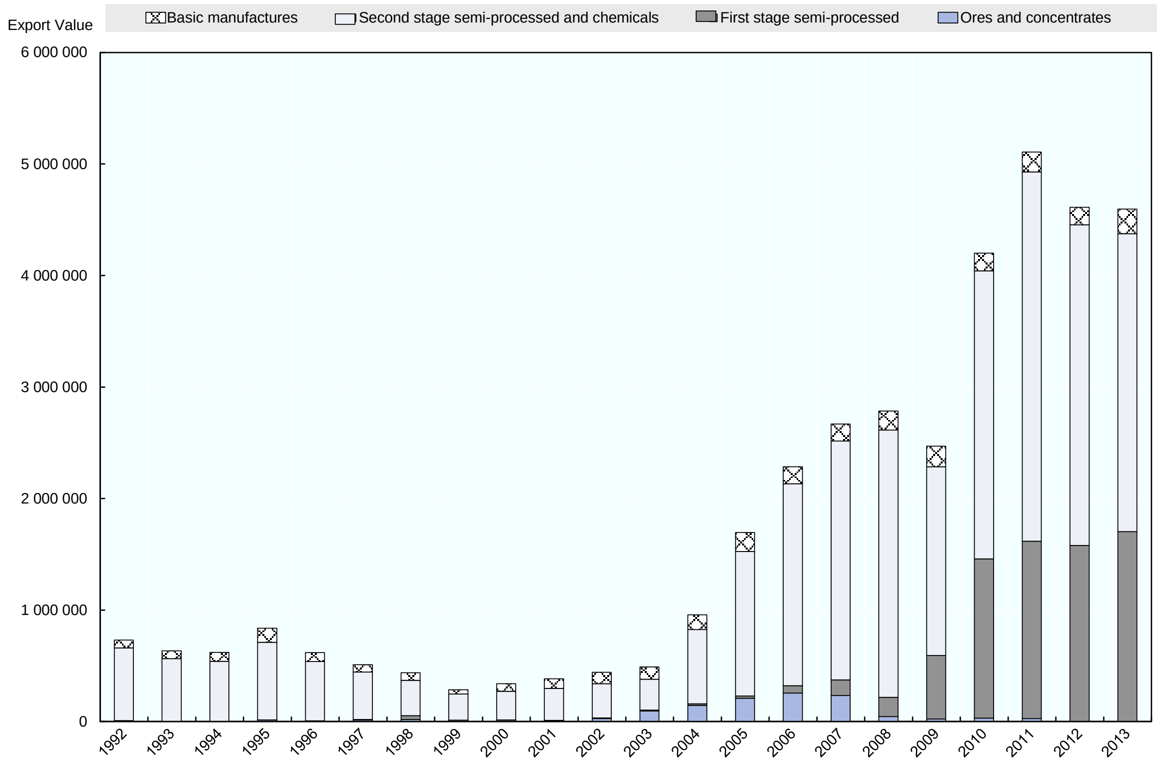
A report by the Zambia Development Agency (2013:6) speaks of a high share of processed products in Zambia's copper exports, which it attributes to various government incentives and conditions for value addition of minerals. Expressly mentioned is the government's export policy and notably an export tax which the government has applied, starting in 2008, to exporters of copper ore. This tax applies also to anodes and other unrefined copper products at the low end of the copper value chain, was initially set at 15% and then lowered to 10%.[15]

Zambia's export regulations have changed several times since 2008. Concern over corruption and tax evasion prompted the government to tighten its regulatory oversight over the mining industry and suspend in late 2011 issuance of new mining licences and the export of all metals, including copper, while audits of production and export transactions of mining companies took place. When the export prohibition was lifted after two weeks, a system of export permits was put into place requiring that all copper exporters obtain from different authorities separate certificates of mineral analysis, mineral valuation and payment of mineral royalty, the rate of which the government had just doubled to 6% for copper, nickel, manganese and iron ore (ICSG, 2012a and 2012b). Reportedly in reaction to complaints from mining companies that there was insufficient local smelter capacity to handle their rising stock of copper concentrate (material for processing was also arriving from the neighbouring Democratic Republic of Congo), the government suspended in the fall of 2013 the 10% export tax for one year. Shortly thereafter the tax was however reinstated by presidential decree (ICSG 2014).

Zambia's imports of copper products have been marginal in the period since 1992. During the early 1990s it imported some copper ore, but by 2012 mostly small volumes of semi-processed products (from the region and from China and India). Within the value chain, using local first-stage processing as a platform for diversification into fabrication of wire, tubes, cables, and copper alloy products has been a long-time yet not realised ambition of Zambia's industrial development strategy. There is a small local copper fabrication industry that produces a narrow range of products for sale at home and in the region, but the World Bank (2011b) was pessimistic about the prospects of the country becoming a major global player in this industry. One reason is that unlike mining companies, fabricators follow and operate close to their customer markets and neither the Zambian market nor the region (except South Africa, which is self-sufficient) are large enough to sustain a major copper fabrication industry. All potential significant market outlets (China, Germany, and the United States) are located far away, putting Zambia at a disadvantage vis-à-vis its competitors in terms of transport costs and time. The country also does not produce locally various alloying metals such as tin, lead, and zinc which fabricators use.

15. Per the Customs and Excise Act of 2008 (Appendix II: Ninth Schedule, Section 72a), the export tax (15%) applied to copper products under HS codes 260300 (ores and concentrates), 740100 (mattes, cement copper) and 740200 (unrefined copper, anodes). No official record was found indicating in which year the rate of the export tax was lowered to 10%.

Figure 8. Zambia's exports of copper products



Note: Export value is in USD.
Source: Own calculations based on data from UN Comtrade (2015).

Chromite mining in Zimbabwe

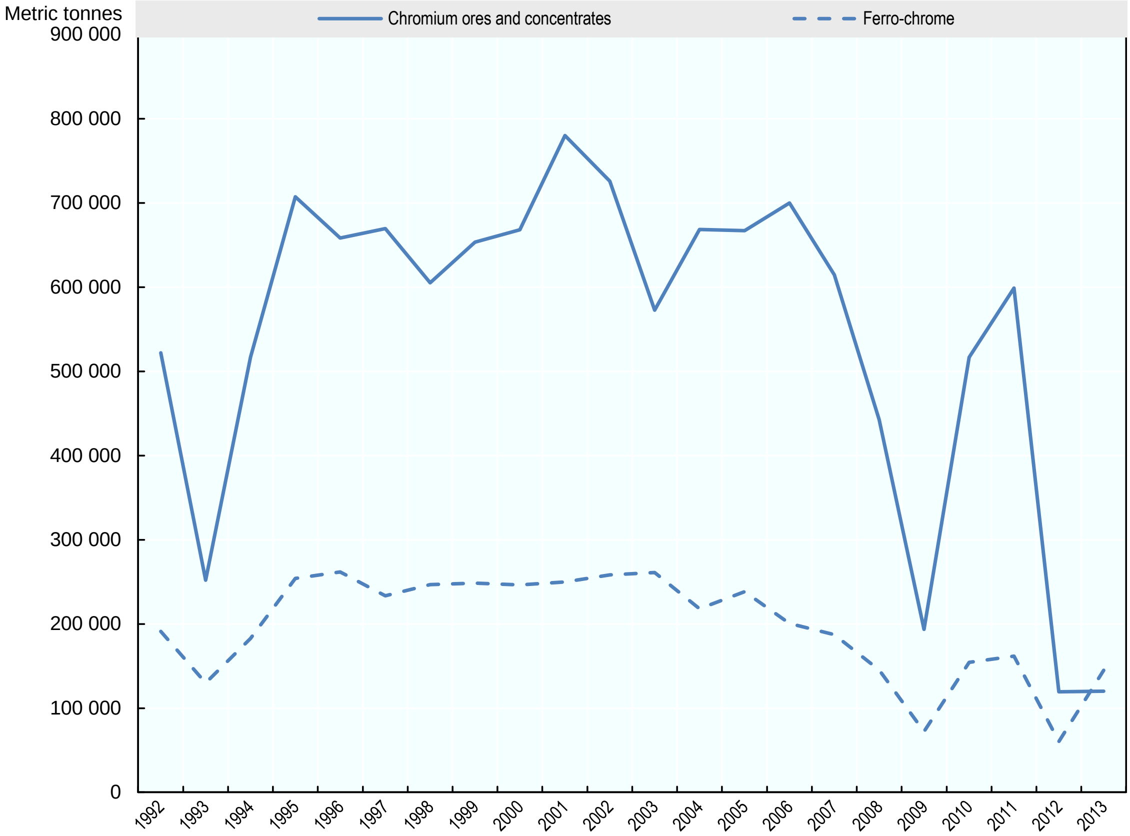
South Africa, Zimbabwe, and Kazakhstan together hold about 95% of the world's reserves of chromite (chromium ore). Some 20 countries around the world operate chromite mines. South Africa and Kazakhstan, along with India account for the lion share of global output. According to USGS (2013) estimates, Africa produced 30 million MT or 38% of world chromite output in 2011, but only three countries are producers, the most important being South Africa (11 million MT in 2011). Zimbabwe (599 000 MT) follows at long distance, and the only other producer in the region is Madagascar.

The chromium industry is composed primarily of chromite ore producers, ferrochromium producers, and stainless steel producers. The demand for chromite ore is generally dictated by the economic conditions of the steel industry and most chromite ore is processed to become ferrochromium used in the manufacture of stainless steel. Other products are chromium chemicals and refractory applications (Papp, 2013).

Global chromite ore production stagnated between 1994 and 1999, but as a result of surging global steel demand and production especially in China and India significantly expanded over subsequent years, reaching 24 million MT in 2008.

Available figures for Zimbabwe's production of chromite ore and concentrate show major fluctuations over time since 1992. As can be seen from Figure 9, production crossed the 700 000 MT mark in 1995, 2001, 2002 and 2006 but stayed at a lower level (500 000 to 650 000 MT) in the other years. The years 2003 and 2009, when global recessions caused global demand for minerals to drop sharply, saw deep temporary declines in output followed by quick albeit partial recoveries. In fact, production started to decline already in 2007, when prices for chromium products were still rising on the international market. It dropped even more sharply in 2012 and stayed at this low level in 2013.

Figure 9. Zimbabwe's production of chromium ore and concentrate



Note: Mine production is expressed in terms of metal content.
Source: British Geological Survey, World Mineral Production, various issues.

Besides mining operations, Zimbabwe has an established smelting capacity going back to the 1950s, and is transforming chromite locally into ferrochromium for export. In fact, ferrochromium is the main chromium product sold abroad.

Zimbabwe's production of ferrochromium, also shown in Figure 9, rose from around 200 000 MT in the early 1990s to around 250 000 MT in the early 2000s. It then stagnated until the economic downturn of mid-2008 triggered by the global financial crisis and collapsing demand and export prices hit chromite mines and ferrochromium producers, including in Zimbabwe, leading to production cutbacks and in some cases shutdowns of plants (Chitambira et al, 2011). Like for its mine production the country experienced a sharp decline in ferrochromium output, to only 72 223 MT in 2009. Production recovered to 161 639 MT in 2011 but then fell again in 2012 – to 60 205 MT. It recovered in 2013 (145 000 MT) but still fell short of the levels seen before the financial crisis.[16]

Historically most extraction and smelting has been carried out by two vertically integrated companies, Zimbabwe Mining and Smelting Company (Zimasco) and Zimbabwe Alloys Ltd. (ZimAlloys). Some small-scale mines and smelter installations have entered the local market over the years, but these two companies still represent more than 90% of Zimbabwe's ferrochrome smelting capacity, producing a range of ferrochrome products (Chitambira et al, 2011). The production chain of chromite does not run deeper. Whatever demand for chromium products there once was in local manufacturing industries has collapsed as a

16. These figures are from the following statistical collections of the British Geological Survey: World Mineral Statistics, 1990-1994, p. 127, World Mineral Production, 2000-2004, p. 54, World Mineral Production 2006-2010, p. 38, and World Mineral Production, 2009-2013, p. 38.

result of the country's economic distress since 2000. Zimbabwe had once important steelworks, but they have been closed for years, and the country's manufacturing sector has disintegrated.

For Zimbabwe's export-dependent chromium industry developments in the global market over the last 20 years have also not been favorable. Notwithstanding the vast reserves, chromite and ferrochromium production and exports have not kept pace with other countries, notably South Africa, which has increased production of chromium ore by 230% and is the leading global exporter of ferrochromium.[17] According to industry observers, investment in Zimbabwe's smelter capacity has been very limited over many years, even for the modernisation of existing smelters. Insufficient investment in smelting capacity and technology in turn has resulted in high operating costs (Chirasha, 2011 and Chitambira et al., 2011).

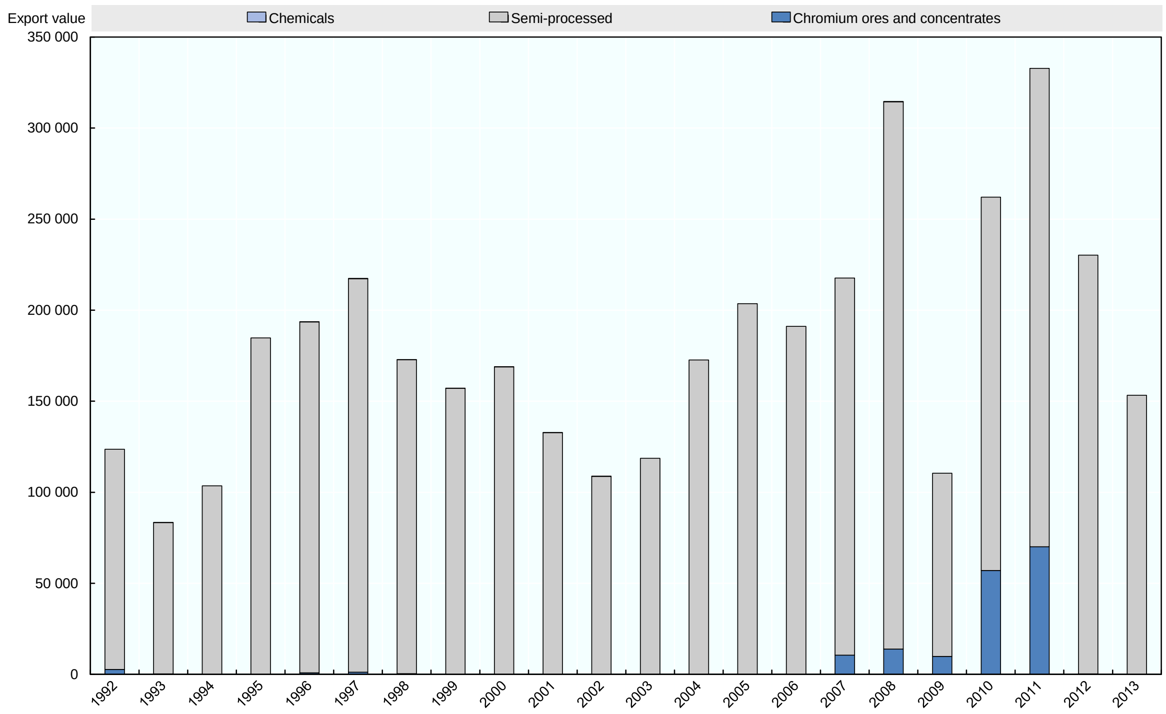
Observers note that Zimbabwe has long pursued a policy to not export chromite ore despite there being a high demand for raw chrome ore on the international markets (particularly on the Chinese market, since China imports chromite for its own production of ferrochromium) (e.g. Mobbs, 1994; Chitambira et al, 2011). The high level of state control of the economy makes export activity highly susceptible to political influence, including insistence that chromite and other raw materials be processed in the country. Chromite mines and plants producing ferrochromium and chromium chemicals are mostly privately owned but obliged to negotiate foreign sales contracts and export through a parastatal organisation (Minerals Marketing Corporation of Zimbabwe, created in 1983). The few foreign investment projects which the government has approved since 1992 are all in the ferrochrome or higher segment of the chromium industry's value chain, although this has not resulted in a noticeable rise of production. For most of the 20 years studied, Figure 10 confirms an absence of ore and concentrate from the composition of the country's export of chromium products; however, this changed after 2006.

Starting in 2007, at a time when global demand for minerals boomed and the price for chromite material skyrocketed before it dropped sharply in 2009 and with it the export earnings from the sector, Zimbabwe began to ship unprocessed chromite abroad. In the same year the government decided to ban the export of chromite ore in an attempt to force companies to process more metal locally and construct new smelters (Mobbs, 2012). As can be seen from Figure 10, sales abroad of chromite ore and concentrate increased markedly in 2010 and some of this export activity continued through 2011. In 2010, reportedly in reaction to complaints from mining companies the government replaced the ban with an export tax. However, it reinstated the export ban in April 2011 and ore and concentrate exports eventually ceased in 2012. According to Mobbs, the ban lowered domestic prices for chromite but there was not sufficient local smelting capacity to process rising stock of material. As a result, Zimbabwe Alloys Chrome Ltd. and other smaller mines suspended their mining operations and some filed for bankruptcy. Confronted with electric power problems at home and excess supply in the global chromium market, existing smelters, too, cut back or suspended their operations. As can be seen from Figure 10, when chromite ore exports stopped in 2012, Zimbabwe's ferrochrome exports also declined.

As of early 2014, the government still resisted pressure to lift the ban, arguing that its effort to attract investors to build smelters would not succeed if ore exports were allowed (Njini, 2014). Zimbabwe's imports of chromium products in the period from 1992 to 2012 have been very small and mainly consisted of pigments and preparations based on chromium.

17. Production figures for Zimbabwe and South Africa are from British Geological Survey, World minerals statistics (searchable database) www.bgs.ac.uk/mineralsuk/statistics/wms.cfc?method=searchWMS. South African production of chromite ore and concentrate rose from 3.4 million MT in 1992 to 6.4 million MT in 2002 and 11.3 million MT in 2012. According to http://worldtradedaily.com/2013/01/14/wit-report-for-hs-code-720241-ferrochromium/, South Africa exported USD 3.3 billion ferrochromium in 2011, followed at long distance by the Russian Federation (USD 242 million), Finland (USD 112 million) and China (USD 110 million).

Figure 10. Zimbabwe's exports of chromium products



Note: Export value is in USD.
Source: Own calculations based on data from UN Comtrade (2015)

IV. Assessment of the effects of export restrictions

This section reports analysis exploring empirically what the effect of export restrictions has been for the countries' mining and downstream industries. The analysis looks for evidence for two effects of export control measures which Section II described by way of the analytical framework of trade theory, namely that such a measure will harm the export competitiveness of the unprocessed mineral, i.e. ores and concentrates, to which it is applied, while it will help the export competitiveness of domestic industries that transform the raw material further. 1992 – 2013 export statistics at the HS 6 level of classification are used, which gives a more detailed picture than the discussion of the previous section of the products of the industries' value chain and the corresponding export activities of the countries, and which makes it possible to identify changes in the countries' export performance at a high level of disaggregation of products.

Methodology

Determining the level of revealed competitiveness

In order to get a deeper understanding of the performance of mining and mineral processing in the selected case studies the Revealed Comparative Advantage (RCA) index was calculated. This index developed by Balassa (1965) measures the revealed comparative advantage (or revealed competitiveness) of countries at the product level using trade data. The RCA approach assumes that if a country has a relative favourable export performance for a product it also has a comparative advantage in the production of that specific product (however, the RCA is a revealed measure and does not show the source of comparative advantage). Annex 1 describes the RCA methodology in more detail, including some of its limitations.

The RCA index is considered a better reflection of industry developments than just looking at trends in nominal export values (shown in the Figures in Section III), as they do not reflect the relative global performance of the local industry. Generally, the index represents a useful tool for investigating the pattern in the specialisation at the different processing stages of the four cases of mineral sectors. Trends in the RCA index reveal whether the country has developed any new production competencies or strengthened existing ones.

For each country case the raw mineral and the processed products of interest were selected according to the classification of the Harmonised System at the detailed six-digit level. The RCA indices were calculated at product level for the period of 1992 to 2013 (HS92 version). The country- and product-level export statistics (using mirror data) were sourced from the UN Comtrade database. The trends from 1992 to 2013 in the RCA for the selected group of raw minerals and related processed products were analysed. The processed products are mostly intermediate mineral products resulting from smelting and refining. The input-output linkages of these intermediate products are more evident from the product descriptions used in the harmonised system of product classification. These semi-processed products in turn are used by various industries in the manufacturing sector, such as automobiles and electronics, which the analysis does not consider.

Identifying structural breaks in competitiveness

Applied to the present study, export restrictions directly affect a country's revealed competitiveness of products subject to those measures and indirectly of related downstream activities. If the export of raw mineral ores is restricted, it is expected that the level of revealed competiveness (measured by the RCA) will decline for the raw material ores but will increase for related semi-processed products (ceteris paribus). The latter happens because as exports become less lucrative for raw minerals producers, local processors can source these at a more favourable price and sell their own products more competitively in the international market.

The effect of export control measures on raw minerals in the selected countries is investigated by way of identifying structural breaks in the level of the RCA index of both raw and related semi-processed minerals. This is done using the Least Squares with Breakpoints method, which is further explained in Annex 1.[18] This model has been used by several studies (Azar, 2013; Hansen, 2001; Garcia and Perron, 1996) but there is very little work with it in the trade policy field (e.g. Abu-Bader et al., 2008).

A structural break reflects a shift in a time series. Its detection requires an uninterrupted RCA data series for the time period under investigation. The break can be either positive or negative, depending on the underlying factors. As far as the extractive sector is concerned, if a negative break in the RCA index for mineral ores and concentrates coincides with, or relatively closely follows, the implementation of an export control measure, the decline in the sector's comparative advantage indicated by the break may have been caused by this measure. Note however that causality has not been statistically proven. Other factors in the industry's environment may have intervened. To narrow the scope of possible explanations for the identified structural breaks, the data underlying the RCA index for the affected raw material is examined to determine whether local or global events are at play.

Restricting the export of raw materials can promote activities downstream by either boosting already existing processing capacity or instigating the development of "new" activities. Depending on the speed of mobilising additional processing capacity, the effects on the comparative advantage of existing processing activities can be either relatively immediate (e.g., smelting and refining capacity exists but is not fully used) or take several years to show up (e.g., when a new refinery is built). An interpretation of the structural break analysis therefore must account for the possibility of time lags. The

18. Estimation outputs are available from the authors upon request.

policy effects of export control measures enabling a country to develop a comparative advantage with respect to “new” processing activities can be difficult to detect with structural break analysis because developing a comparative advantage may take time. Evidence in this regard relies on the examination of trade statistics and RCA trends around the time of introduction of an export control measure.

Results

The following sections report the results of the analysis by country, following these two stages of inquiry – identifying, through the lens of the RCA index, countries’ pattern of export performance within the value chain of a mineral, and using structural break analysis to assess export control measures which the countries have adopted, for effects on these activities. Tables reporting detailed results can be found in Annex 2. For countries showing structural breaks for raw materials, national trade performances were compared with world trade in order to determine whether local or global factors caused the shift. Country and world exports of a sector’s raw material and of total exports are shown in Annex 3.

Export tax on manganese in Gabon

The results of the analyses on the level of Gabon’s revealed competitiveness within the manganese industry are shown in Table A1 of Annex 2. For manganese, the vertical value chain comprising the extraction of ore and production of intermediate products is relatively short. The first three columns of the Table show different products in the sector (classified at the six-digit level of the HS) grouped according to their respective stage of processing. Gabon exported five semi-processed and chemical products in the period since 1992. However, export activity was relatively erratic (see column 4). For four other manganese-related products the country has not developed any competencies.

Using continuity of exporting over time and the calculated average of an RCA of more than 1 as a rough indicator of a country’s sustained and strong ‘core competencies’ of production, column 5 identifies the products where Gabon has performed well. Apart from manganese dioxide (HS282010) and manganese oxides (HS282090) Gabon has not developed any strong competencies in activities downstream from manganese mining since 1992.

Table A1 also shows the patterns in the comparative advantages within Gabon’s manganese industry. Columns 6, 7 and 8 depict the patterns in a country’s export performance (i.e. the RCA index) for ores and products at different stages of transformation for the period from 1992 to 2013. Gabon relatively strong comparative advantage in manganese ore exports declined after 2008. Although its production and exports increased, as seen in Figures 3 and 4 in Section III, its specialisation in manganese ore production has not kept up with the global trend. In the processing sector, the country’s comparative advantage in manufacturing manganese-based chemicals diminished during the 2000s. The country has not been able to sustain its exports of manganese dioxide and oxides. Some new processing activities were developed in the period from 1992 to 2013 but the products in question were not competitive and their export was not sustained over time.

The last column (9) of Table A1 shows Gabon’s share in global exports for the different manganese products. The country is an important supplier in the global market for manganese ore, whereas its role in the processing segment of the global manganese industry is negligible.

Section III discussed Gabon’s’ export tax put in place in 1999 on manganese ores. Whether the export tax has had an effect on the downstream activities within Gabon’s manganese industry is analysed by identifying structural breaks in the level of revealed comparative advantage (RCA indices) of manganese ores and products for the period from 1992 to 2013. The results of this analysis are shown in Table A2 in Annex 2. A sudden shift in the level of the RCA of manganese ore following Gabon’s introduction in 1999 of a 3% export tax on ores may imply a policy effect. Column 6 in Table A2 in Annex 2 shows any structural break identified and column 7 indicates whether the change was positive or negative.). The analysis does not reveal an effect for the export tax. The only break identified is on manganese ore and concentrate. However, it occurred in 2008 and cannot be explained by the export tax introduced many years earlier. Further inspection of the RCA index before and after the implementation of the export tax is shown in columns 4 and 5. It finds that comparative advantage has weakened for all processed products. The export tax thus has not lowered the comparative advantage of manganese ores but it has also not enabled Gabon to develop competitive export activity downstream. Given the modest rate of the tax, this is perhaps not surprising.

License requirements for South African exporters of unprocessed lead and some semi-processed products

Section III showed that in terms of value, South Africa's lead industry revolves around exporting ore and concentrate, which is complemented by other products resulting from diversification of production within the lead value chain. Table A3 in Annex 2 depicts the results of the analyses of the competitiveness of South Africa's lead industry. The country has exported in the period from 1992 to 2013 (column 3) a variety of lead products (15) falling in the lower and higher segments of the lead value chain as well as some finished products containing lead (glassware of lead crystal, lead acid batteries). Most of these products have been exported on a more or less continuous basis (column 4).

From the trends in the revealed comparative advantages of products in the value chain of the lead industry (shown in columns 6 to 8) it is evident that South Africa's competitive position as supplier of unprocessed lead concentrate (HS 26077) is declining. This is consistent with the decline in production shown in Figure 5 in Section III. The country has developed core competencies[19] in semi-processing activities; it produces and exports also chemical compounds like lead monoxide (HS282410), red/orange lead (HS282420) and lead oxides (HS282490) as well as basic fabricated lead products (see column 5 in Table A3 in Annex 2).

The general low levels of revealed comparative advantage shown for semi-processed products could be explained by there being domestic demand for these products for metallurgical fabrication of simple lead products and the manufacturing of various finished products (e.g. lead acid batteries, glass). However, recent deterioration of the country's competitiveness in the semi-processing and fabrication segments coincides with the introduction of the export permit system in 2008.

Unlike Gabon's export tax, the export control regime used by South Africa is not confined to the mined raw material (ores and concentrate). Besides mined lead ores and concentrate (HS 260700) the list of controlled products also includes secondary raw material (lead waste and scrap HS 780200) along with several intermediate products: lead ingots (HS 780110), lead plates, sheets, strip and foil; lead powder and flakes (HS 7804), lead tubes, plates and tube or pipe fittings (HS 780500), and Other articles of lead (HS 780600). Note that a decline in the RCA index is not observed for lead monoxide, lead oxides, and unwrought lead containing antimony, exports of which are not listed as requiring a permit from the authorities. Note also that in the South African case, the raw material from which refined lead is produced serving as input for products higher up on the value chain, is not the mined ore but secondary material, i.e. lead waste and scrap, also listed as a controlled export item.

Like for most intermediate products, the development of competencies in finished products (lead crystal glassware, lead acid batteries) has been marginal, although these products have been consistently exported since 1992. The last columns in Table A3 provide some insights in the global position of the South African lead industry in terms of its shares in worldwide exports. With the exception of lead monoxide (6.5% of world exports), the country is a small global player across the lead value chain.

19. Core competence refers to a product with a consistent flow of exports over time and a relative high level of RCA (>1).

The impact of South Africa's export licencing regime is investigated by looking for structural breaks from 2008 onward in the RCA indices of any of the lead items. A challenge is the lack of information about how the export licensing regime has been applied. Once the policy is in place, and independent of the export discouragement effect which obliging exporters to apply and obtain explicit permission to ship their products abroad likely has, the government has in principle considerable leeway in deciding how restrictively it wants to manage the system, and for how long. Officials could thus approve all applications for licences in a given period of time (a permit is valid for six month) but then reject some or all applications in another period of time.

From the results shown in Table A4 (column 4 and 5) the export control measure may have lowered the level of comparative advantage of lead ores and concentrates in 2010, when a negative structural break is observed. Further inspection of the underlying data shows that South Africa's exports of lead ores increased again after 2010; however, this increase was outperformed by the growth in the global export of lead ores, ultimately resulting in a diminishing relative comparative advantage of South Africa (see Figure 1 in Annex 3). In China, the by far leading export market for South Africa's lead extractive sector, total imports of lead ore and concentrate increased whereas imports from South Africa actually decreased. Hence, factors within South Africa`s lead industry played a role here as the country was not able to keep up with the global trend.

The government's export control list includes seven intermediate and fabricated lead products (marked in bold in Table A4). Any post-2008 structural breaks in the respective RCA levels of these specific products may be a result of export licensing policy restraining the outflow of lead scrap, the raw material with which the South African processing industry works, or they may result from the exports of these products being restricted directly.

For lead waste and scrap, the structural break analysis shows a positive break in its level of revealed competitiveness in 2009 (see Table A4). This implies that the export performance of this raw material was not held back by the export permit system put in place in 2008. Further inspection of the trade data reveals a remarkable upsurge in the value of exports of lead scrap after 2008 against the background of a much more modest increase in global exports (see Figure 2 in Annex 3). Most of these exports were destined for two countries - Belgium and India - for which South Africa received increasing export unit values after 2008 (ITC, 2016). The export market for lead scrap seems to have become more lucrative for scrap traders compared to domestic demand from processors.

As described in Section III, complaints from local metal scrap users motivated the government to clamp down on scrap exports in 2013 by way of guidelines expressly giving local users preferential access to scrap at a substantial price discount. The move came in response to complaints led by foundries and other users of ferrous scrap about there being not enough reasonably priced high-quality scrap because too much was being exported, and which put local processors out of business. These newly issued guidelines applied to any ferrous and non-ferrous metal scrap, including lead scrap.

Table A4 confirms a deteriorating situation for the South African lead metals industries. Among thirteen structural breaks identified in the level of competitiveness of downstream activities, nine were negative. For four of six controlled lead product items (marked in bold) - unwrought refined lead at the semi-processing stage and fabricated plates and sheets, powder and flakes, pipes and tubes- negative structural breaks in the RCA indices occurred in 2010 or 2011. For one other controlled category of lead products, miscellaneous fabricated lead articles, a positive post-2008 structural break was identified. Further inspection of the underlying trade data shows that, apart from lead powder and flakes, these structural changes in levels of competitiveness can be attributed to internal factors rather than global market dynamics.

Table A4 shows that a number of structural breaks have also occurred in uncontrolled semi-processed products as well as chemicals and manufactured lead products. Three of these eight products, namely unwrought lead, lead oxides and glassware of lead crystal, exhibit a positive structural break in their respective levels of revealed competitiveness after 2008. The underlying trade data show that the breaks in competitiveness of all these products are also due to domestic factors.

Most of the downstream activities comprising South Africa's lead sector depend on secondary lead obtained from waste and scrap. Hence, the drop in their revealed competitiveness may be related to the observed upsurge in exports of scrap from 2009 until 2012, and more specifically to a rising world price that appears to have affected this segment of the South African lead industry more adversely than competing foreign exporters. Domestic demand for scrap must have been relatively weak because the volume of scrap imports declined after 2005 and notwithstanding a temporary spike in 2012, this trend did not reverse between 2007 and 2013. If there had been insufficient supply in the local market one would expect that imports would have risen. That negative breaks are found in 2010 also for lead products downstream from refined lead, i.e. automotive and other kinds of batteries (HS 850710 and 20), which preceded rather than followed the 2011 break on refined lead, also argues for conditions of weak demand emanating from local industrial users. The weakening competitiveness of local lead battery manufacturing specifically might also be attributed to battery scrap being shipped back to original battery manufacturers located abroad (e.g. South Korea, Belgium, and India). This has raised the cost of locally recycled lead.

Having not managed to develop a comparative advantage over the 20 years studied, South African lead-based manufacturers appear to be more and more on the defensive against competition from foreign producers, notably from Asia. Although many of the lead products with breaks require themselves permits if sold abroad, this makes it unlikely that the government, keen to promote local industries using the country's natural resources, has restricted exports permits for these products, which otherwise might explain the deterioration of their competitive position.

Because they entered into force only in the fall of 2013, towards the end of the time period studied, the analysis cannot take account of the guidelines which the South African government adopted in its attempt to stem the export flow of scrap by obliging all metal scrap suppliers wishing to sell abroad, to first offer the material to domestic buyers at a preferential price.

If anything can be concluded about South Africa's export licensing regime, it is that it has not prevented the processing sector's weakening performance in recent years, shown by mostly low or disappearing revealed comparative advantages. Levels of RCAs have risen mostly in the chemicals segment. The multiple significant structural breaks observed between 2009 and 2011 for 16 of the 20 products comprising the lead export sector suggests that local factors profoundly unsettled this sector's performance at that time.

Export tax in the copper industry of Zambia

The results of the analysis of the level of competitiveness of the Zambian copper industry are reported in Table A5 in Annex 2. The overview of Zambia's copper industry in Section III already showed that Zambia is engaged in activities of processing copper ores.

The first four columns of Table A5 show that, apart from copper ores, Zambia exported 44 different copper-based intermediates at some time during the period from 1992 to 2013. Only five of these products were exported uninterruptedly from 1992 to 2013, and a few processed products are missing from its export basket altogether (last rows).

Column 5 shows that Zambia has developed so-called core competencies[20] in a relatively narrow range of semi-processing activities, which include the production of copper cathodes (HS740311); copper anodes (HS740200); refined copper products, unwrought (HS740319); bars, rods and profiles of

20. Identifying products with a consistent flow of exports over time and a relative high level of RCA.

refined copper (HS740710); plates sheets, strips of refined copper (HS740919); and wire of refined copper (HS740811 and HS740819). Developing and sustaining these competencies is supported by growth in the mining of copper, as is apparent from Figure 9 in Section III, but the evidence of success is mixed.

Columns 6, 7 and 8 in Table A5 depict the patterns in Zambia's revealed comparative advantage (i.e. the RCA index) for copper ores and different semi-processed copper products for the period from 1992 to 2013. The country has been losing comparative advantage for copper cathodes (HS740311) and plates, sheets and strips of refined copper (HS740919). On the other hand, Zambia has strengthened some of its production competencies for less processed products since 1992. The most important developments are a significant rise in the revealed comparative advantages of copper anodes (HS740200), ash and residues (HS26030) and, to a lesser extent, refined copper products, unwrought (HS740319).

The last column of the Table shows that the country is a very important global player in copper anodes (HS740200) with a share in global exports of almost 22 percent. As was explained in Section III, anodes exports are a recent development. Zambia's global position in ash and residues (HS26030) and copper cathodes (HS740311) is also relatively significant.

Section III discussed the 15% export tax put in place by Zambia in 2008 to increase local processing of copper ores. The export tax was applied to copper ore and concentrate (HS260300) and also to products resulting from first-stage processing, namely unrefined copper anodes (HS740200), copper mattes (HS740110) and cement copper (HS740120). In addition to having to pay this export tax, exporters of copper ore have since late 2011 to obtain an export permit.

Whether the export tax on copper ore, first alone and since 2011 in combination with the export permit requirement has had an effect on downstream activities within Zambia's copper industry is analysed by identifying structural breaks in the RCA indices of copper ores and semi-processed products for the period from 1992 to 2013. The results of this analysis are shown in Table A6 in the Annex 2. A sudden shift in the level of the RCA of copper ore following Zambia's implementation of export control measures on copper ores in 2008 and 2011 may imply a policy effect. Copper ores may be directly affected by a decrease in its comparative advantage due to this policy measure, whereas the semi-processed copper products may be indirectly affected through their input-output linkage with copper ores.

Column 7 in Table A6 shows the identified structural breaks and columns 8 indicates whether this was a positive or negative break in the level of comparative advantage (i.e. RCA). A structural break in the comparative advantage of copper ores occurred in 2010. Zambia's RCA of copper ores decreased and this could be linked to the imposition of a 15% export tax in 2008 (allowing for a time lag effect of two years). Deeper inspection of the underlying data shows that this decrease in comparative advantage can be attributed to local rather than global factors. Zambia's exports of copper ores dropped in 2010, a time when global trade of copper ore witnessed a strong increase (see Figure 3 in Annex 3).

As far as the indirect effect of the tax on the levels of comparative advantage in processing activities is concerned, no structural breaks in 2010 or later is observed on products at the first stage of transformation or higher up. Hence the export tax of 2008 (suspended briefly in 2013 and then reintroduced) on copper ores seem to have had no promotional effect on any of the existing semi-processed copper products.

Only copper products with an uninterrupted export flow in the period under investigation can be statistically analysed for structural breaks in their respective levels of RCA. Columns 4, 5 and 6 show the average level of RCA for the periods before, between and after the implementation of the export control measures, which might give some indication of newly developed activities in the period under investigation in relation to the implementation of the export tax. The table shows that the opposite seems to be the case, namely that the number of downstream activities in the copper industry before the implementation in 2008 was higher than the number of activities by 2013. Hence, Zambia's policy measure did not instigate the development of any new downstream activities. The copper sector shows a trend of specialisation in downstream activities rather than diversification; this trend seems however unrelated to the export control measures on copper ores.

Export ban in Zimbabwe's chromium industry

The results of the analyses of Zimbabwe's chromium industry are shown in Table A2.7 in Annex 2. It is evident from the table that Zimbabwe has a sustained comparative advantage in chromium mining and has used this resource as a basis for specialising in the export of ferro-chromium and related products. The country's share in global trade for the four semi-processed chromium products in which it has a comparative advantage is very small (see column 9). This specific group of products represents over 70 percent of total global trade in chromium-related products. Hence, from a global trade perspective greater benefits from local transformation of chromium implies boosting existing activities rather than developing new ones (i.e. diversification). There were sporadic exports in chromium-based chemicals, but these were not sustained.

Analysis of the RCA patterns shows that Zimbabwe's comparative advantage in chromium ores took off from 2007 onwards, whereas the RCA values in semi-processing all show a pronounced negative trend in the period from 1992 to 2012, apart from ferro-chromium of high carbon content (HS720241) which built up and then maintained its level of RCA. The country does not engage in the manufacture and trade of stainless steel or specialty steel applications higher up on the value chain, for which ferro-chromium serves as a base material.

Table A8 in Annex 2 shows furthermore that the export ban on chromium ore which entered into force in January 2007 was not effective. The fact that in 2007-2009 the revealed comparative advantage of this product soared (rather than drop and cease) suggests that the ban was not fully enforced and that a craze of selling abroad occurred. When the ban was lifted in 2010 and replaced by an export tax, the high level of export activity continued as is evident from the positive structural break shown for 2010, but suddenly dropped again in 2012. In that specific year a negative structural break occurred. This drop can be explained by the once again changing policy of the government, which in April 2011 reinstalled the export ban. Further analysis of the underlying trade data confirms that this surge and drop in the comparative advantage of chromium ores was due to local and not global factors. Zimbabwe's exports increased and declined against the background of relative stable growth in the country's total exports as well as a stabilising growth in the global trade of chromium ores (see Figure 4 in Annex 3).

The structural break in the RCA of ferro-sillico-chromium (HS720250) in 2009 resulted in an increase of its comparative advantage. As this structural break precedes the negative structural break for ores occurring in 2012, the government`s reinstalled export ban cannot have had an effect on the production and exports of this product. Also, while the reinstalled export ban was more effective in cutting chromium ore exports, the analysis does not find evidence of a subsequent improvement in the international competitiveness of the high-carbon ferro-chromium, the industry's leading export item. The revealed comparative advantage of this product did not improve and vanished for the other semi-processed products.

Overall, the changes in the RCA index speak against the 2007 ban on chromite ores having had a positive effect on the ferrochromium sector or other downstream activities. It seems to have backfired. The extractive sector however clearly suffered from the trade policy. The export tax implemented in 2010, followed by an attempt in 2011 to stop exports of chromium ores completely, drastically reduced the comparative advantage of chromium ores in the subsequent years.

Summary of the results

Table 2 provides a summary of the results of the analysis of changes in the revealed comparative advantage within the respective mining sectors that may be attributed to the export control measures. The fifth column shows the identification of a negative structural change in the revealed competitiveness (RCA) of raw products which can be linked to an effective local export control measure shown in column 3. It is evident that this was the case in three of the studied control measures. As mentioned before, an effective export control measure on raw materials (column 5) is assumed to have a positive effect on the level of revealed competitiveness (RCA) of value-adding transformation of the raw material. Column 6 shows whether this is the case for the respective control measures and, as was evident from the discussion in the previous sections, no such relationship could be identified in any of the four cases studied.

Table 2. Summary of the results

Country	Mineral ore and concentrate	Export control measure	Year of introduction	Negative structural break in the RCA of mineral ores and concentrates attributable to the export control measure	Positive structural break in the RCA of downstream processing activities attributable to the export control measure on raw materials
1	2	3	4	5	6
Gabon	Manganese	Export tax (3-3.5%)	1999	No	NA
South Africa**	Lead	Non-automatic export license	2008	Yes	None
	Lead waste and scrap***			No	NA
Zambia	Copper	Export tax (15%)	2008	Yes	None
		Export tax suspended, then reinstituted	2013	No	NA
Zimbabwe	Chromite	Export ban	2007	No	NA
		Export tax (15-20%)	2010	No	NA
		Export ban	2011	Yes	None

Note: *NA – not applicable; in cases where no effective export control measure on the raw material was identified. ** South Africa implemented a licensing requirement also for various semi-processed lead products; these are not considered in the last column. *** used as input for lead processing activities as no local lead concentrate refinery facility exists.

V. Conclusions

This paper has described the evolution of industries and their value chains for specific minerals mined in four countries over the last two decades, and explored whether export control measures used by governments can be linked to higher-value transformation of raw materials in line with trade theory prediction and government justifications for their use. The analysis finds that the export control measures may have affected the mining industries, and that the effects have been adverse overall and the processing industries have not benefited.

Examination of the disaggregated export composition of the countries shows that the countries differ in the level of vertical diversification which they have achieved in the course of the last twenty years. As would be expected and is reflected in the RCA indices, all countries started with a comparative advantage in the extractive sector. Zambia's copper, Zimbabwe's chromium and South Africa's lead industries have also managed to develop competencies in processing enabling them to produce higher value metals products for the local or international market. Some local processing has taken root also in

Gabon's manganese sector, but the base is low in terms of both product variety and the level of comparative advantage measured by the RCA index.

The export control measures studied consist of export taxes, export licence requirements and outright export bans. The export tax policies pertained to the copper industry (Zambia), chromium industry (Zimbabwe) and manganese industry (Gabon). For Gabon's manganese industry there is no evidence that the export tax has impacted the levels of comparative advantage of the mining or processing activities. In the case of Zambia's copper industry, the revealed comparative advantage of copper ore and concentrate decreased, suggesting that the mining sector may have been hurt by the export tax. Zimbabwe's chromium ore sector has witnessed a similar deterioration. While these findings are in line with what trade theory would predict to be one of the consequences of export taxes, the export performance of the countries' downstream processing sector has also not benefited. Diversification within the Zambian copper industry's value chain predates the 15% export tax of 2008. After the export tax was introduced, the RCA index rose for only one semi-processed copper product, anodes, to which the export tax also applied. For Zimbabwe, the effect of the export tax is difficult to disentangle from the effect of the preceding and subsequent bans, but the RCA of chromium dropped sharply whereas ferro-chromium exports have not seen any improvement in relative competitiveness. The rates of the export taxes were relatively high in Zambia and Zimbabwe (15% and 20%, respectively), which could help explain the pronounced decline of the revealed comparative advantage of their extractive sectors. The fact that this decline has not been offset by competitiveness gains for the processing industry does not bode well for the countries' respective copper and chromium industries and their contribution to economic growth and development.

Zimbabwe's export ban has backfired and some important lessons can be drawn from this case. It is reported that when the ban was introduced producers of chromite ore had difficulties finding local processors. Unable to sell abroad and locally, some mining operations closed down completely.[21] This is not in the interest of the economy, which depends on the mining sector for foreign exchange, and not a circumstance that the government appears to have thought of when it imposed the export ban – the strictest of all export control measures –hoping to attract investment in the country's smelting capacity and further up the value chain. Furthermore, the Zimbabwe case illustrates that the actual trade effects depend crucially on the enforcement of trade measures.

South African lead industry is the only country case where producers have to obtain a licence in order to be able to export lead and a wide range of other minerals. Like with the export tax in Zambia, the export licence requirement applies to mined output as well as to some semi-processed products. The requirement was implemented in 2008 followed by a structural decline in the comparative advantage of lead ores in 2010, but this is a relative long time lag for a cause and effect relationship for an export control measure. Neither is there evidence that export of lead waste and scrap or any other lead products included in the control list, as administered prior to 2013, was effectively restrained. The structural decline in the competitiveness of several semi-processed products appears to be related to cost and possibly other factors depressing demand for scrap on the part of the South African lead using industry.

In the light of the findings, it is hard to defend export restrictions as a tool for stimulating local mineral processing. There was no improvement in the comparative advantage of semi-processed products, which would have benefited from the measures taken. South Africa, Zambia and Zimbabwe all have developed smelting and refining competences and positioned themselves as exporter of certain semi-processed products, but these achievements cannot be attributed to the export control measures studied, which did not improve the relative export performance of these products. On balance, the export

21. Bloomberg (Felix Njini) www.bloomberg.com/news/articles/2014-03-11/rising-chrome-ore-demand-pressures-zimbabwe-to-lift-export-ban.

restrictions may have undermined the overall performance of the industries in Zambia and Zimbabwe because the relative export performance of their mining sectors weakened.

From the description of the industries provided by this paper it is apparent that factors other than export control measures have also shaped the situation in the countries' minerals sector. The finding that the export control measures have not helped the processing industries raises the question of what mix of basic conditions are needed for strong processing sectors to develop in these countries.

For industries strung along the value chain, raw materials are a necessary input and availability and price of the primary (or secondary) raw materials is a key determinant of the cost and levels of production at subsequent stages of intermediate products. However, this is neither a sufficient condition for processing to take place nor is it the only factor that determines whether processed products can compete on the global market.

Minerals processing industries typically consume large amounts of energy and water and employ a labour force with higher skills than is found in the extractive sector. The argument that export restrictions on raw materials will create local jobs overlooks that most downstream mineral processing activities require capital and specialised knowledge rather than the low-skilled labour abundant in many resource-rich developing economies. Proximity of sales markets and the state of infrastructure influence transport costs, another important co-determinant of export price and global competitive advantage. The overview of the industries covered by this study has alluded to various domestic factors acting as a constraint on the establishment or growth of processing facilities. Power supply for example appears to be inadequate and limit the furnace operations of ferrochrome producers in Zimbabwe. In Gabon, too, the capacity of the electricity sector to support more manganese processing plants is weak. In some of the countries studied political instability has hampered efforts to attract foreign capital on which governmental plans for developing the minerals sector depend. Also, because it is landlocked and further away from major consuming markets, higher transportation costs disadvantage Zimbabwe relative to other major ferrochromium producers like South Africa and Kazakhstan (World Bank, 2011b, Chitambira et al, 2011).

Water and power are examples of factors unrelated to the supply of the raw material that can act as binding constraints on achievable production levels. It is difficult to see how the favourable terms of sourcing raw material brought about by export control measures can get production to respond when existing capacity is limited – or how the advantage of cheap local supply of the raw material can offset other major constraints on the operation and growth of the processing industries and their export performance. The empirical analysis presented in this paper has investigated the effect of one policy-related factor, export control measures, and no attempt has been made to analyse how other domestic factors individually or in combination have impacted the export performance of the countries studied.[22] Clearly, a systematic stocktaking and comparative analysis of the industries' enabling environment would seem necessary if one were to understand why some countries are able to develop downstream activities in their mineral sectors and others not.

22. This includes the tax regimes on mining, which governments design so as to attract investors in the extractive sector while securing an equitable share of monetary and other benefits for the local economy from the exploitation and sale, often abroad, of non-renewable resources. Such tax regimes may offer additional fiscal incentives when the raw material is processed locally. Even highly favourable tax treatment may however fail to establish processing in the country if essential other inputs and conditions for production are not present (Charlet et al., 2013).

References

Abu-Baser, Suleiman and Aamer S. Abu-Qarn (2008), "The impact of GATT on international trade: Evidence from structural break analysis", *Applied Econometrics and International Development*, Vol. 8, No. 2, 23-36.

African Union (2009), *Africa Mining Vision*, February 2009, http://ti.au.int/en/sites/default/files/Africa%20Mining%20Vision%20english.pdf.

Azar, S.A. (2013), "Inflation and stock returns II", *International Journal of Economics and Finance*, Vol. 6-1, 208 – 216.

Bai, Jushan (1997), "Estimating multiple breaks one at a time", *Econometric Theory*, 13, 315–352.

Bai, Jushan and Pierre Perron (1998), "Estimating and testing linear models with multiple structural changes", E*conometrica*, 66, 47–78.

Bai, Jushan and Pierre Perron (2003a), "Computation and analysis of multiple structural change models", *Journal of Applied Econometrics*, 6, 72–78.

Bai, Jushan and Pierre Perron (2003b), "Critical values for multiple structural change tests", *Econometrics Journal*, 18, 1–22.

Balassa, B. (1965), "Trade liberalization and revealed comparative advantage", *The Manchester School of Economic and Social Studies*, 33(1), 99-123.

Bermúdez-Lugo, Omayra, Philip M. Mobbs, Harold R. Newman, Mowafa Taib, Glenn J. Wallace, David R. Wilburn, and Thomas R. Yager (2014), "The mineral industries of Africa", *2011 Minerals Yearbook – Africa*, U.S. Geological Survey, September 2013, revised May 2014. http://minerals.usgs.gov/minerals/pubs/country/2011/myb3-sum-2011-africa.pdf

British Geological Survey (2014), *World Mineral Production 2008-12*, Keyworth, Nottingham, United Kingdom. www.bgs.ac.uk/mineralsuk/statistics/worldArchive.html

Charlet, A., B. Laporte and G. Rota-Graziosi (2013), "La fiscalité minière en Afrique de l`Ouest et du Centre", *Revue de Droit Fiscal*, No. 48, 28 November, 1-22.

Chirasha, J (2011), "Ferrochrome smelting and smelting capacity investment in Zimbabwe", *Southern African Pyrometallurgy 2011*, edited by R.T. Jones & P. den Hoed, Southern African Institute of Mining and Metallurgy, Johannesburg, 6–9 March 2011.

Chitambira, B., D. Miso-Mbele and M. Gumbie (2011), "Ferrochrome smelting in Zimbabwe", Presentation to the Zimbabwe Branch Conference, African Institute of Mining and Metallurgy (SAIMM) 7 p., www.saimm.co.za/download/saimmbranches/zimbabwe/FERROCHROME%20SMELTING%20IN%20ZIMBABWE.pdf.

Commonwealth of Australia, Industry Commission (1991), *Mining and minerals processing in Australia*, Vol. 1: Report, Report No. 7, 25 February 1991, 200p.

Corathers, Lisa A. (2002), Manganese, in *U.S. Geological Survey Minerals Yearbook*, 2002, 16 p. United States Geological Survey, http://minerals.usgs.gov/minerals/pubs/commodity/manganese/mangamyb02.pdf.

DMR (2014), *South Africa's mineral industry 2013 - 2014 (SAMI)*. Department of Mineral Resources (DMR), Republic of South Africa, Directorate: Mineral Economics. Pretoria, South Africa.

Economic Commission for Africa (2004), *Minerals cluster policy study in Africa: Pilot studies of South Africa and Mozambique*, ECA/SDD/05/08, Addis Ababa, Ethiopia, www.africaminingvision.org/amv_resources/AMV/Mineral_cluster_study_SA_Mozambique.pdf.

EY's Global Mining & Metals Center (2015), *Mining & Metals - Resource nationalism update*, March 2015, www.ey.com/Publication/vwLUAssets/EY-resource-nationalism-update-march-2015/$FILE/EY-resource-nationalism-update-march-2015.pdf.

Fung, K. and J. Korinek (2013), "Economics of export restrictions as applied to industrial raw materials", *OECD Trade Policy Papers*, No. 155, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k46j0r5xvhd-en.

Garcia, Rene and Pierre Perron (1996), "An analysis of the real interest rate under regime dshifts", *The Review of Economics and Statistics*, 78, 111–125.

Government of Canada, Minister of Public Works and Government Services Canada (1998), *From mineral resources to manufactured products: Towards a value-added mineral and metal strategy for Canada*, Ottawa.

Government of Zambia (2008), *Customs and Excise (Amendment) Act, 2008*, 28 March 2008 available at www.zambialii.org/files/zm/legislation/act/2008/2/caea2008199.pdf.

Hansen, Bruce E. (2001), "The New Econometrics of Structural Change: Dating Breaks in U.S. Labor Productivity", *Journal of Economic Perspectives*, 15, 117–128.

International Copper Study Group (2014), *Survey of regulatory developments affecting copper: 2014*, ICSG/EEC37/5, September 2014, Lisbon, Portugal.

International Copper Study Group (2013), *Survey of regulatory developments affecting copper: 2013*, ICSG/EEC35/4, September 2013, Lisbon, Portugal.

International Copper Study Group (2012a), *Survey of regulatory developments affecting copper: 2012* Edition, ICSG/EEC33/4, October 2012, Lisbon, Portugal.

International Copper Study Group (2012b), Country profile Zambia, ICSG/EEC32/4, prepared for Environmental and Economic Committee Meeting, 32rd Regular Meeting, 26 April 2012, Lisbon, Portugal.

International Lead and Zinc Study Group (2015), Lead and Zinc statistics (database), www.ilzsg.org/static/statistics.aspx?from=1.

International Lead and Zinc Study Group (2014), *Review of trends in 2013: Lead*, Press Release of 17 February 2014, Lisbon, Portugal.

International Trade Centre (2016), *Trade Maps*, Geneva, Switzerland, http://www.intracen.org/.

International Trade Centre (2012), *Africa's Trade Potential: Export Opportunities in Growth Markets*, Doc. No. MAR-12-226.E, Geneva, Switzerland.

Korinek, J. and J. Kim (2010), "Export Restrictions on Strategic Raw Materials and Their Impact on Trade", *OECD Trade Policy Papers*, No. 95, OECD Publishing, Paris, http://dx.doi.org/10.1787/5kmh8pk441g8-en.

Kropschot, S.J. and Jeff L. Doebrich (2011), *Lead – soft and easy to cast*. Fact Sheet 2011-3045, U.S. Geological Survey, https://pubs.er.usgs.gov/publication/fs20113045.

Mobbs, Philip M. (2012), "The mineral industry of Zimbabwe", *Minerals Yearbook 2012, Volume III. -- Area Reports: International*, Advance Release, U.S. Geological Survey.

Mobbs, Philip M. (1994), "The mineral industry of Zimbabwe", *Minerals Yearbook 1994, Volume III. -- Area Reports: International*, U.S. Geological Survey.

Njini, F. (2014), Rising chrome-ore demand pressures Zimbabwe to lift export ban, *Bloomberg*, 13 March, www.bloomberg.com/news/articles/2014-03-11/rising-chrome-ore-demand-pressures-zimbabwe-to-lift-export-ban.

Nyagah, Nelly (2014), *Gabon's mining sector is under the spotlight*, Oxford Business Group, 24 March, www.matchdeck.com/article/5285-gabon-s-mining-sector-is-under-the-spotlight#/index.

OECD, Inventory of restrictions on exports of raw materials, http://qdd.oecd.org/subject.aspx?Subject=ExportRestrictions_IndustrialRawMaterials.

OECD (2014), Export restrictions in raw materials trade: Facts, fallacies and better practices, OECD, Paris. http://www.oecd.org/tad/benefitlib/export-restrictions-raw-materials-2014.pdf.

OECD (2010), The economic impact of export restrictions, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264096448-en.

Papp, J. F (2013), *Chromium*, U.S. Geological Survey, April 2013 [revised June 2013], advance release http://minerals.usgs.gov/minerals/pubs/commodity/chromium/myb1-2011-chrom.pdf.

Perron, Pierre (2006). "Dealing with Structural Breaks," in: Palgrave *Handbook of Econometrics*, Vol. 1: Econometric Theory, T. C. Mills and K. Patterson (eds.), Palgrave Macmillan, New York.

Piermartini, Roberta (2004), *The Role of Export Taxes in the Field of Primary Commodities*, World Trade Organization, Switzerland, www.wto.org/english/res_e/booksp_e/discussion_papers4_e.pdf.

Republic of South Africa, Department of Trade and Industry, International Trade Administration Commission of South Africa (2008), Consolidated list of restricted and prohibited export, Notice 672 in *Staatskoerant (Gazette*) No. 31145, 20 June 2008.

Republic of South Africa, Department of Economic Development (2014), Notice R 714 in *Staatskoerant* No. 37992, 12 September 2014, p. 3-11.

Republic of Zambia, Ministry of Mines and Minerals Development (2006), Consultation document on the Mineral Policy and Strategy for Zambia. Document compiled by SKM Consulting Associates Limited, April.

Solberg, B. et al (2010), "Forest sector market impacts of changed roundwood export tariffs and investment climate in Russia", *Forest Policy and Economics*, 12 (1), p. 17-23.

The International Manganese Institute (2011), *2011 Annual Market Research Report* (Public Report), www.manganese.org/market-research/annual-reports.

U.S. Geological Survey (2013), Minerals Yearbooks 1994 – 2010. Data set for concentration of global production of select processed minerals and the share of production by the top three producing countries. https://pubs.usgs.gov/of/2013/1184/excel/ofr2013-1184_table.xlsx.

Van der Merwe, W. H., *Strategic alignment in the South African lead industry*, Dissertation, Faculty of Management, University of Johannesburg, South Africa, October 2008, 135 p., https://ujdigispace.uj.ac.za/bitstream/handle/10210/3454/van%20der%20Merwe.pdf?sequence=1.

World Bank (2011a), *What would it take for Zambia's copper mining industry to achieve its potential?* Report No. 62378-ZM, June 2011, http://documents.worldbank.org/curated/en/461971468170956129/pdf/623780ESW0Gray0e0only0900BOX361532B.pdf.

World Bank (2011b), *What is the potential for more copper fabrication in Zambia?* Report No. 62379-ZM, June 2011, https://openknowledge.worldbank.org/bitstream/handle/10986/2812/623790ESW0P1070sclosed0Dec027020110.pdf?sequence=1&isAllowed=y.

WTO (2013), Trade policy review - *Report by the Secretariat* - *Countries of the Central African Economic and Monetary Community (CEMAC) – Revision*. WT/TPR/S/285/Rev.1, 12 December 2013.

WTO (2007a), *Trade Policy Review – Gabon*, Report by Gabon, WT/TPR/6/188 of 27 August 2007.

WTO (2007b), *Trade Policy Review – Report by the Secretariat– Gabon* - Revision WT/TPR/S/188/Rev.1, 5 December 2007.

WTO (2001), *Trade policy review* - *Report by the Secretariat – Gabon*, WT/TPR/S/86, 28 May 2001.

Yager, Thomas R., Omayra Bermúdez-Lugo, Philip M. Mobbs, Harold R. Newman, and David R. Wilburn (2007), The mineral industries of Africa, *2005 Minerals Yearbook – Africa*, U.S. Geological Survey, August 2007, 26 p., http://minerals.usgs.gov/minerals/pubs/country/2005/myb3-sum-2005-africa.pdf.

Yao, Yi-Ching (1988), "Estimating the Number of Change-points via Schwarz' Criterion," *Statistics & Probability Letters*, 6, 181–189.

Zafar, Ali (2004), *What happens when a country does not adjust to terms of trade shocks? The case of oil-rich Gabon*, World Bank Research Working Paper 3403, September 2004, http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-3403.

Zambia Development Agency (2013), *Sub-sector profile: Mineral beneficiation Industrial Minerals*, June 2013.

ANNEX 1

Methodology

A. Revealed Comparative Advantage (RCA)

The comparative advantage is reflected by a product's share in a country's total exports relative to the respective product's share in global trade. It thus reflects a country's relative level of specialisation in the production of a specific product. The RCA is calculated as follows:

$$RCA_{ik} = \frac{x_{ik}}{X_i} \Big/ \frac{x_{wk}}{X_w}$$

where x represents exports, of product *i* by country *k*, *X* represents total exports and *w* all countries. The RCA gives the share of a commodity in a country's export portfolio relative to the share of that commodity in world exports. An index of greater than one indicates a revealed comparative advantage (in exports) and an index of smaller than one reflects a comparative disadvantage. The country- and product-level export statistics (using mirror data[23]) was sourced from the UN Comtrade database and specified in the 1992 version of the harmonised system (i.e. HS92). The trends in the RCA for the selected group of raw minerals and related semi-processed products were analysed for the period from 1992 to 2012. Due to data constraints on detailed value-adding linkages at product level, only products resulting from the stages of processing associated with smelting and refining processes and simple metals fabrication are included in the scope of this study. The input-output linkages of these intermediate products are more evident from the product descriptions used in the harmonised system of product classification. These products in turn are inputs for various industries in the manufactured sector, such as automobiles and electronics, which are not considered.

The RCA index reflects is a *revealed* advantage based on export flows which does not capture instances of comparative advantages in the production of inputs and intermediates solely for domestic use. Furthermore, the RCA concept may overestimate a comparative advantage in cases where relative little value is added to imported inputs. It is however assumed that these specific situations are erratic within the context of the selected case studies as none of the countries studied imports the respective mineral ores and all of them have a revealed comparative advantage (i.e. RCA >1) in the production of these raw materials.

Another limitation that should be noted is that domestic policy distortions in terms of industry protection and support as well as exchange rates can inflate the RCA index without changes in the underlying comparative advantage. The index is however a better reflection of industry developments than just looking at trends in *nominal export values* as they do not reflect the relative global performance of the industries studied and the trend of an industry's export value is more prone to be influenced by shocks in global markets. Generally, the index represents a useful tool for investigating the pattern in the specialisation of mineral mining and processing in the selected case studies.

23. Inconsistency in the reporting of export data by the selected country case studies necessitated the use of mirror data as reported by the importing countries.

B. Least squares with breakpoints

The standard linear regression model (that is, Ordinary Least Squares or OLS) does not allow for shifts in data. Also, the method assumes that the parameters of the estimated model do not vary across observations. Yet, a shift of parameters at points in time in a sample period is of empirical importance when conducting applied time series analysis. Hence, much research has been focussed on developing testing and estimation methods for regression models which take into account shifts. These new methods have proven useful to identify shifts or breaks in data over time. Useful appraisals of the literature on this topic are provided by Hansen (2001) and Perron (2005).

To test for shifts in the level of competitiveness of mining and processing activities, specific tools were used for estimating linear regression models that are subject to structural change. If the breakpoints or shift periods are known they may be specified *a priori*, or if unknown, estimated using the Bai (1997), Bai and Perron (1998), and related techniques.

For the current case, a standard multiple linear regression model with T periods and m potential breaks (producing $m+1$ regimes[24]) is considered. For the observations $T_j, T_j+1, \dots, T_{j+1}-1$ in regime j the subsequent regression model is estimated,

$$y_t = X_t'\beta + Z_t'\delta_j + \epsilon_t \quad (1)$$

for the regimes $j = 1, \dots, m$. In the model, y_t represents the observed independent variable, X_t and Z_t denote vectors of covariates, β and δ_j $(j = 1, \dots, m+1)$ are the corresponding vectors of coefficients, and ϵ_t represents errors associated with the specification of the model (that is, the effects of omitted variables, etc.) (Bai & Perron, 1998). Also δ_j is equal to 0 before and in the same year of the introduction of the export control measure, and equal to 1 following the year of implementation for $j = 1, \dots, m+1$ years where j refers to the regimes. The regressors in the estimation are divided into two groups, that is, the X variables, which are those whose parameters do not vary across regimes; and the Z variables, which have coefficients that are regime-specific.

Though it is more suitable to define the date of a break or shift to be the last date of a regime, we instead define the date of a break to be the first date of the following regime. The endpoints are fixed by setting $T_0 = 1$ and $T_{m+1} = T + 1$.

After defining the number and identity of the breakpoints, the model is estimated using standard regression techniques. The above equation specification is rewritten as a standard regression equation,

$$y_t = X_t'\beta + \bar{Z}_t'\bar{\delta} + \epsilon_t \quad (2)$$

with fixed parameter vectors β and $\bar{\delta} = \left(\bar{\delta}_0', \bar{\delta}_1', \dots, \bar{\delta}_m'\right)$, where $\bar{Z}_t'$ is an expanded set of regressors interacted with the set of dummy variables corresponding to each of the $m+1$ regime segments (Bai, 1997; Bai & Perron, 1998).

24. A regime refers to a period of relative stability in the structure and function of a system. Regime shifts are therefore large, sudden and persistent changes in the structure and function of a system (Biggs et al., 2009). In the current case, this refers to shifts in the level of competitiveness of mining and processing activities. Regimes are considered persistent relative to the period over which a shift/change/break occurs. The change of regimes, or the shift/break, usually occurs when a smooth change in an internal process (feedback) or a single disturbance (external shock; i.e. the imposition of export controls) triggers a completely different system behaviour.

The breakpoints are either known *a priori* or they are estimated using several approaches. The breakpoint estimation approaches used in this research can be divided into two categories, that is, global *maximisers* for breakpoints and *serially determined* breakpoints. In the current case, the former is used.

Bai and Perron (1998) describe global optimization procedures for identifying the m multiple breaks and associated coefficients which minimize the sums-of-squared residuals of the regression model Equation (1).

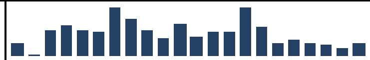
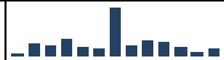
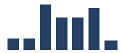
If the desired number of breakpoints is known, the global m -break optimizers are the set of breakpoints and corresponding coefficient estimates that minimize the sum-of-squares for that model (Bai, 1997; Bai & Perron, 1998). If the desired number of breakpoints is unknown, a maximum number of breakpoints may be specified and tested to determine the “optimal” number of breakpoints.

The method applied is known as the “global tests of l breaks versus none” (Bai-Perron 1998). Within this test, the test of l versus no breaks procedure is applied either sequentially, beginning with a single break until the null is not rejected, or it is applied to all breaks with the selected break being the highest statistically significant number of breaks, or it employs unweighted or weighted double maximum statistics (UDmax or WDmax). More information about this method is provided by Bai-Perron (1998).

To identify shifts in the level of competitiveness of mining and processing activities for the selected countries, a specific econometric model is used, namely least squares with breakpoints that are estimated using a global maximisers for breakpoints approach (Bai, 1997; Bai & Perron, 1998). Heterogeneous error distributions across breaks are assumed and as much as five breaks are allowed for.

ANNEX 2

Table A2.1. Analysis of Gabon's manganese industry

Stage of processing	HS code	Product	Number of years exported ('92-'13)	Average RCA>1 ('92-'13)	Avg RCA ('92-'95)	Avg RCA ('11-'13)	Trend in RCA > 1 ('92-'13)	Share of in global exports ('11-'13)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Raw mineral	**260200**	**Manganese ores and concentrates, with a mangane**	22/22	x	281.9	264.4		15%
Chemicals	282010	Manganese dioxide	16/22	x	2.9	NA		0.0%
	282090	Manganese oxides (excl. manganese dioxide)	11/22	x	0.2	0.0004		0.00001%
Semi-processed	720219	Ferro-manganese, nes	2/22		NA	0.4		0.01%
	720230	Ferro-silico-manganese	5/22		NA	0.02		0.001%
	811100	Manganese and articles thereof, including waste	4/22	x	NA	NA		0.0%
Not exported	720211	Ferro-manganese, containing by weight more than						
	722720	Bars & rods, of silico-manganese steel, hr, in						
	722820	Bars and rods of silico-manganese steel nes						
	722920	Wire of silico-manganese steel						

Note: Products subject to export controls are highlighted in **bold** (export tax of 3-3.5% / implemented in 1999 on HS260200).

Column 4: the number of years the product was exported in the period from 1992-2013 as indication of the consistency in export flows. Column 5: indication of whether the country has developed revealed comparative advantage (RCA >1) in the respective product. Columns 6 and 7: long-term trend in the comparative advantage of each product; an RCA index marked in red indicates a decrease in revealed competitiveness compared to the period 1992-1995; an increase in the RCA index is marked in green. Column 8: bar chart of the annual development in revealed comparative advantage (i.e. the RCA has to be >1) per product. Column 9: share of the country in global exports per product to indicate its position in the global market. *Source*: Own calculations based on data from UN Comtrade (2015).

Table A2.2. Structural breaks in Gabon's manganese industry

Stage of processing	HS code	Product	Avg RCA before 1999	Avg RCA after 1999	Structural breaks in RCA after XCM's (1999)	Change in RCA
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Raw mineral	**260200**	**Manganese ores and concentrates, with a mangane**	374.88	351.56	2008	-
Chemicals	282010	Manganese dioxide	5.14	1.30		
	282090	Manganese oxides (excl. manganese dioxide)	2.08	1.22		
Semi-processed	720219	Ferro-manganese, nes	0.00	0.03		
	720230	Ferro-silico-manganese	0.03	0.01		
	811100	Manganese and articles thereof, including waste	3.50	0.00		
Not exported	720211	Ferro-manganese, containing by weight more than				
	722720	Bars & rods, of silico-manganese steel, hr, in				
	722820	Bars and rods of silico-manganese steel nes				
	722920	Wire of silico-manganese steel				

Note: Products subject to export controls are highlighted in **bold** (export tax of 3-3.5% / implemented in 1999 on HS260200).

Column 4 and 5: average RCA's before and after the implementation of the export control measure: sum of RCA's / total number of years in the time-period. Column 6: structural break in RCA after XCM: statistical significant change in the level of RCA's in any year after the implementation of the export control measure (XCM) determined by the least squares with breakpoints analysis (see Annex 1), "none" indicates no structural break detected after implementation and an empty cell indicates no structural analysis could be conducted for a product due to data limitations. Column 7: change in RCA: a positive (+) or negative (-) structural break in the level of RCA.

Source: Own calculations based on data from UN Comtrade (2015).

Table A2.3. Analysis of South Africa's lead industry

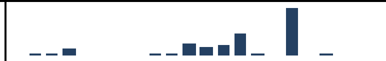
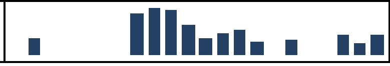
Stage of processing	HS code	Product	Number of years exported ('92-'13)	Average RCA>1 ('92-'13)	Avg RCA ('92-'95)	Avg RCA ('11-'13)	Trend in RCA >1 ('92-'13)	Share of in global exports ('11-'13)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Raw minerals	**260700**	**Lead ores and concentrates**	22/22	x	12.9	2.3		1.9%
Semi-processed	721020	Flat rlld prod,plated or coated wit	20/22		0.1	0.2		0.1%
	780110	**Lead refined unwrought**	22/22		0.6	0.2		0.2%
	780191	Lead unwrought containing by wt. an	22/22		0.2	0.6		0.5%
	780199	Lead unwrought nes	22/22		1.1	0.4		0.3%
Basic manufactures	780300	Lead bars, rods, profiles and wire	21/22	x	3.0	0.0		0.02%
	780411	**Lead sheets, strip and foil of a th**	19/22		0.0	0.1		0.1%
	780419	**Lead plates, sheet, strip and foil**	21/22		0.2	0.5		0.4%
	780420	**Lead powders and flakes**	19/22	x	3.8	0.2		0.1%
	780500	**Lead pipes or tubes and fittings (f**	19/22	x	1.9	0.1		0.1%
	780600	**Articles of lead nes**	21/22	x	1.0	1.6		1.3%

Table A2.3. Analysis of South Africa's lead industry (cont.)

Stage of processing	HS code	Product	Number of years exported ('92-'13)	Average RCA>1 ('92-'13)	Avg RCA ('92-'95)	Avg RCA ('11-'13)	Trend in RCA >1 ('92-'13)	Share of in global exports ('11-'13)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Chemicals	282410	Lead monoxide (litharge, massicot)	22/22	x	1.7	7.9		6.5%
	282420	Red lead and orange lead	22/22	x	0.3	5.0		1.6%
	282490	Lead oxides, nes	22/22	x	0.9	10.6		2.7%
	283670	Lead carbonate	11/22	x	NA	NA		NA
	284120	Chromates of zinc or of lead	20/22	x	0.2	0.2		0.1%
Secondary materials	**780200**	**Lead waste and scrap**	21/22		0.2	0.3		0.3%
Processed lead	701391	Glassware nes of lead crystal (othe	22/22		0.0	0.1		0.1%
	850720	Lead-acid electric accumulators nes	22/22		0.1	0.2		0.1%
	850710	Lead-acid electric accumulators of	22/22		0.7	0.4		0.3%

Note: Products subject to export controls are highlighted in **bold** (non-automatic export licence requirement implemented in 2008).

Column 4: the number of years the product was exported in the period from 1992-2013 as indication of the consistency in export flows. Column 5: indication of whether the country has developed revealed comparative advantage (RCA >1) in the respective product. Columns 6 and 7: long-term trend in the comparative advantage of each product, an RCA index marked in red indicates a decrease in revealed competitiveness compared to the period 1992-1995; an increase in the RCA index is marked in green. Column 8: bar chart of the annual development in revealed comparative advantage (i.e. the RCA has to be >1) per product. Column 9: share of the country in global exports per product to indicate its position in the global market. *Source*: Own calculations based on data from UN Comtrade (2015).

Table A2.4. Structural breaks in South Africa's lead industry

Stage of processing	HS code	Product	Average RCA before XCM	Average RCA after XCM (2008)	Structural breaks in RCA after XCM (2008)	Change in RCA
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Raw minerals	**260700**	**Lead ores and concentrates**	9.4	2.8	**2010**	-
Semi-processed	721020	Flat rlld prod,plated or coated wit	0.6	0.2	None	
	780110	**Lead refined unwrought**	0.3	0.4	2011	-
	780191	Lead unwrought containing by wt. an	0.5	1.1	2011	-
	780199	Lead unwrought nes	0.3	0.4	2009	+
Basic manufactures	780300	Lead bars, rods, profiles and wire	1.0	1.8	None	
	780411	**Lead sheets, strip and foil of a th**	0.6	0.1	None	
	780419	**Lead plates, sheet, strip and foil**	0.5	0.6	2011	-
	780420	**Lead powders and flakes**	1.4	0.3	2011	-
	780500	**Lead pipes or tubes and fittings (f**	4.0	0.4	2010	-
	780600	**Articles of lead nes**	1.7	1.2	2011	+
Chemicals	282410	Lead monoxide (litharge, massicot)	2.0	8.9	2010	-
	282420	Red lead and orange lead	0.4	3.2	None	
	282490	Lead oxides, nes	1.0	6.7	2011	+
	283670	Lead carbonate	1.4	1.6	None	
	284120	Chromates of zinc or of lead	1.5	0.1	2009	-
Secondary materials	**780200**	**Lead waste and scrap**	0.2	0.3	2009	+
Processed lead	701391	Glassware nes of lead crystal (othe	0.04	0.1	2011	+
	850720	Lead-acid electric accumulators nes	0.6	0.3	2010	-
	850710	Lead-acid electric accumulators of	0.8	0.4	2010	-

Note: Products subject to export controls are highlighted in **bold** (non-automatic export licence requirement implemented in 2008).

Columns 4 and 5: average RCA's before and after the implementation of the export control measure: sum of RCA's / total number of years in the time-period. Column 6: structural break in RCA after XCM: statistical significant change in the level of RCA's in any year after the implementation of the export control measure (XCM) determined by the least squares with breakpoints analysis (see Annex 1), "none" indicates no structural break detected after implementation and an empty cell indicates no structural analysis could be conducted for a product due to data limitations. Column 7: change in RCA: a positive (+) or negative (-) structural break in the level of RCA.

Source: Own calculations based on data from UN Comtrade (2015).

Table A2.5. Analysis of Zambia's copper industry

Stage of processing	HS code	Product	Number of years exported ('92-'13)	Average RCA>1 ('92-'13)	Avg RCA ('92-'95)	Avg RCA ('11-'13)	Trend in RCA >1 ('92-'13)	Share in global exports ('11-'13)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Raw mineral	**260300**	**Copper ores and concentrates**	20/22	x	0.01	1.4		0.1%
First stage semi-processed	**740200**	**Copper unrefined, copper anodes for**	21/22	x	17.2	578.6		21.8%
	740110	**Copper mattes**	18/22	x	0.04	0.5		0.01%
	740120	**Cement copper (precipitated copper)**	8/22	x				0%
Basic manufactures	740312	Wire bars, copper, unwrought	18/22	x	1430.5	NA		0%
	740313	Billets, copper, unwrought	15/22	x	13.5	1.6		0.1%
	740319	Refined copper products, unwrought,	21/22	x	6.3	139.8		1.7%
	740321	Copper-zinc base alloys, unwrought	19/22	x	2.4	0.1		0.003%
	740322	Copper-tin base alloys, unwrought	12/22		9.8	NA		0%
	740323	Copper-nickel base alloys or copper	1/22	x				NA
	740329	Copper alloys, unwrought (other tha	12/22	x	3.9	5.2		0.1%
	740500	Master alloys of copper	4/22		0.3	NA		0%
	740710	Bars, rods and profiles of refined	22/22	x	60.6	2.0		0.1%
	740721	Bars, rods and profiles of copper-z	10/22		0.1	0.2		0.004%
	740722	Bars,rods and profiles of copper-ni	1/22					0%
	740729	Bars, rods and profiles, copper all	18/22	x	8.2	1.0		0.04%
	740811	Wire of refined copper of which the	22/22	x	30.8	16.7		0.6%
	740819	Wire of refined copper of which the	22/22	x	1.8	10.0		0.02%
	740821	Wire, copper-zinc base alloy	2/22		1.3	NA		0%
	740822	Wire, copper-nickel base alloy or c	2/22					0%
	740829	Wire, copper alloy, nes	10/22		1.0	0.8		0%
	740911	Plate, sheet & strip of refined cop	12/22	x	27.9	0.1		0.005%
	740919	Plate,sheet&strip of refined copper	21/22	x	306.3	15.9		0.6%
	740921	Plate,sheet&strip of copper-zinc ba	5/22		0.5	NA		0.0%
	740929	Plate,sheet&strip of copper-zinc ba	5/22	x	NA	25.4		1.3%

Table A2.5. Analysis of Zambia's copper industry (cont.)

Stage of processing	HS code	Product	Number of years exported ('92-'13)	Average RCA>1 ('92-'13)	Avg RCA ('92-'95)	Avg RCA ('11-'13)	Trend in RCA >1 ('92-'13)	Share in global exports ('11-'13)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Basic manufactures	740931	Plate, sheet & strip of copper-tin	1/22		0.5	NA		0%
	740940	Plate,sheet&strip of copper-nickel	1/22		2.3	NA		0%
	740990	Plate, sheet & strip of copper allo	9/22	x	0.8	0.7		0.01%
	741012	Foil, copper alloy, not backed	1/22					0%
	741021	Foil of refined copper, backed	3/22					0%
	741110	Pipes and tubes, refined copper	3/22		0.1	NA		0%
	741121	Pipes and tubes, copper-zinc base a	2/22		NA	0.0004		0%
	741122	Pipes and tubes,copper-nickel base	1/22					0%
	741129	Pipes and tubes, copper alloy, nes	6/22	x	11.0	NA		0%
	741210	Fittings, pipe or tube, of refined	2/22		NA	0.0003		0%
	741220	Fittings, pipe or tube, copper allo	8/22		0.02	0.0001		0%
	741300	Stranded w ire,cable,plaited bands a	12/22	x	0.5	7.6		0.3%
	854411	Insulated (including enamelled or a	18/22		0.3	0.05		0.001%
Chemicals and powders	282550	Copper oxides and hydroxides	8/22	x	NA	0.2		0.005%
	282741	Chloride oxides and chloride hydrox	7/22		133.3	0.02		0.0004%
	283325	Sulphates of copper	4/22		NA	NA		0%
	740311	Copper cathodes and sections of cat	22/22	x	353.5	123.7		4.8%
	740610	Pow ders, copper, of non-lamellar st	2/22					0%
	740620	Pow ders, copper, of lamellar struct	3/22					0%
Secondary materials	262030	Ash and residues containing mainly	18/22	x	0.4	397.8		7.8%
Not exported	740939	Plate,sheet&strip of copper-tin bas						
	741011	Foil of refined copper, not backed						
	741022	Foil, copper alloy, backed						

Note: Products subject to export controls are highlighted in bold (export tax 15% implemented in 2008, non-automatic export licensing requirement in 2011).
Column 4: the number of years the product was exported in the period from 1992-2013 as indication of the consistency in export flows. Column 5: indication of whether the country has developed revealed comparative advantage (RCA >1) in the respective product. Columns 6 and 7: long-term trend in the comparative advantage of each product, an RCA index marked in red indicates a decrease in revealed competitiveness compared to the period 1992-1995; an increase in the RCA index is marked in green. Column 8: bar chart of the annual development in revealed comparative advantage (i.e. the RCA has to be >1) per product. Column 9: share of the country in global exports per product to indicate its position in the global market.
Source: Own calculations based on data from UN Comtrade (2015).

Table A2.6. Structural breaks in Zambia's copper industry

Stage of processing	HS code	Product	Avg RCA before 2008	Avg RCA 2008-2012	RCA 2013	Structural breaks in RCA after XCM's (2008)	Change in RCA
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Raw mineral	**260300**	**Copper ores and concentrates**	10.91	10.08	1.42	2010	-
First stage semi-processed	**740200**	**Copper unrefined, copper anodes**	31.56	530.26	537.07	2009	+
	740110	**Copper mattes**	10.90	92.59	0.90		
	740120	**Cement copper (precipitated copper)**	62.15	7.19			
Basic manufactures	740312	Wire bars, copper, unw rought	404.52	0.18			
	740313	Billets, copper, unw rought	18.33	5.19			
	740319	Refined copper products, unw rought,	46.49	21.84	249.45		
	740321	Copper-zinc base alloys, unw rought	1.92		0.14		
	740322	Copper-tin base alloys, unw rought	3.81				
	740323	Copper-nickel base alloys or copper	1.57				
	740329	Copper alloys, unw rought (other tha	1.56		5.37		
	740500	Master alloys of copper	0.12				
	740710	Bars, rods and profiles of refined	26.41	2.71	0.23	none	
	740721	Bars, rods and profiles of copper-z	0.13	0.06			
	740722	Bars,rods and profiles of copper-ni	0.70				
	740729	Bars, rods and profiles, copper all	3.50	0.80	2.24		
	740811	Wire of refined copper of w hich the	27.47	22.43	17.07	2010	-
	740819	Wire of refined copper of w hich the	13.44	3.44	28.92	none	
	740821	Wire, copper-zinc base alloy	0.10				
	740822	Wire, copper-nickel base alloy or c		2.37			
	740829	Wire, copper alloy, nes	0.62	0.46			
	740911	Plate, sheet & strip of refined copper	1.03	0.07	0.06		
	740919	Plate, sheet & strip of refined copper	657.99	10.05	0.77	2008	+

Table A2.6. Structural breaks in Zambia's copper industry (cont.)

Stage of processing	HS code	Product	Avg RCA before 2008	Avg RCA 2008-2012	RCA 2013	Structural breaks in RCA after XCM's (2008)	Change in RCA
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Basic manufactures	740921	Plate,sheet&strip of copper-zinc ba	0.32				
	740929	Plate,sheet&strip of copper-zinc ba	0.10	25.37			
	740931	Plate, sheet & strip of copper-tin	0.03				
	740940	Plate,sheet&strip of copper-nickel	0.14				
	740990	Plate, sheet & strip of copper allo	45.31		0.75		
	741012	Foil, copper alloy, not backed					
	741021	Foil of refined copper, backed					
	741110	Pipes and tubes, refined copper	0.01				
	741121	Pipes and tubes, copper-zinc base	0.01				
	741122	Pipes and tubes,copper-nickel base					
	741129	Pipes and tubes, copper alloy, nes	1.50	8.34			
	741210	Fittings, pipe or tube, of refined					
	741220	Fittings, pipe or tube, copper allo					
	741300	Stranded wire,cable,plaited bands	0.13	3.20	9.66		
	854411	Insulated (including enamelled or a	0.13		0.06		
Chemicals and powders	282550	Copper oxides and hydroxides	0.27	0.67			
	282741	Chloride oxides and chloride hydrox	3.78	0.01			
	283325	Sulphates of copper		0.09			
	740311	Copper cathodes and sections of	226.46	118.44	129.32	2009	-
	740610	Powders, copper, of non-lamellar st		0.36			
	740620	Powders, copper, of lamellar struct	0.05				
Secondary materials	262030	Ash and residues containing mainly	199.74	536.42		none	
Not exported	740939	Plate,sheet&strip of copper-tin bas					
	741011	Foil of refined copper, not backed					
	741022	Foil, copper alloy, backed					

Note: Products subject to export controls are highlighted in bold (export tax 15% implemented in 2008, non-automatic export licensing requirement in 2011).
Columns 4 and 5: average RCA's before and after the implementation of the export control measure: sum of RCA's / total number of years in the time-period. Column 6: structural break in RCA after XCM: statistical significant change in the level of RCA's in any year after the implementation of the export control measure (XCM) determined by the least squares with breakpoints analysis (see Annex 1), "none" indicates no structural break detected after implementation and an empty cell indicates no structural analysis could be conducted for a product due to data limitations. Column 7: change in RCA: a positive (+) or negative (-) structural break in the level of RCA. *Source*: Own calculations based on data from UN Comtrade (2015).

Table A2.7. Analysis of Zimbabwe's chromium industry

Stage of processing	HS code	Product	Number of years exported ('92-'13)	Average RCA>1 ('92-'13)	Avg RCA ('92-'95)	Avg RCA ('11-'13)	Trend in RCA > 1 ('92-'13)	Share in global exports ('11-'13)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Raw mineral	**261000**	**Chromium ores and concentrates**	19/22	x	8.63	48.04		0.8%
Chemicals	281910	Chromium trioxide	4/22					0.0%
	281990	Chromium oxides and hydroxides (exc	5/22		1.08	NA		0.0%
	283323	Sulphates of chromium	2/22					0.0%
Semi-processed	261900	Slag, dross, etc, from the manufact	1/22					0.0%
	320620	Pigments and preparations based on	7/22			0.09		0.001%
	720241	Ferro-chromium containing by weight	22/22	x	181.92	244.81		3.3%
	720249	Ferro-chromium, nes	22/22	x	293.24	0.82		0.01%
	720250	Ferro-silico-chromium	20/22	x	907.80	1.28		0.006%
	811220	Chromium and articles thereof, incl	2/22			2.28		0.02%

Note: Products subject to export controls are highlighted in bold (export ban implemented in 2007; export tax of 15-20% implemented in 2010; export ban in 2011).

Column 4: the number of years the product was exported in the period from 1992-2013 as indication of the consistency in export flows. Column 5: indication of whether the country has developed revealed comparative advantage (RCA >1) in the respective product. Columns 6 and 7: long-term trend in the comparative advantage of each product, an RCA index marked in red indicates a decrease in revealed competitiveness compared to the period 1992-1995; an increase in the RCA index is marked in green. Column 8: bar chart of the annual development in revealed comparative advantage (i.e. the RCA has to be >1) per product. Column 9: share of the country in global exports per product to indicate its position in the global market.

Source: Own calculations based on data from UN Comtrade (2015).

Table A2.8. Structural breaks in Zimbabwe's chromium industry

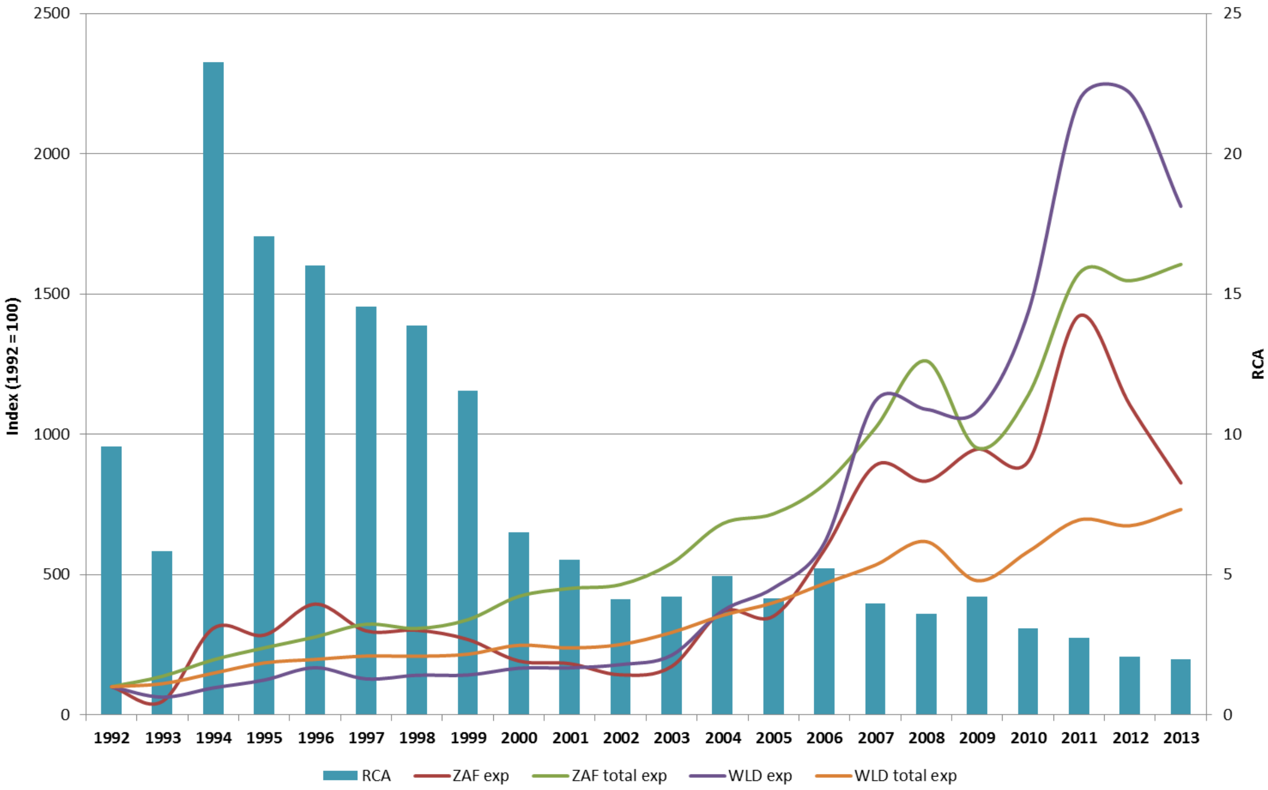
Stage of processing	HS code	Product	Avg RCA before 2007	Avg RCA 2008-2009	RCA 2010	Avg RCA after 2011	Structural breaks in RCA after XCM's (2007)	Change in RCA
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*		*(7)*	*(8)*
Raw mineral	**261000**	**Chromium ores and concentrates**	2.69	41.09	200.49	0.38	2010	+
							2012	-
Chemicals	281910	Chromium trioxide	0.09					
	281990	Chromium oxides and hydroxides (exc	0.01	0.31				
	283323	Sulphates of chromium	0.18					
Semi-processed	261900	Slag, dross, etc, from the manufact		0.00007				
	320620	Pigments and preparations based on	0.0035			0.0171		
	720241	Ferro-chromium containing by weight	209.39	212.50	283.36	246.23	none	
	720249	Ferro-chromium, nes	219.76	2.10	2.02	0.22	none	
	720250	Ferro-silico-chromium	489.48	246.72	68.27	0.64	2009	+
	811220	Chromium and articles thereof, incl	0.0002					

Note: Export restriction applicable to products highlighted in bold (export ban implemented in 2007; export tax of 15-20% implemented in 2010; export ban in 2011).

Columns 4 and 5: average RCA's before and after the implementation of the export control measure: sum of RCA's / total number of years in the time-period. Column 6: structural break in RCA after XCM: statistical significant change in the level of RCA's in any year after the implementation of the export control measure (XCM) determined by the least squares with breakpoints analysis (see Annex 1), "none" indicates no structural break detected after implementation and an empty cell indicates no structural analysis could be conducted due to data limitations. Column 7: change in RCA: a positive (+) or negative (-) structural break in the level of RCA.
Source: Own calculations based on data from UN Comtrade (2015).

ANNEX 3

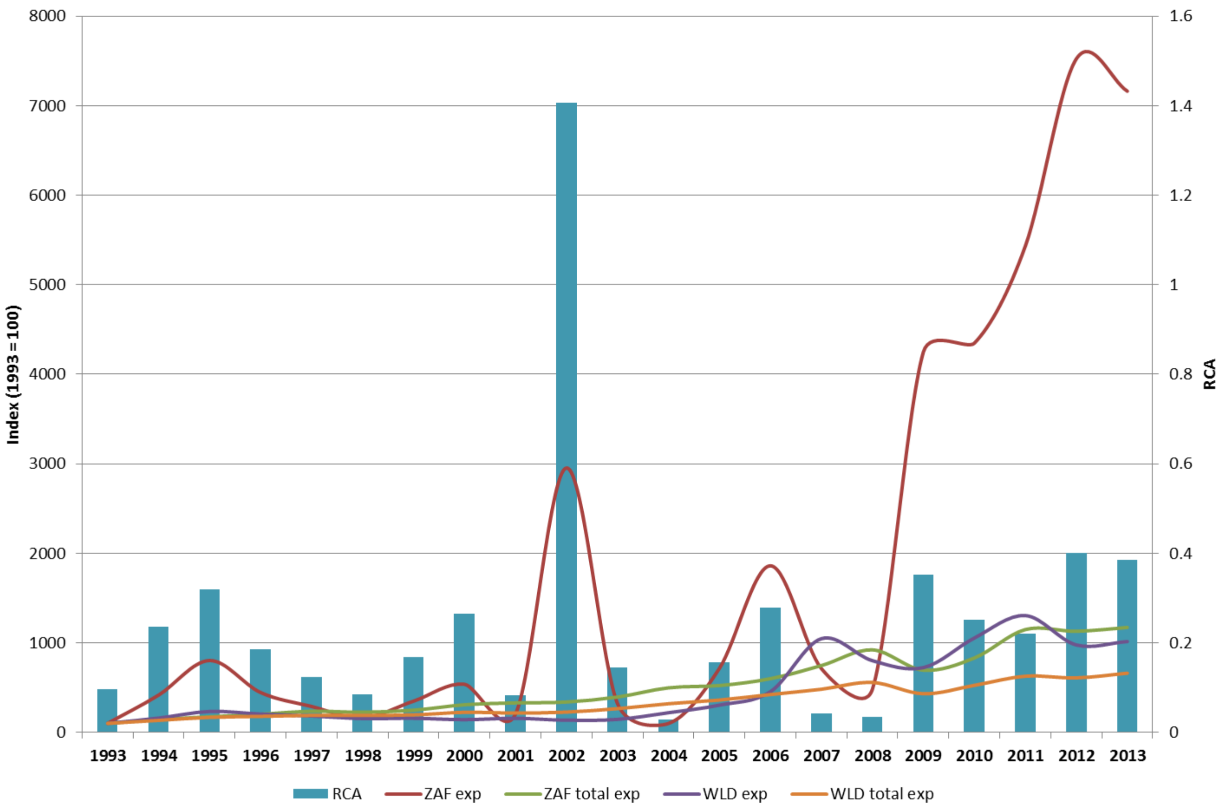
Figure A3.1. Decomposition of South Africa's revealed comparative advantage (RCA) in lead ores (mine production)



Note: The RCA index is plotted on the secondary y-axis. ZAF– South Africa; WLD – World. (exp. – export of lead ores and concentrate; total exp. – total exports)

Source: Own calculations based on data from UN Comtrade (2015).

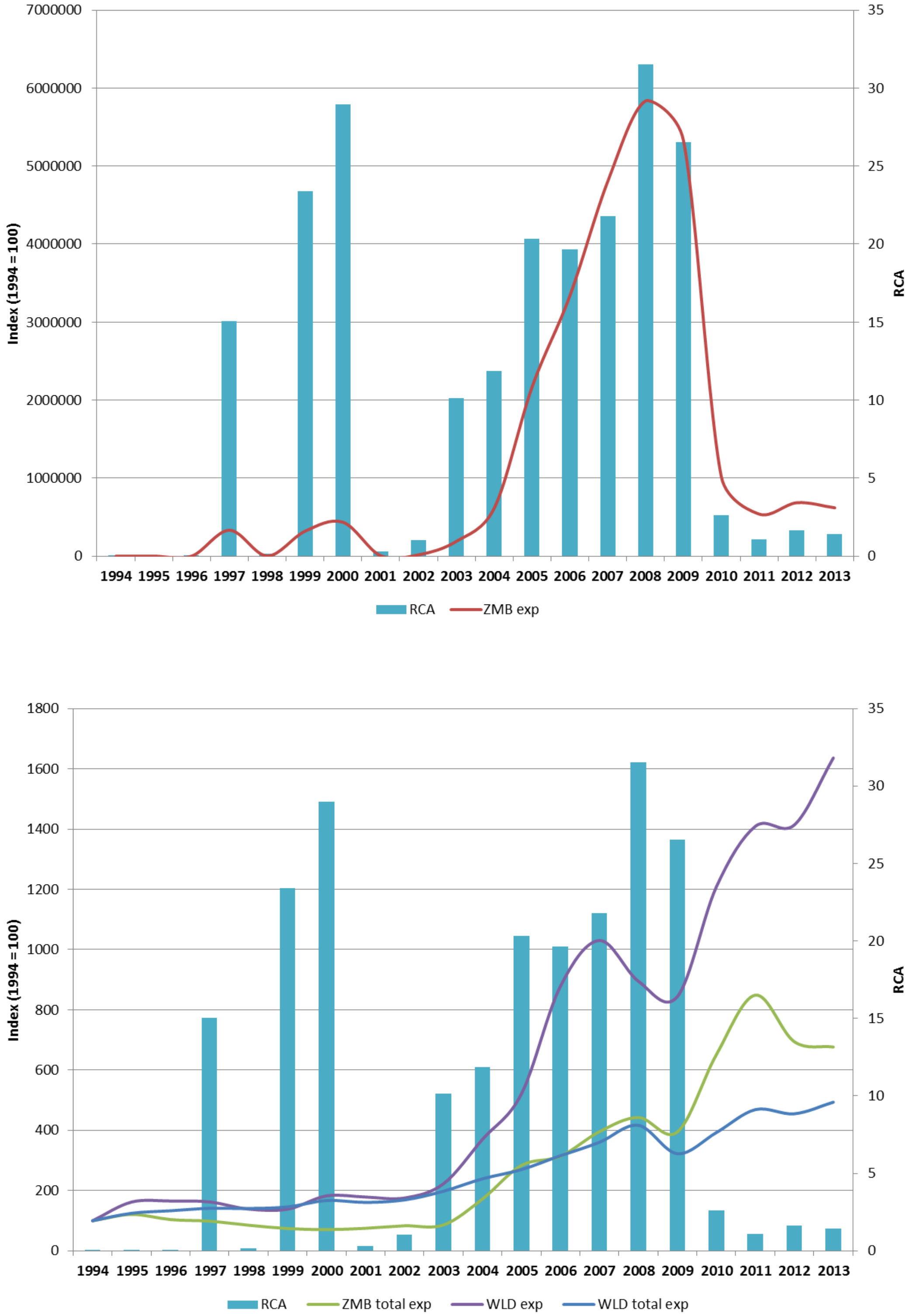
Figure A3.2. Decomposition of South Africa's revealed comparative advantage (RCA) in lead waste and scrap



Note: The RCA index is plotted on the secondary y-axis. ZAF– South Africa; WLD – World. (exp. – export of lead waste and scrap; total exp. – total exports)

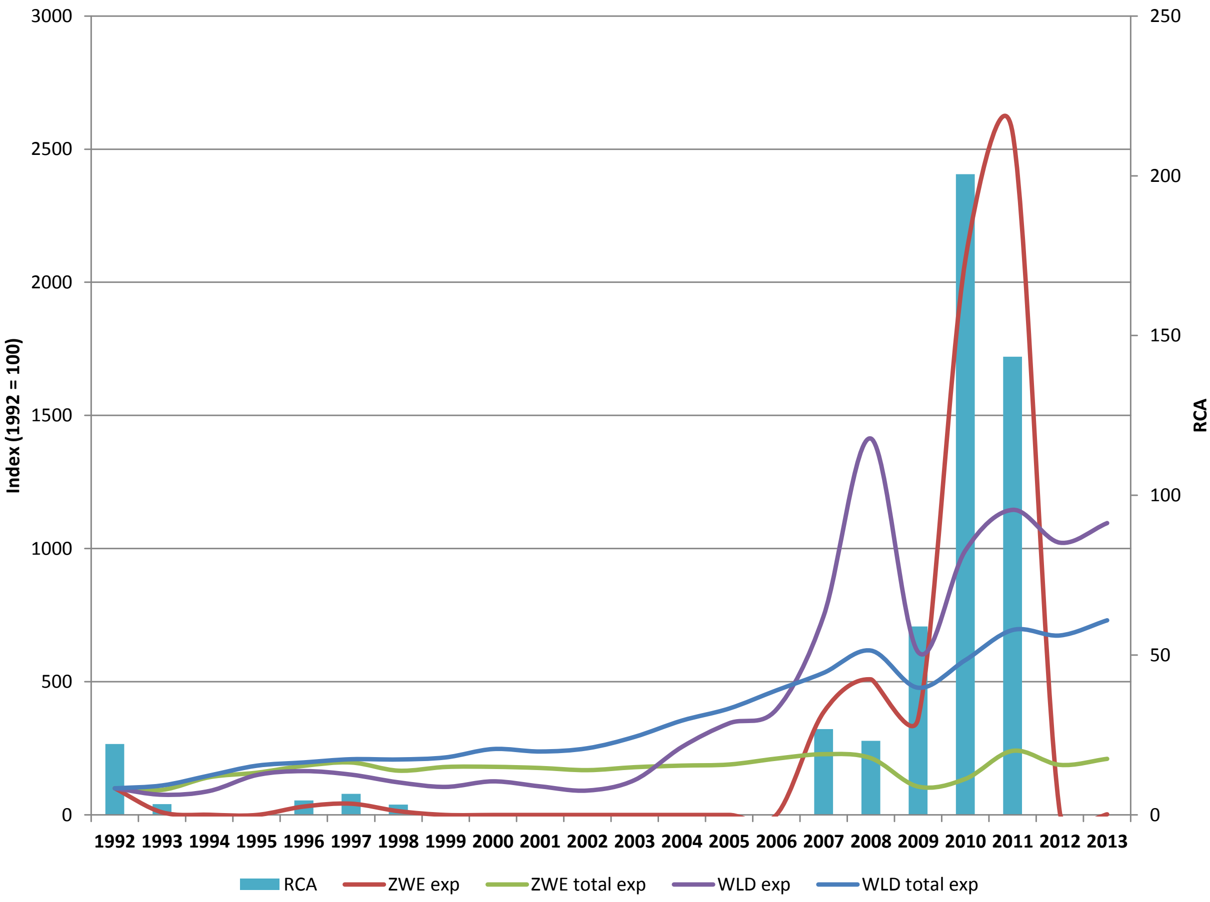
Source: Own calculations based on data from UN Comtrade (2015).

Figure A3.3. Decomposition of Zambia's revealed comparative advantage (RCA) in copper ores (mine production)



Note: The RCA index is plotted on the secondary y-axis. ZMB – Zambia, WLD – World. (exp. – export of copper ores and concentrate; total exp. – total exports)
Source: Own calculations based on data from UN Comtrade (2015).

Figure A3.4. Decomposition of Zimbabwe's revealed comparative advantage (RCA) in chromium ores



Note: The RCA index is plotted on the secondary y-axis. ZWE – Zimbabwe, WLD – World. (exp. – export of chromium ores and concentrate; total exp. – total exports)

Source: Own calculations based on data from UN Comtrade (2015).

ANNEX 4

Box A4.1. Manganese mining and processing: The story told by Eramet

Mining and transportation

Manganese ore is mined from Moanda, Gabon, Africa. After it is extracted from the earth, the ore is sent across the country via rail to the port of Owendo, where it is loaded onto ships bound for the United States.

Once in the United States, the ore travels by barge to the Eramet Marietta facility located on the Ohio River. Once the ore makes it to the plant, it is off-loaded and moved to Eramet Marietta's Product Yard until ready for mixing.

Manganese mixing

Once the manganese ore is ready for mixing and refining, it is sent to Eramet Marietta's mixhouse, where production employees combine it with additional materials to create the manganese alloy product ordered by customers.

Eramet Marietta makes two kinds of manganese: silicomanganese and refined ferromanganese, each of which is used in unique final applications.

Manganese refining process

After manganese ore is combined with other raw materials, the mix is added to a submerged arc electric furnace, where it is smelted. Smelting is the process of heating ore, causing it to react with other materials to remove impurities and extract a more pure form of metal.

After smelting, for Eramet Marietta's ferromanganese product, the refining process continues. The molten metal undergoes an oxygen spargging process which helps to further purify the product.

Manganese tapping

Once the manganese alloys have been smelted, and have reached the desired temperature, the furnace is "tapped" and the molten material flows from the furnace into a ladle. Impurities rise to the top, which are then poured off into a series of cascading slag pots. The result of this tapping and pouring process is a purer manganese product. Once the product is sufficiently separated from the impurities or "slag," it is poured into casting "beds" to mold into a workable shape.

Manganese cooling and stacking

In the final step of this phase, large slabs of manganese alloy are cast, cooled and transported to the Product Yard to continue cooling.

Crushing

Manganese isn't a one-size-fits-all material. When a customer places an order, the cooled product slabs are transported to Eramet Marietta's crusher system where the manganese is broken up into a variety of sizes according to the customer's specifications.

Packing and shipping

Once the manganese alloys have been sized correctly, the product is generally loaded into trucks, although some orders are packaged in bags, and shipped to customers, most of which are located within 500 miles of our southeastern Ohio plant.

Many of the largest customers are steelmakers. Once the manganese is added, the steel can be molded into many things.

Source: adapted from www.erametmarietta.com/first-steps-of-manganese-processing.

ANNEX 5

Box A5.1. Emerging Gabon:
The development strategy of the Government of Ali Bongo Ondimba

" … In the past, Gabon relied on the export of primary materials. Today, the country is committed to diversifying its economy and becoming an emerging economic power by 2020 through its sustainable development strategy referred to Emergent Gabon. The new strategy is built on three pillars:

"Gabon Vert" (Green Gabon): to sustainably develop Gabon's natural resources.

"Gabon Industriel" (Industrial Gabon): to promote local processing of primary materials, export of high value-added products.

"Gabon des Services" (Services Gabon) to develop the Gabonese workforce to become a regional leader in financial services, ICT, with green economy, higher education and health level.

The emerging Gabonese economy is based on the domestic conversion of raw materials. "The Industrial Gabon" component will draw on the domestic processing of our raw materials to produce goods. No country can grow by relying solely on raw material exports. The dynamic trend has started with the ferro-manganese production which will be consolidated thanks to the exploitation of new manganese deposits, the construction of new railway sidelines and the exploitation of iron from Belinga. In the long term, Gabon will become a metallurgy centre, with a dynamic fabric of SMEs exporting iron-based products to the whole subregion and beyond ..."

Source: Republic of Gabon - Promoting exploration, mining and investment. Statement (undated) by Head of State Ali Bongo Ondimba, available at ONDIMBA www.mines.gouv.ga/object.getObject.do?id=730.