NWU BUSINESS SCHOOL

A DOCUMENT OF STRATEGIC INTENT REGARDING THE MERITS OF A PROPOSED EXPORT TAX ON CHROME ORE IN SOUTH AFRICA

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"It is our time to proudly have South African decisions made for South Africans, which will, in turn, benefit the ailing South African economy"
Gadifele Mokgabudi (2021)

EXECUTIVE SUMMARY

The South African Reserve Bank (2021) reported December 2013 as the commencement of the longest downward phase in the South African business cycle since 1945, when such analyses commenced — this is the longest downward phase since World War II. Like most African countries, South Africa finds itself challenged by the so-called 'resource curse'. Although the continent holds the majority of the world's known resources, African countries have not been able to leverage these assets to create prosperity for their people.

Various ministers, and, over the past few years, also President Cyril Ramaphosa of South Africa, have expressed support for industrialisation of the South African value chain. Government started to introduce mechanisms such as export taxation in the scrap steel industry to increase local beneficiation. A chrome ore export tax was approved by Cabinet in October 2020, but is yet to be implemented.

Taking the lead, the North-West Business School conducted extensive multi-disciplinary scientific research to study the merits of a proposed export tax on chrome ore and the influence thereof on the chrome–ferrochrome value chain.

This document gives a synopsis of the research report. The research approach was one of mixed methods, and, because of the multi-disciplinary nature of the problems facing industry, the PESTEL analyses technique was followed.

From the research, it is evident that there would be both positive and negative effects of the proposed chrome ore export taxation. The energy crisis and, specifically, Eskom pricing create a major challenge for South Africa, but also for energy-intensive industries such as ferrochrome smelting. The rising electricity price, together with downward trends in chrome ore prices, resulted in China overtaking South Africa as the largest ferrochrome manufacturer, despite the fact that South Africa holds over 72% of the world's chrome resources.

The research made use of the Revealed Trade Index developed by Vollrath in 1991, which showed that South Africa has a high level of competitiveness in both chrome ore and ferrochrome. However, it is disturbing that the level of competitiveness in ferrochrome shows a decreasing trend over time, whilst that of

chrome ore is increasing. The opposite would be more favourable from an economic development perspective.

Making use of the SMART software (Software for Market Analyses and Restrictions on Trade), the analysis shows that chrome exports will decrease depending on the level of taxation, but could potentially increase domestic ferrochrome production by between 53% and 107%, again depending on the level of taxation.

The study revealed that it is important to differentiate taxation between the various types of chrome ore — cheap UG2 (low-grade chrome ore produced as a by-product in the platinum process) should be levied at a higher rate than traditional mining of chromite seams. Based on the research, a differentiation of between 30% and 40% should be considered. Using the proposed taxation percentage of TIPS (2019, updated 2020) of 30%, this would result in 30% export taxation on traditional chromite seams and 60% to 70% on the low-grade by-product seams. Similarly, using 10% as a base for the traditional seams will result in a 40% to 50% taxation on the low-grade seams.

Recent case studies on interventions in countries such as Indonesia, India, Russia, Zimbabwe, and many others have shown that, when specific criteria are met, interventions such as export taxation are, overall, positive for the country.

In breaking news, the latest taxation applied as an interventionist measure occurred in Indonesia, which has already banned a number of unprocessed ore exports, including nickel, tin, and copper, to stimulate downstream industry development, including batteries for electric vehicles, stainless steel and the aluminium industry. The country's president, Joko Widodo, said the country is planning to "hit the brakes" on the export of all commodities, in efforts to encourage investment and create jobs in the domestic economy.

From the research it is apparent that the South African chrome sector meets the criteria to successful implement export taxation; albeit a short- to medium-term intervention to create a period within which to address domestic challenges such as energy.

With more detail given in this synopsis, it is evident that export taxation on chrome ore can be successful if the following criteria are met: South Africa has significant market power; there is beneficiation capacity downstream; South African chrome ore cannot easily be displaced; and the country has the necessary know-how, knowledge, and capacity to beneficiate. From the research, it is apparent that South Africa meets these criteria in terms of the chrome sector. This said, taxation should only be used as a short- to medium-term intervention to create a period in which to address domestic challenges such as energy.

In a question-and-answer session between President Ramaphosa and the North-West Chamber of Commerce and Industry on 8 October 2021, President Ramaphosa confirmed the government's intent to implement an export taxation on chrome ore, in order to improve the chrome–ferrochrome value chain for beneficiation in South Africa.

This study concluded that such a differentiated export taxation on chrome ore meets the criteria identified in the research, and that such taxation will increase domestic ferrochrome production, which, in turn, will support the South African economy by creating employment opportunities, increasing local spend, driving development, and adding to the value chain. Such taxation should only be used in the short to medium term, during which period South Africa and industry need to overcome challenges, particularly those related to energy.

INTRODUCTION

The Business School of the North-West University (NWUBS) completed a research project to determine the merits of a proposed export tax on chrome ore in South Africa as one of the interventions to regain the global competitive advantage of the domestic ferrochrome industry, as well as the influence thereof on the chrome–ferrochrome value chain (CFcVC). This synopsis summarises the full report completed by the NWUBS research team. The references of the full research report are included in this synopsis.

The team was made up of members of various departments and universities. These members are:

PROJECT LEADER

Prof R Lotriet

NWU Business School. Professor in Strategy. Exco member of the North-West Chamber of Commerce

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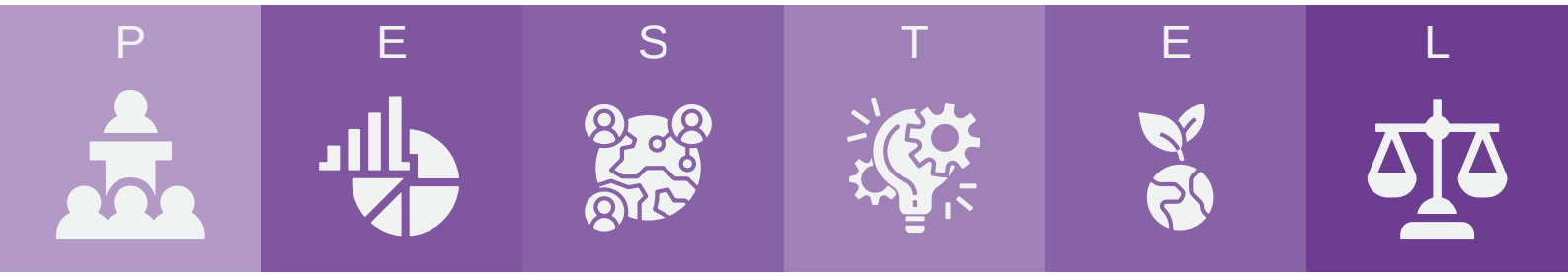
RESEARCH APPROACH

The research approach was one of mixed methods, where secondary data were mined and interviews were conducted with a number of decision-makers in the CFcVC, including C-suite executives, local government, organised labour, investors, a representative of a special economic zone, and financiers in the broader ferrochrome mining space. The research team surveyed a comprehensive range of publications (industry-specific news articles, textbooks, journals, authoritative websites, and conference papers), and focused on those that had direct relevance to the purpose of the research project. Case study analysis was also done to review some of the many instances where export taxes had been utilised over time as trade protection and for other aims by countries across the globe. Because of the multi-disciplinary nature of the problems facing the ferrochrome industry, the PESTEL analysis technique (*Political*, *Economic*, *Social*, *Technological*, *Environmental*, and *Legal* factors) was followed to clarify the dominant threats to and opportunities for the industry going forward. Limitations to the study are also noted in the master report.



CONTEXT

"Mining remains a sunrise sector that can still sustainably develop our country" (DMRE, 2021).

Currently, South Africa's chrome ore is largely unbeneficiated, with excess capacity available in the South African smelting industry. In order to enhance domestic beneficiation, an export tax on chrome ore was approved by the South African Cabinet in 2020, but has not yet been implemented. The research focus is predominantly on the activities of the CFcVC, although the broader context of the mining sector in South Africa and macro-economic indicators cannot be ignored. Therefore, cases where export taxes had been utilised to further and protect industrial socio-economic beneficiation were examined.

POLITICAL CONSIDERATIONS

The political landscape research spans the period 2022 to 2029. Political risk is, to a significant extent, impacted upon by economic risk. Despite beneficiation being official government policy, most South African commodities are exported with very limited beneficiation or benefit to the fiscus. President Ramaphosa and the Minister of Trade, Industry, and Competition, Ebrahim Patel, have expressed, through numerous policy documents, support for industrialisation of the South African value chain.

With an unemployment rate of 34.4% in the second quarter of 2021, it seems logical and obvious that government would use all statutory means possible to encourage beneficiation. The ideal is for capital owners to find value in an evolving value chain.

In terms of international relations, the political ties between South Africa and China are described as strong, and are consolidated in the co-operative arrangements between the BRICS countries (Brazil, Russia, India, China, and South Africa). In the context of this relationship and the shared ideological disposition between China and South Africa, any trade relationship between the two countries, such as trade tariffs, will come about through consultation. In interviews during this research with union representatives experienced in negotiating a duty on scrap metal, it was notable that government representatives from China featured in many meetings, with the obvious intension to influence the process.

Two scenarios are presented, both within the realm of likely political outcomes. The pragmatist scenario suggests conditionalities of low risk and high economic return, while the populist scenario contains conditionalities of high risk and low economic return. Current conditionalities, on a continuum, correlate with the second (populist) scenario. Both scenarios assume that the existing political regime of South Africa will continue, but the outcomes of the scenarios vary significantly. Each scenario contains several variables identified as important considerations. There is currently no indication that the ANC will lose either its absolute majority or relative majority (which will allow the party to continue to govern in coalitions) for the next two national and provincial elections. Any new tax dispensation to benefit beneficiation will have to be negotiated in that context.

The motivation for two scenarios is that capital either finds the conditionalities conducive to operational traction in a political economy (pragmatist scenario), or operates under high-risk–low-return circumstances (populist scenario). Many observers have described the current situation of South Africa as a high-risk–low-return ratio. In a pragmatist, high-growth–high-return scenario, government policies include compromises between state, capital, and labour, aimed at industrialisation and beneficiation, specifically in the mining, manufacturing, and energy sectors of the economy. Government's ideal of developing a value chain of beneficiation never truly came to fruition. In various public speeches during 2021, President Ramaphosa expressed the need for the industrialisation of the economy and evolution of the value chain through beneficiation.

In South Africa, massive unemployment and disinvestment in industries and economic sectors that historically absorbed low-skilled labour have led to various legislative, statutory, and policy initiatives. Many of these initiatives are aimed at adding value and opportunities through beneficiation and industrialisation. These include the National Development Plan (Republic of South Africa, 2012), the Industrial Policy Action Plan (Department of Trade and Industry, 2013), and the Minerals Beneficiation Strategy (Department of Mineral Resources, 2011). These legislative and policy regimes have generally not translated into sustainable investment and development, especially in the agricultural and mining sectors, which have the capacity to absorb low-skilled labour.

The chrome–ferrochrome industry lends itself perfectly to President Ramaphosa's need for industrialisation of the economy and value-chain evolution through beneficiation, which should be pursued as a matter of urgency.

ECONOMIC CONSIDERATIONS

The South African Reserve Bank (2021) reported December 2013 as the commencement of the longest downward phase in the South African business cycle since 1945, when such analyses commenced. It is clear that the domestic economy was already in difficulty before the first Covid-19 lockdown, in March 2020[1].

[1] **This synopsis was completed before the publication of the revised and rebased GDP data by Statistics South Africa on 25 August 2021, and the revised figures are not used in this report. There are marginal differences between the actual figures, economic growth rates, and ratios expressed as percentages of the GDP in this report and the revised and rebased figures and data. In addition, the base year used for real calculations in this report is 2010, while the base year for real calculations has been revised to 2015. These changes in actual figures and in the base year do not indicate a change in the trends highlighted in this report, or the conclusions reached.**

Over the past decade, South Africa recorded economic growth of about 1.5% per annum or lower, which compares poorly with growth over the same period in other emerging economies, with the country slipping in comparison to its peers. South Africa's gross domestic product (GDP) declined by 7% in 2020 (StatsSA, 2021), which wiped out most of the economic growth recorded over the past decade. Moreover, if the economy is not lifted to a higher growth trajectory, it will take three or four years to regain the level of economic activity recorded at the end of 2019.

More disconcerting is the fact that the South African business cycle phases calculated by the South African Reserve Bank (2021) show that the country has been in a downward phase since December 2013, i.e. for more than seven years. This is the longest downward phase since WWII, well exceeding the downward phase of four-and-a-half years (55 months) recorded from March 1989 to May 1993. At the same time, South Africa's population growth continues at a rate around 1.5% per annum (World Bank, 2021). As a result, South Africa's GDP per capita has been on a declining trend or stagnating since 2015.

South Africa's long-term potential growth rate declined over time, from a level around 3% per annum, initially to a level around 2.5% per annum, and recently to a level around 1.5% per annum (Anvari, Ehlers & Steinbach, 2014). This decline in South Africa's growth potential was confirmed by Fedderke and Mengisteab (2016).

Table 1: The South African economy: Summary of performance, 2015 - 2020

	2015A	2016A	2017A	2018A	2019A	2020A
Real GDP (% change)	1.3%	0.6%	1.2%	0.7%	0.1%	- 7.0%
Real gross fixed investment (% change)	2.5%	-3.5%	1.0%	-1.4%	-0.9%	- 17.5%
Exports (% change)	2.8%	1.0%	-0.1%	2.0%	-2.5%	- 10.3%
Imports (% change)	5.4%	-3.8%	1.6%	3.8%	-0.5%	- 16.6%
Inflation (average) CPI	4.6%	6.4%	5.3%	4.7%	4.1%	3.3%
Unemployment rate (annual average)	25.3%	26.7%	27.5%	27.1%	28.7%	29.2%
Current account: % of GDP (annual average)	-4.6%	-2.8%	-2.4%	-3.7%	-3.7%	2.2%
Interest rates						
Three-month JIBAR annual average	6.6%	7.4%	7.2%	7.2%	6.9%	4.4%
Prime overdraft rate end of period	9.75%	10.50%	10.25%	10.25%	10.00%	7.00%
Long-term bond annual average	8.17%	9.02%	9.09%	9.55%	9.15%	9.83%
Exchange rates						
US$/ZAR (average)	12.77	14.71	13.26	13.19	14.50	16.46
€/ZAR (average)	14.10	16.22	15.06	15.61	16.18	18.77

Sources: Statistics South Africa, South African Reserve Bank, and own calculations from various sources

President Ramaphosa, in a press release on 3 September 2021, confirmed that South Africa is experiencing an unemployment crisis. Porter and Rivkin (2014:4-10) remarked that workers are captives of the weakest aspects of a business environment, and that *"any leader with a long view understands that business has a profound stake in the prosperity of the average citizen"*. Even before assuming the presidency, President Ramaphosa announced a 'New Deal' at an ANC conference in Soweto in 2017 (Institute of Race Relations, 2019). Promising to create *"at least one million jobs in five years"*, President Ramaphosa identified the primary strategy as *"largely manufacturing-led"*. This must include considerably more effective exploitation of South Africa's natural resources. As President Ramaphosa emphasised, the intention of government is *"to address the decline over many years of our manufacturing capacity, which has deeply affected employment and exports."*

Various role players from business and labour, as well as community leaders, signed a framework agreement at the Jobs Summit, aimed at creating 275 000 jobs every year for the next five years (Sibongile & Niselow, 2018). The deal includes a promise by government that it will not cut any jobs in the public sector and will fill all critical vacancies, while private-sector representatives committed to *"do everything possible"* to avoid job losses. Some of the plans included in the agreement that President Ramaphosa hoped would help cut South Africa's (then) unemployment rate of 27.2% (Sibongile & Niselow, 2018) are as follows:

- The government committed to finalising a scrap metal export tax to ensure scrap metal products remain in South Africa, to create value for local industry.
- The Jobs Summit agreed that business and government will urgently come up with measures to address recurrent electricity outages in several municipalities, which have been harming local economies.
- The automotive sector is currently drawing up a master plan to increase the local content of vehicles assembled in South Africa to 60%.
- Business bodies committed to developing stricter measures to combat corruption and support government's anti-graft strategies.
- The agreement includes a plan to improve the employment opportunities of school-leavers through training at TVET (technical and vocational education and training) colleges, with a particular focus on scarce technical skills.

Lower economic growth, coupled with lower collections, put government revenue under pressure, which resulted in substantial borrowing to fund government deficits as expenditure continued unabated. This has brought South Africa close to the brink of the fiscal cliff, i.e. the point where civil service remuneration, social grant payments, and interest on government debt will exceed 100% of government revenue (Joubert & Rossouw, 2021).

Table 2 shows the main revenue sources of the government for the fiscal years 2019/20, 2020/21, and 2021/22. It is evident from this table that the three main revenue sources of the South African government are personal income tax, company tax, and value-added tax (VAT).

Export taxes currently contribute very little to South Africa's total tax revenue. Economic growth with increasing employment will result in growth in overall tax revenue, but specifically from the three main tax sources:

- To the degree that higher economic growth leads to increased employment, the number of personal income taxpayers will increase, and personal income tax collection will therefore show a concomitant increase.
- Increased economic growth will result in an increase in the number of businesses in the economy and in the profitability of businesses, which will result in an increase in tax raised from this source.
- Increased final consumption will increase VAT collection.

Table 2: Government revenue since the 2019/20 fiscal year

R billion	2019/20 Actual	2019/20 % of total	2020/21 Rev. Budget	2020/21 % of total	2021/22 Budget	2021/22 % of total
Persons and individuals	527.6	38.9%	482.1	39.8%	516.0	37.8%
Companies	211.5	15.6%	188.8	15.6%	213.1	15.6%
Value-added tax	346.7	25.6%	324.6	26.8%	370.2	27.1%
Dividends tax	27.9	2.1%	23.0	1.9%	26.7	2.0%
Specific excise duties	46.8	3.5%	24.7	2.0%	43.7	3.2%
Fuel levy	80.2	5.9%	75.2	6.2%	83.2	6.1%
Custom duties	55.4	4.1%	45.2	3.7%	53.1	3.9%
Ad valorem excise duties	4.1	0.3%	3.3	0.3%	3.5	0.3%
Other	55.5	4.1%	45.3	3.7%	55.6	4.1%
Gross tax revenue	**1 355.7**	**100.0%**	**1212.2**	**100.0%**	**1365.1**	**100.0%**

Source: National Treasury Budget Review 2021

It stands to reason that the introduction of export taxes will further increase the growth in tax revenue. Furthermore, value chains result in a multiplier effect that generates employment opportunities, and are at the heart of economic growth, as they create an environment conducive to reimagined economic opportunities. Economic growth and development are the function of sustainable supply chains and extensive value chains. Growth in value-added exports will benefit domestic economic activity. For instance, a larger domestic workforce will increase the demand for goods and services produced locally, resulting in an expenditure multiplier effect in the domestic economy.

A recent initiative that could stimulate economic growth is the call for local procurement by President Ramaphosa. He commented: *"We call on every South African to contribute to our recovery effort by choosing to buy local goods and support local businesses. This is one way that every one of us can contribute to building a new economy"* (Kgosana, 2020). This strategy reminds of the *Buy America* Executive Order issued by President Joe Biden of the USA, with the only difference that the Executive Order will be implemented immediately, while the South African government is still contemplating its strategy.

The full impact of the additional employment is difficult to estimate. Domestic beneficiation of chrome ore as ferrochrome will increase employment at local production facilities. However, increased local ferrochrome production will result in larger production of chrome ore only if the total international and domestic demand for ferrochrome increases. Research institution TIPS (Trade & Industrial Policy Strategies), in an unpublished report (February 2021) stated that 11 210 direct jobs in the ferrochrome industry could be safeguarded by taxation; in fact, by starting up the idle ferrochrome capacity in South Africa, up to 2 769 additional direct long-term jobs could be created. This is in sharp contrast to the 1 280 directly linked UG2 chrome ore jobs (Genesis, unpublished report, July 2020). Genesis goes further to state that the introduction of a chrome ore tax will largely not affect these 1 280 direct jobs.

Ferrochrome demand is dependent on the international demand for stainless steel. If the domestic production of ferrochrome simply replaces international production but overall international demand remains the same, the demand for chrome ore will also not increase. The demand for stainless steel falls outside the scope of the study, but it is notable from multiple sources that the demand for stainless steel increases between 3% and 5% year on year. By increasing beneficiation, other domestic employment opportunities can also open up in other areas of the domestic economy, even if the total international production of ferrochrome does not change (i.e. international ferrochrome demand simply shifts from China to South Africa), as local producers will need a wide range of goods and services supplied by the domestic economy. These additional employment and economic outputs could result in other domestic benefits, such as an increase in the government's tax base.

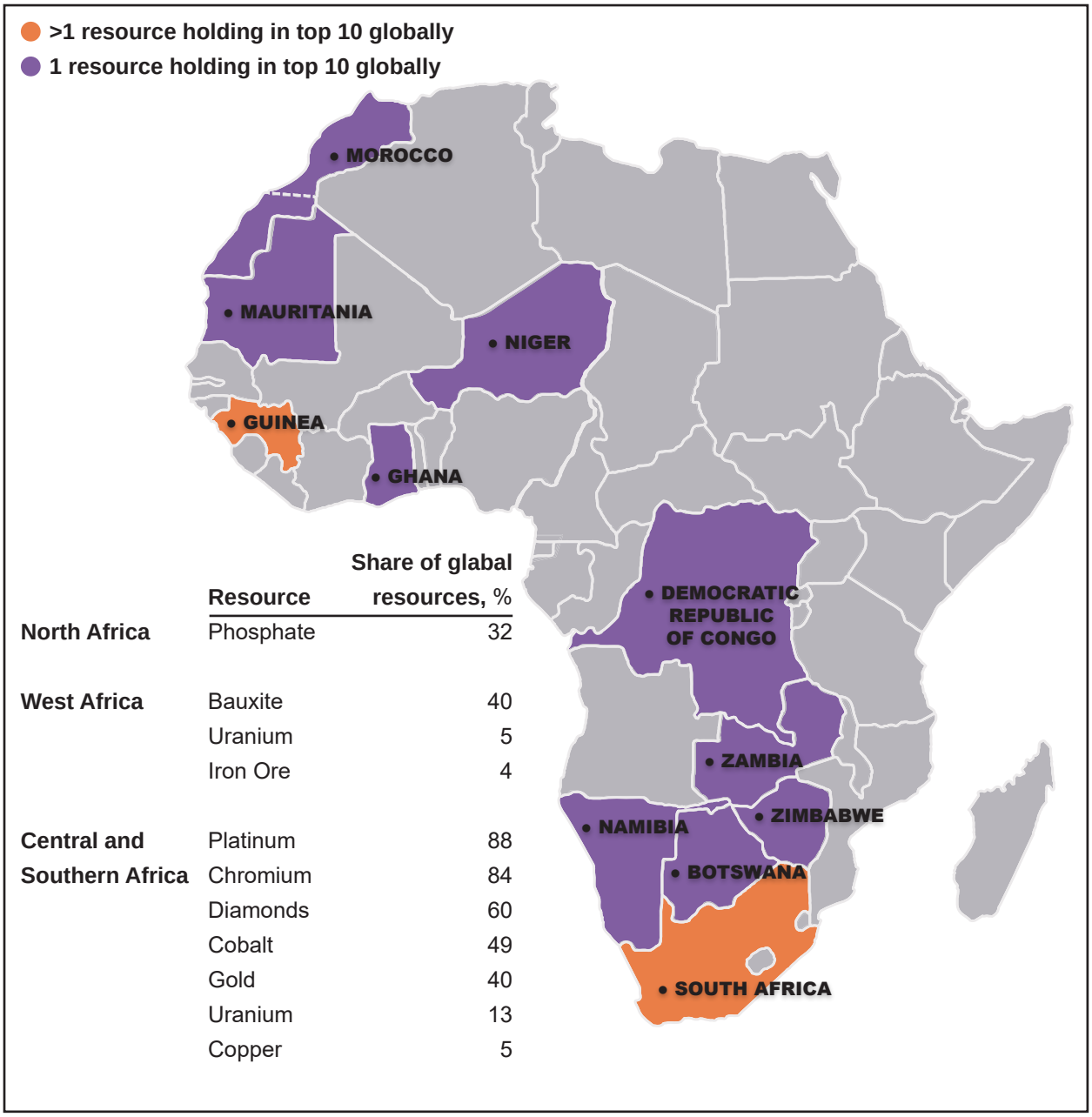
The National Treasury is clearly committed to resolving South Africa's fiscal difficulties, but the support of the rest of the executive to achieve its objectives is required. Among others, this requires a reprioritisation of expenditure priorities. South Africa's fiscal position shows that the South African government has exhausted its ability to borrow and spend large amounts in attempts to stimulate the economy. The only remaining option to ensure employment growth is therefore to create an environment conducive to the private sector investing in growth projects such as infrastructure development and production capacity.

The single main limitation on economic growth, and a major challenge in the context of this economic review, is electricity supply by Eskom. Many investment decisions are impeded by Eskom's inability to guarantee electricity supply to any sector of the domestic economy. Unfortunately, private-sector electricity generation will only supply power after a lead time. This, in itself, is one of the biggest problems facing the beneficiation of chrome ore as ferrochrome, as ferrochrome production is highly power-dependent. At the same time, domestic investment in ferrochrome production is dependent on some form of guarantee of future domestic electricity prices, as sharp increases in the cost of electricity reduce the competitiveness of domestic ferrochrome production. Export taxation could be one type of intervention with which to buy the time required to find solutions to the energy challenge in South Africa.

Africa's mining sectors present a paradox: although the continent is richly endowed with mineral resources (it has the majority of the world's known resources of platinum, chrome, and diamonds, as well as a large share of the world's bauxite, cobalt, gold, phosphate, and uranium deposits; see figure below), the mining of these has not been the consistent engine of economic development.

To date, resource-driven countries have tended to underperform compared to those without significant resources. Almost 80% of the former have a per-capita income below the global average. More than half of these countries have failed to match the average growth rate of all countries. Only one-third have maintained growth beyond the resource boom.

"Almost 80% of the former have a per-capita income below the global average."



	Resource	Share of glabal resources, %
North Africa	Phosphate	32
West Africa	Bauxite	40
	Uranium	5
	Iron Ore	4
Central and Southern Africa	Platinum	88
	Chromium	84
	Diamonds	60
	Cobalt	49
	Gold	40
	Uranium	13
	Copper	5

Figure 1: Countries rich in resources
Source: Bardouille, Hamblin & Pley (2010)

From the above figure, it is clear that South Africa dominates in more than one resource holding in the top 10 globally. The mining value chain in South Africa is the historic bedrock of country's economy. It directly contributes more than R300 billion to the country's GDP, directly employs more than 450 000 people, and is the economic anchor of many communities around the country (Cassim *et al.,* 2019). Unfortunately, much of the news about South African mining in recent years has been negative.

The mining sector, especially the CFcVC, will be critical to accelerated growth in South Africa's broader economy as a key source of stimulus for other sectors of the economy,

including infrastructure, energy, and transportation. A renewed mining industry can once again be a primary engine of growth, job creation, and development for South Africa.

South Africa is a major global producer of minerals. In 2020, it was the world's largest producer of platinum group metals (PGMs), accounting for over 70% of world output. It is also the world's leading producer of chrome ore and manganese, and the second-largest producer of titanium. In 2000, South Africa was by far the largest producer of gold, at 428 tonnes, but the industry has since contracted substantially, and the country produced only 97 tonnes in 2020. With this level of output, South Africa is now the seventh-largest producer of gold in the world. In 2020, total export sales of the South African mining industry were R767.4 billion, and the industry employed over 450 000 people.

The production of other minerals has not grown significantly, or has declined since 2015. Besides gold, there were falls in physical volumes of PGMs, diamonds, copper, iron ore, nickel, and building materials from 2015 to 2019, before the impact of Covid-19 on production. Coal-production volumes increased slightly during this period, but the production of chrome, manganese, and some other minerals expanded substantially. Although this increased production contributed to increased exports of minerals, it did not result in more domestic beneficiation.

In the main, in South Africa, minerals have been extracted, subjected to some basic processing, and then exported as ores without a great deal of beneficiation or fabrication. This limited process creates a large gap between mining and manufacturing, to the detriment of both sectors and the national economy. The value chain and linkages so necessary for efficient and competitive production of finished goods have been seriously undermined. As Turok (2013) already pointed out years ago to parliament, a mineral resource endowment does not necessarily translate into manufacturing beneficiation. The isolation of ore mining from the total industrial value chain also has consequences for labour policy. Thousands of mining job losses caused displacement of these workers into other activities.

Some of the potential spin-offs from mining value chain beneficiation are:

- Greater collaboration in research and development efforts pertaining to mining technology, innovative applications of mining and/or beneficiated products, with positive spin-offs for sectoral competitiveness and demand for mining and manufacturing output;
- Infrastructure-sharing potential, improved logistics co-ordination, potentially positive repercussions for associated costs; and
- Employment creation and skills development, improved welfare, and socio-economic stability.

Interviewees from the Industrial Development Corporation (IDC) commented that:

- The IDC considers investment in smelters if it presents a viable value-added opportunity.
- They have had discussions with Treasury and various state departments on the tax proposal.
- They are under the impression that the tax proposal is being considered favourably, and that it is subject to approval by Treasury. As such, the IDC will pursue the matter of the approved Cabinet policy with Treasury and give feedback.
- According to the IDC, a tax is a worthy suggestion, but should be considered in the context of technological innovation and measures to reduce energy costs.
- The IDC foresees investment and involvement in value chain design and formation (beneficiation). The concern of the IDC, too, is that South Africa may not exploit the advantage of controlling the world's chrome reserves.
- The IDC also does not think that the Chinese government will respond adversely to a tax imposition, as it seems to be an important feature of the country's existing import–export regime.

The then Minister of Trade and Industry, Dr. Rob Davies, as early as 12 June 2013, reiterated that minerals beneficiation is an important element of the industrialisation of South Africa and the African continent. The Minister said that beneficiation

will ensure that more value was added to domestic mineral products before exporting these: *"What we need to address is how we can use the minerals of our country as a tool of development, and the only way to achieve this is through beneficiation. Beneficiation will create more jobs and promote industrialisation."* Minister Davies concluded by saying that development of new export markets, particularly for value-added production, is also essential for the industrialisation of the African continent.

The business of beneficiating ferrochrome could be increasingly lucrative in the years ahead, and it is crucial to the economic prospects of South Africa, requiring both the government and the relevant CFcVC companies to rethink their business models — specifically, shifting from an extraction mind-set to one of development, systematically learning the priorities of governments and local communities, and then forging partnerships to deliver on these.

South Africa is the world's largest source of chrome, and accounts for approximately 72% of global reserves (KPMG, 2018). As a result, South Africa is one of the most economic chrome producers in the world. In 2016, South Africa produced 49% of the world's chrome ore. About half of the chrome ore produced in South Africa is exported for smelting into ferrochrome, which is then processed into stainless steel. The demand for stainless steel is driven mainly by China, followed by other Asian countries and Europe. Therefore, stainless steel prices drive the price of ferrochrome, which, in turn, determines the price of chrome ore (KMPG, 2018).

Ferrochrome production cost is highly dependent on the cost of ore, electricity pricing, and the cost of labour. South African industries have faced severe constraints regarding electricity supply and high electricity costs. Ferrochrome smelting is an energy-intensive process; hence, high electricity prices and power shortages were contributors to decreased production by producers of ferrochrome. It now seems that South Africa has exported its competitive advantage in the production of ferrochrome to China by supplying China with cheaply priced ore, a major cost driver for China's ferrochrome production.

Data from TIPS (unpublished report, 2021) indicate that chrome ore export prices have eroded, which can be explained by the increase in availability of a low-cost by-product — UG2 (low-grade chrome concentrates) — produced by operating platinum mines. Trends

in the pricing of chrome ore are detailed in the table and graph below.

Table 3: Chrome ore pricing history

Year	40/42 UG2 Publication	38/40 ROM Publication	Premium/ Discount to UG2	40/42 ROM Publication	Premium/ Discount to UG2
2017	US$215/Mt	US$201/Mt	-US$14/Mt	US$219/Mt	US$4/Mt
2018	US$190/Mt	US$182/Mt	-US$8/Mt	US$202/Mt	US$12/Mt
2019	US$155/Mt	US$152/Mt	-US$3/Mt	US$168/Mt	US$13/Mt
2020	US$135/Mt	US$140/Mt	US$5/Mt	US$154/Mt	US$18/Mt

Source: TIPS (2021)

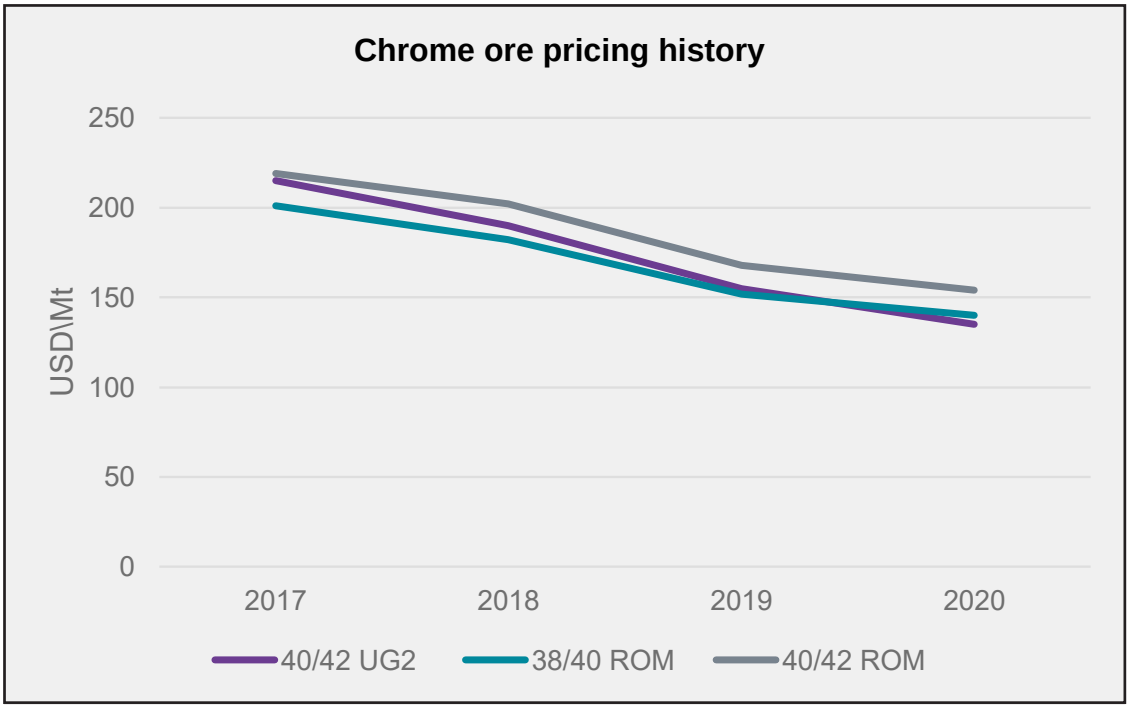


Figure 2: Chrome ore pricing history
Source: Self-produced from TIPS (2021)

TIPS (2021) also provided a comparison of Chinese and South African ferrochrome production costs for the period 2017 to 2019. The 2019 figures were used to create the table below. As can be seen from this table, based on the 2019 figures, at least USc/lb of 3.70 is required to even out cost. This relates to an 11% increase in the 2019 ore price based on an USc/lb basis.

Table 4: Ore price increase to even out costs based on TIPS (2021

	China 2019		South Africa 2019		% Difference China vs SA
	USc/lb	%	USc/lb	%	
Ore	33,3	45,00%	16,3	20,98%	51%
Power	15,7	21,22%	23,4	30,12%	-49%
Labor	2,8	3,78%	3,7	4,76%	-32%
Reductants	11,3	15,27%	15,4	19,82%	-36%
Other	9	12,16%	12,3	15,83%	-37%
Delivery Cost	1,9	2,57%	6,6	8,49%	-247%
Total	74	100,00%	77,7	100,00%	
Requirement to get prices equal USc/lb				3,70	
New ore price required in China				37,00	
% increase in ore cost required to China based on 2019				**11%**	

Source: Reworked table from TIPS (2021)

These tables indicate the impact of increasing electricity prices and reductions in the price of ore imported by China. China and others have consequently been able to produce ferrochrome at costs lower than those of South Africa. Electricity pricing remains a concern, as the South African electricity price is not only relatively higher than that of China and Indonesia, but is increasing while others have been able to contain these costs. This, together with the low-cost ore supplied into China, resulted in a continuous decline of the South African ferrochrome industry.

The sector is a significant contributor to the South African mining sector, and South Africa plays a significant role in China's stainless steel value chain. *Mining Weekly* (2021) indicated that China is responsible for 53% of global stainless steel production, using several inputs, including ferrochrome, and, as the sections below indicate, South Africa is the main supplier of ferrochrome to China. However, China's local ferrochrome production has continued to increase while South Africa's production continues to fall, mainly due to rapid increases in the cost and unreliability of electricity supply and the cheap UG2 chrome ore supply to China.

In 2002, only 7% of chrome exports consisted of ore; by 2020, this share had increased to 40%. Hence, the contribution of processed ferroalloy (HS720241) became much smaller over time, indicating that South Africa is exporting more raw materials, and less processing of these products is being done locally.

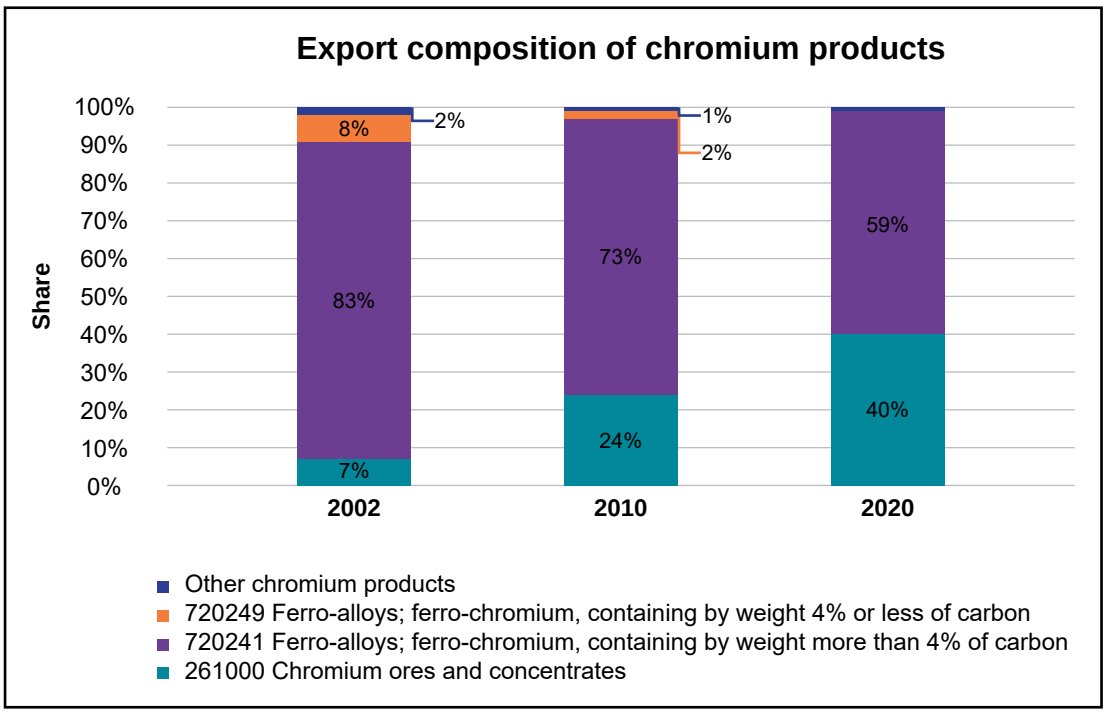


Figure 3: South Africa's export composition of chromium products: 2002, 2010, and 2020
Source: Authors' own compilation based on data from UN ComTrade (2021)

The medium-term trend in exports of the two main chrome products for the period 2002 to 2020is depicted in Figure 3. The left bar shows the trend in values, and the right bar shows the trend in exported volumes. It is evident that the value of ferrochrome exports is significantly higher than that of ore exports. However, the gap slowly closed over the depicted period. In 2013, ferrochrome exports were 18 times larger than chrome exports; by 2020, this ratio had dropped to 1.5. Ferrochrome showed strong growth in export value until 2012, after which exports stabilised and even started to decline in 2018.

Overall, the export markets for chrome ore have become more concentrated over time. This indicates that all processing of chrome ores is now occurring in China, and, as indicated in the foregoing graphs, the processing of ferrochrome moved to Chinese producers over time. Figure 4 illustrates the composition of South Africa's export markets for chromium ore in 2002 to 2010, and 2020. It is important to note that the ultimate

destination for chromium exported to Mozambique is mainly China. This is also evident from the Tex Report (October 28, 2021) that indicates that, in 2020, an amount of 11 723 104 metric tonnes (mt) was exported to China, out of a total of 14 321 951 tonnes. Hence, in 2020, 82% of chrome ore imported by China came from South Africa, with 61% directly exported from South Africa and the rest re-exported via Mozambique; included in the 24% indicated in the figure below.

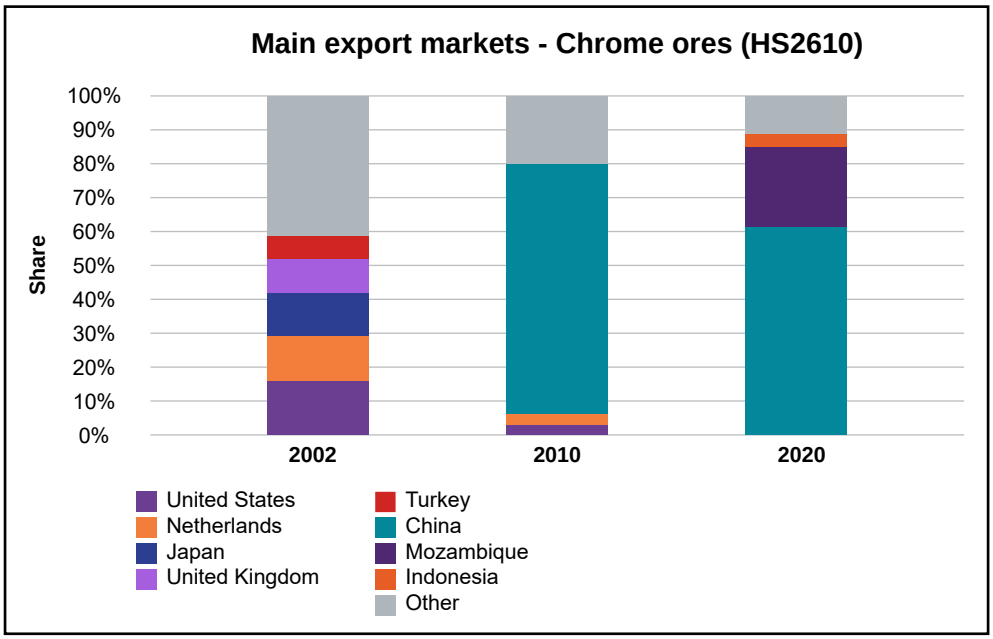


Figure 4: Trend in South Africa's main export markets of chromium ores (2002/2010/2020)
Source: Authors' own compilation based on data from UN ComTrade (2021)

The revealed level of competitiveness of South Africa's exports of chrome ore and ferrochrome for the period 2002 to 2020 can be determined using the Revealed Trade Advantage (RTA) Index. The RTA Index was developed by Vollrath (1991), and is deemed a good proxy for the revealed level of a country's product specialisation. An index value of more than zero implies a revealed specialisation in production.

Figure 5 presents the results of the analysis. Given the relative level of the RTA indices, it is evident that South Africa has a high level of revealed competitiveness in both chrome ore and ferrochrome. The level of competitiveness in ferrochrome shows a slowly decreasing trend over the depicted period, while the level of competitiveness of chrome ores shows an increasing trend. In 2012, chrome ores surpassed ferrochrome in terms of competitiveness. This implies that, since 2012, the country's level of specialisation in raw material has been higher than that for the processed product. The opposite would be more favourable from an economic development perspective.

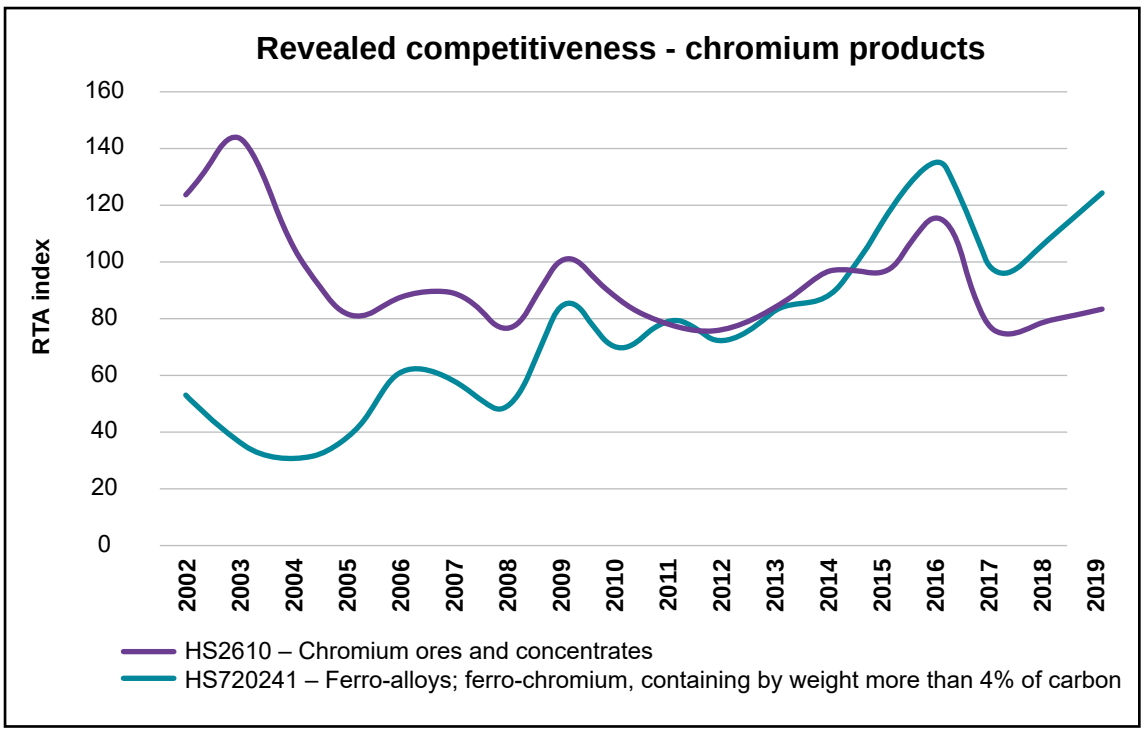


Figure 5: Trend in South Africa's revealed competitiveness of selected chromium products, 2002–2019
Source: Authors' own calculations based on data from UN ComTrade (2021)

Figure 6, below, shows that South Africa remains the largest exporter of chrome ore (Harmonised System (HS) Code 2610). Note that China is the largest ferrochrome producer; however, China uses the ferrochrome directly in its downstream stainless steel industry, leading to insignificant chrome ore exports from China. South Africa's exports of chrome ores are significantly larger than those of any of the competing nations, i.e. Turkey, Pakistan, Kazakhstan, and Zimbabwe. Zimbabwe banned all exports of lump ore, and will ban all concentrate exports from June 2022 — this will reduce imports into China from Zimbabwe by at least 568 843 tonne, based on 2020 figures. In August 2021 Minister Monica Mutsvangwa from Zimbabwe stated: "The ban will capacitate current smelters and maximise the value chain to be realised from the country's abundant resources." Furthermore, Kazakhstan exports only to Commonwealth of Independent States (CIS) countries, mainly Russia, which explains some of the declining trends illustrated in Figure 6. The graph does, however, show a large spike in 2017, and thereafter a significant decline up to 2020 (Note that China was added to the graph for purposes of comparison with South Africa). Therefore, displacement of South African chrome ore will not be easy, especially when considering interventions implemented by many countries.

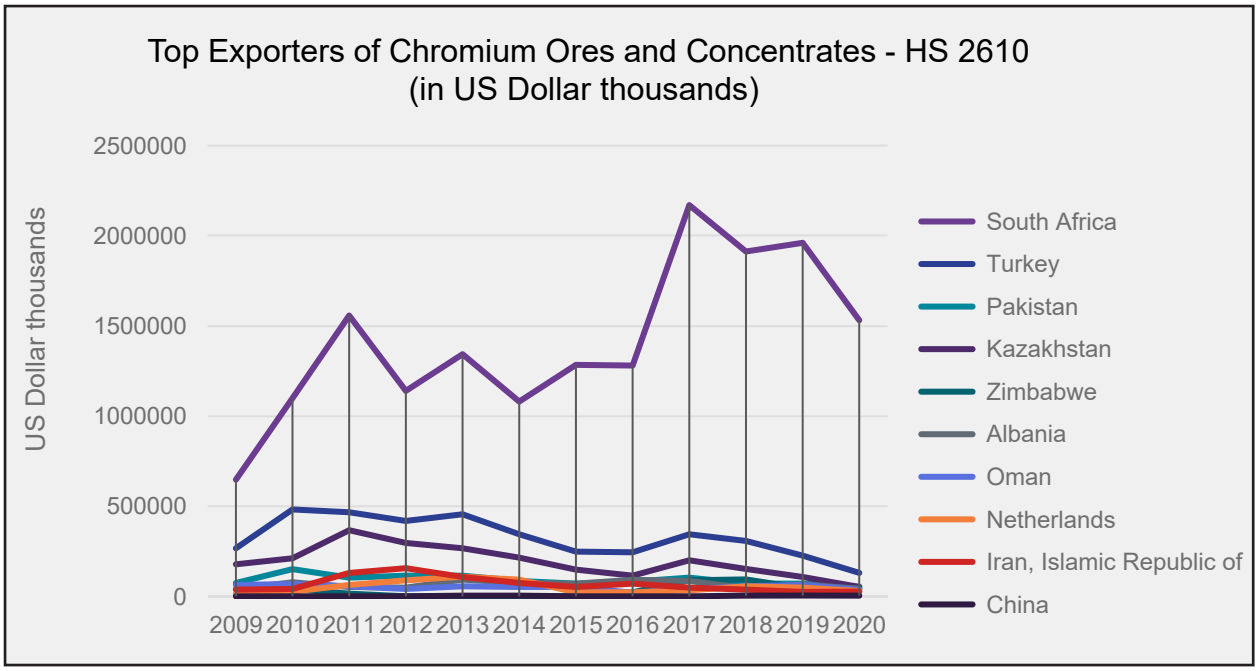


Figure 6: Top exporters of chromium ores and concentrates (HS code 2610), 2009–2020
Source: Authors' own calculations based on data from ITC (2021)

The following figures indicate South Africa's top competitors in the Chinese market. For chrome ores, South Africa's closest competition is Turkey and Zimbabwe; however, these suppliers have not been able to come close to the export figures of South Africa in the last decade, again indicating that South Africa cannot easily be displaced as a global supplier, and that the country should, in theory, be a global price-setter. Important to note is that countries such as Zimbabwe has now introduced bans on lumpy chrome ore, with bans on concentrates to follow middle 2022, likely removing them as a supplier to China.

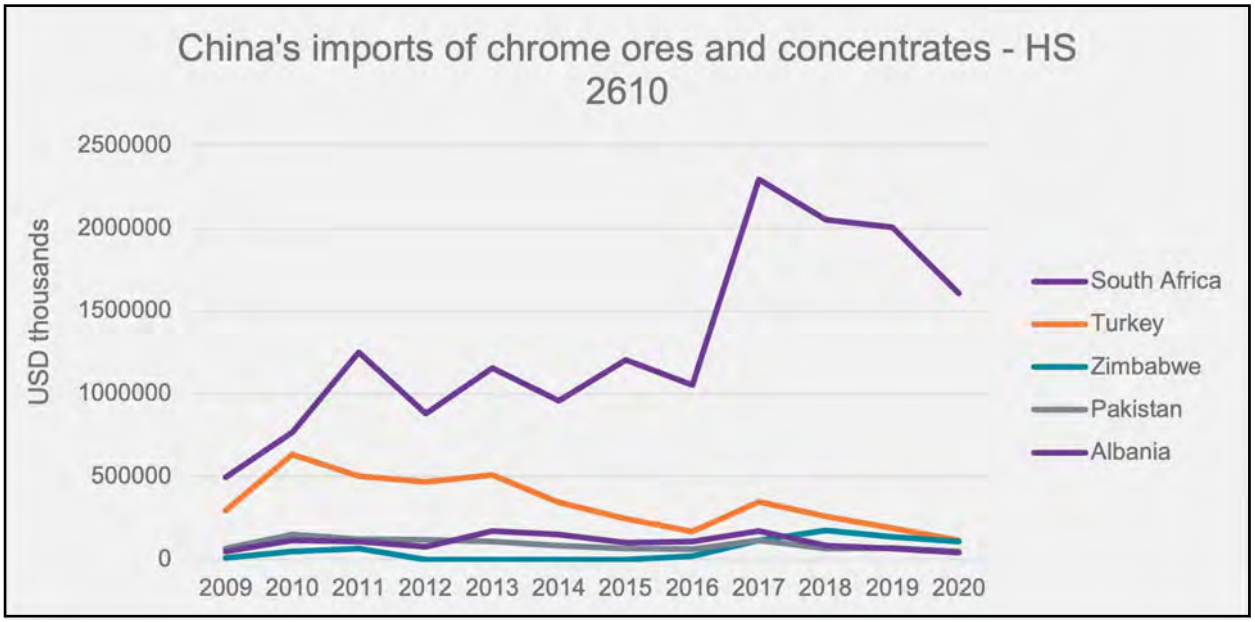


Figure 7: China's imports of chrome ore and concentrates (HS code 2610), 2009–2020
Source: Authors' own calculations based on data from ITC (2021)

South Africa has also been the leading supplier of China's imports of ferrochrome containing more than 4% carbon, followed by Kazakhstan and India, as indicated in the following figure.

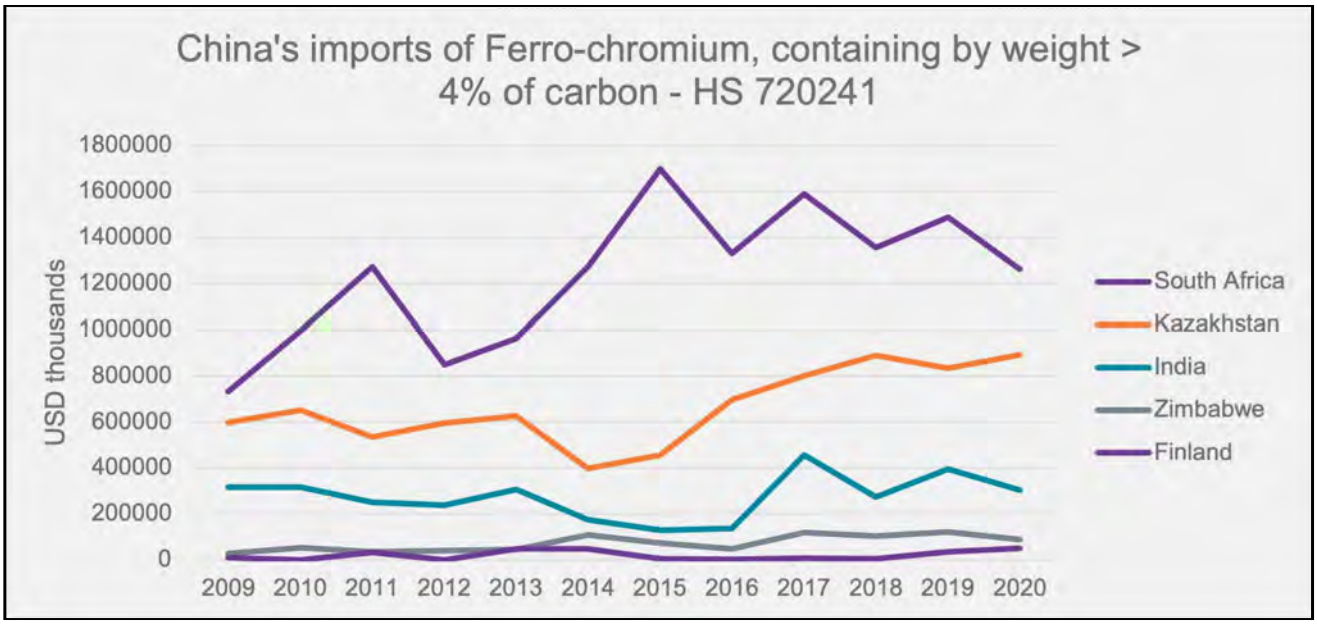


Figure 8: China's imports of ferrochrome (HS code 720241), 2009–2020
Source: Authors' own calculations based on data from ITC (2021)

It is imperative that South Africa's dominance in the supply chain of the chrome sector be used as leverage to further develop this industry. Such development should be aimed especially at the production of ferrochrome and downstream businesses, in order to increase South Africa's competitiveness.

The implementation of an export restriction or export control measure is greatly dependent on the sector itself, other local factors that contribute to the cost of exports, and the country's position in the world market. In theory, countries that have market power in a certain product may, in fact, gain from implementing an export tax measure. This is the case in South Africa's chrome ore sector. Based on trade figures shown earlier, it is possible that the implementation of such a tax in a sector where South Africa is a market leader may hold benefits.

Export taxes have been used by governments as a tool in their industrial policy since the 11th century. The most notable account is the use of export taxes in Europe *"as a*

source of revenue and a means of preserving raw materials for domestic manufacture" (Goode, Lent & Ojha, 1966:454).

In England, export taxes were applied to raw wool and hides from 1275 to 1660, to promote domestic industry processing. As wool manufacturing capacity grew in England, "so *did the export duties, until England had sufficient production capacity to process all the wool they produced"* (Reinert, 2008:80). Many consider the Tudor Plan the foundation of England's industrial greatness. The Florentines were not able to compete with their English counterparts, because export duties on English raw wool ensured that it went to domestic producers for processing (Reinert, 2008:80). Like Venice and Holland, and by the same methods, England acquired the same triple rent situation: a strong industrial sector, a raw material monopoly (wool), and overseas trade.

Britain used export taxes extensively, not only for revenue, but also for industrial processing and industrial competition. The earliest British preferential export tax was that on tin ore from the Federated Malay States. The USA attempted to develop a smelter industry; however, it needed to import the raw tin from British colonies. The larger export tax made this difficult, and, eventually, all new smelters in the USA were forced to shut down because the industry was not able to compete. According to the Governor of the Federated Malay States, the export tax had accomplished its intended objective. He stated that the export tax was exacted *"for the purpose of preventing the transfer of the smelting industry to the United States"* (James, 1924:57, as cited by TWN, 2018).

Export taxes have, over centuries, been used for diverse reasons:

- Industrial development

  England, Venice, and Holland acquired an industrial and trade strategy for export duties on raw wool (later a full embargo on raw wool) to successfully acquire the triple rent situation: a strong industrial sector, a raw material monopoly (wool), and overseas trade (Reinert, 2008:80).

- A source of government revenue

  This is done by the OPEC oil cartel, Mexico, Brazil, Vietnam, and Argentina. Almost 50% of Russia's total tax revenue is derived from energy taxes. Belarus

derives 15% of total revenues from minerals and energy, and Kazakhstan 13%. Countries with a development status similar to that of South Africa, such as Indonesia, Ethiopia, Malaysia, and Egypt, use export taxes as a source of revenue. This is done to:

- encourage value added and infant industries;
- attract foreign investment;
- achieve price stability;
- improve terms of trade;
- deal with currency devaluations and inflation; and
- address tariff escalation in importing countries.

Export taxes are increasingly becoming a focus of attention in the trade policies of developing countries, specifically in the BRICS countries. In 2008, the EU noted that, *"increasingly, many emerging economies are pursuing industrial strategies aimed at protecting their resource base to generate advantages for their downstream industries. This is apparent in the proliferation of government measures that ... include export taxes and quotas... Over 450 export restrictions on more than 400 different raw materials (e.g. metals, wood, chemicals, hides and skins) have been identified"* (European Union, 2008:4-5).

The implementation of an export tax has had varied effects in several industries and countries around the world. Data from the World Bank in the table below indicate the percentage of export taxes in total tax revenue in several countries from 2000 to 2017. The figures are sorted from the highest to lowest, and the table shows the top 20 countries according to contribution of export taxes to total tax revenue. South Africa was added for the purposes of this report's focus.

Table 5: Export taxes as percentage of total tax revenue: 2000 - 2017

Country	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017
Solomon Islands				18.55	18.30	17.03	19.72	21.04	22.28	21.99
Russian Federation	16.44	37.63	41.84	44.61	43.37	43.31	43.73	31.59	26.02	20.94
Kazakhstan	0.05		17.46	15.69	11.08	25.42	26.88	22.89	17.35	20.61
Cote d'Ivoire		21.00	13.31	17.38	12.23	13.95	14.17	16.01	16.25	16.79
Belarus		3.74	5.95	15.98	13.69	10.63	6.69	23.48	18.40	16.22
Guinea-Bissau										11.37
Argentina	0.12	15.23	20.78	19.30	17.99	13.08	14.00	9.76	7.06	5.56
Papua New Guinea	13.12						2.68	3.45	3.49	3.25
Uzbekistan								0.00	0.00	1.65
Central African Republic			2.30	2.45	2.13		1.41	1.44	1.55	1.26
Tanzania					0.56	0.38	0.30	0.63	0.41	0.91
Cameroon					0.43	0.59	0.68	0.72	0.70	0.91
Afghanistan			0.03	0.17	0.21	0.07	0.11	0.11	8.45	0.87
Malaysia	2.12	2.59	1.65	1.54	1.30	1.24	1.15	0.63	0.58	0.76
Bahamas, The	1.52	1.57	1.44	1.10	1.29	1.28	0.87	0.63	0.77	0.51
Fiji		1.05	0.72	0.49	0.44	0.25	0.48	0.42	0.43	0.35
Togo		0.20	0.58	0.60	0.48	0.52	0.44	0.58	0.50	0.32
Cambodia		4.76	2.53	3.56	2.69	2.94	2.29	1.68	0.26	0.32
Indonesia			1.23	3.30	2.17	1.47	0.99	0.30	0.23	0.31
Vanuatu					0.00	0.01	0.01	0.05	0.07	0.28
South Africa		*0.00*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*

Source: World Bank (2021)

The top five countries that gain some advantage from export taxes as a revenue are the Solomon Islands, Russia (although there was a declining trend between 2010 and 2017), Kazakhstan, Cote d'Ivoire, and Belarus (which has seen a drastic increase in export taxes as a percentage of tax revenue). South Africa, on the other hand, has only imposed export levies on unpolished diamonds, some agricultural goods (Sandrey, 2014), and,

recently, the export of scrap metal. The data shows that some countries do gain some revenue advantages from export taxes, and that South Africa is not optimally utilising this trade intervention, despite it being a resource-rich economy. Exporting countries that have market power gain from export taxes, as they can apply a welfare-optimising level of export tax and push the burden of the tax onto the importers.export levies on unpolished diamonds, some agricultural goods (Sandrey, 2014), and, recently, the export of scrap metal. The data show that some countries do gain some

The proposed export tax would seek to ensure that South Africa's ferrochrome manufacturers have a price advantage relative to ferrochrome producers elsewhere, including China, the main market for exported South African ore. The effectiveness of this intervention has been proven through many examples of countries using it for certain trade strategies over centuries. Some mini case studies are used to explain both the positive and negative effects of such a tax.

The following studies showed a positive outcome:

- Indonesia is the third-largest producer of cocoa beans, competing mostly with Cote d'Ivoire and Ghana. Rifin (2015) analysed the impact of export tax policies on cocoa beans in Indonesia. The aim of the export tax implemented on cocoa beans in 2010 was to ensure the availability of the product in the domestic market for raw materials in the processed cocoa industry, and to eventually develop the downstream cocoa industry. The implementation of the export tax initially reduced export values by 48.3% and the export quantity by 51.4% in the year of implementation. After implementation, the contribution of processed cocoa products increased significantly as the cocoa processing industry expanded.
- Russia implemented export taxes on roundwood in 2007, a product of which they were one of the largest exporters, mainly to China, Finland, and Japan. However, Russia was only the sixth-largest processor of industrial roundwood, and therefore added very little value to the wood products. This led to the decision to increase its export tax to almost 80%. The objective was to add more value to existing resources, protect domestic employment, and increase exports of processed wood products. Sari Karvinen (2020) indicated that, in 2019, Russia's export of roundwood was at a record low, and the president is now considering the implementation of a complete export ban in 2022, which is expected to have a

significant effect on global forest-product markets. The effect will mostly be felt by the Chinese lumber industry, the largest importer, and China will most likely look to source more products from other regions in the world. The Russian export ban is expected to increase investment in new lumber capacity, and, if the country is able to grow its wood-processing industry, it may become a competitive player in the world market (Margules Groome, 2021).

- Indonesia became the largest plywood exporter in the world (from a 4% market share to 80%) in a few years through a combination of export taxes, export restrictions, and government procurement of domestic plywood. A next round of export taxes further encouraged value-added processing within Indonesia. Tralac (2014:12) notes that, *"according to the authorities, this policy seems to have been successful in achieving its objectives".* By the early 1990s, shortly after these measures were taken, Indonesia became the largest manufacturer of hardwood plywood in the world (Thee, 2009:138).
- India imposed a 100% tax on chrome exports, and Indonesia imposed a complete ban on nickel ore exports, to protect and then nurture their value-add industries, with great success. *"These two countries are incredibly good examples, but are seldom referenced",* as indicated in a lobby group interview (Interviewee 29, Augustus 2021).
- Zimbabwe has the world's second-largest reserves of high-grade chromium ore, after South Africa (12% of global total). Zimbabwe banned the export of chrome ore from 2011, and removed the export restrictions in 2015. Zimbabwe banned export of raw chrome ore with immediate effect this year, and will ban export of chrome ore concentrate from 2022, in order to secure its ferrochrome industry. It was pointed out that, unless chrome mining capacity is expanded, smelting operations could face the challenge of insufficient feedstock. The balance of what is not consumed domestically by the ferrochrome industry is exported to China (4% of China's chrome ore imports of roughly 14 million tonnes). The competitive price of Zimbabwe's ore, similar to that of Turkey, Albania, Iran, and Pakistan, recently gained increasing interest from Chinese buyers. The consequence was that Turkish chrome ore prices increased, and the export ban increased prices further. Production costs for Chinese smelters will subsequently be higher as well. Market analysts are of the opinion that the ferrochrome sector could attract more

foreign investment. China's Tsingshan Holding Group is developing a US$1 billion composite project for a steel plant, an iron ore mine, and a ferrochrome plant in Zimbabwe.

- Russia historically used export taxes on oil to aid its transitional economic development after the fall of the Soviet Union. The new government retained control over energy exports (Parker & Thornton, 2007:525). The export tax and value-added tax were the largest sources of tax revenue for the Russian government in the new tax code legislation. Along with energy resources, the government also imposed rising export taxes on hydrocarbons, metals, and other commodities. In addition to the export taxes, a four-fold devaluation of the Russian ruble was implemented. The policy outcomes have been mostly successful. With rising energy prices, federal government budget revenue doubled from 12% to 24% of the GDP in 2005, and the Russian fiscal balance shifted from a deficit of 6% to a surplus of 9% of GDP. Parker and Thornton (2007:532) state that *"federal revenues, trade duties (primarily energy export revenues) are equal to 8% of GDP, with other natural resource taxes providing an additional 4%."* Russia also imposed a log tax aimed at slowing down the shipment of raw logs and encouraging more domestic lumber manufacturing (Hamilton, 2008). Russia has considered a third tax increase for the Russian metals and mining industry since the start of 2021, when the government raised the MET (mineral extraction tax) export tax for metals firms to boost proceeds. Russia has already imposed new export taxes on steel, nickel, aluminium, and copper (*Mining Weekly*, 2021).
- China: The imposition of export restrictions on a range of commodities has long been part of China's trade policy. The list of items subjected to various forms of export restrictions goes beyond the minerals listed in this case. China is a major producer and exporter of the majority of these commodities, which are often strategically important for a range of manufacturing sectors. For example, bauxite, which is a main source of aluminium, is widely consumed in electronic and consumer goods; fluorspar is used in steel production; phosphate is an essential component of agricultural fertilisers; and silicon is an input in the production of semiconductors. The Chinese domestic demand-and-supply structures and international market conditions for each of these commodities vary considerably.

- Canada maintained more than 100 years of provincial government policy and, to a lesser extent, federal policy dedicated to halting the export of raw logs (BCFED, 5:2006). *"This policy of adding value in Canada prior to export reflects a common understanding that the creation of jobs and a viable tax/royalty base was critical to the prosperity of the country"* (BCFED, 2:2006). That common understanding allowed for investment in the value-added forest sector and created thousands of jobs across the British Columbia province.
- Mongolia is amongst those developing countries that impose export duties on raw materials; however, as a condition to become a member of the World Trade Organization (WTO), Mongolia forfeited some of this freedom by undertaking a commitment to phase out and eliminate its export duty on raw cashmere within 10 years of taking up membership of the WTO. In January 2007, Mongolia filed a Request for a Waiver, asking the Council for Trade in Goods to postpone the implementation of the commitment for five years, because the export duty on raw cashmere was needed for its economic development. In the official request to the WTO, Mongolia recognised several functions that the export tax performed in its economy. Export taxes are not prohibited under WTO agreements; these are well-known policy instruments that can effectively provide incentives for the local processing of raw materials. The taxes may assist in adding value to exports, bringing greater export earnings and increasing the diversification of exports, thereby contributing to an overall reduction of the economic vulnerability that affects the Mongolian economy. Finally, the application of export taxes on raw cashmere also serves environmental objectives, as it contributes to the regulation of goat herds, and is part of government efforts to fight environmental damage and desertification (WTO: G/C/W/571). The document also indicates that preserving the export tax on raw cashmere would create employment.

As with all interventions, there are also negative outcomes:

- Mamina, Maganga, and Dzwiti (2020) examined Zimbabwe's implementation of export tariffs and embargoes to stimulate downstream mineral beneficiation. They found that these policies mostly failed to yield tangible results, due to inadequate capabilities of the country in terms of factor endowment and support for downstream beneficiation. Additionally, the lack of investment in downstream

industries contributed to poor domestic demand for raw materials. Interesting to note is that, with the renewed ban on chrome ore, China is now investing to create downstream capacity in Zimbabwe.

- Fliess *et al.* (2017) evaluated the implementation of export control measures such as export taxes, licences, and bans in the mineral and ore sectors in Gabon, Zambia, and Zimbabwe. The study evaluated export tax policies relating to the copper industry in Zambia, the chromium industry in Zimbabwe, and the manganese industry in Gabon. The study found that Gabon's export tax did not impact the levels of comparative advantage of mining and processing activities, and Gabon has continued exporting the raw products. Zambia's copper industry's comparative advantage also decreased, and the export tax had a negative effect on the mining sector. A similar deterioration occurred in Zimbabwe's mining sector, and the country was only able to increase its revealed comparative advantage (RCA) for one semi-processed copper product. For all countries involved, the resulting decline in trade was not offset by gains in competitiveness for the processing industries. Zambia, and Zimbabwe were all able to develop smelting and refining competencies to position themselves as exporters of certain semi-processed products, but, according to Fliess *et al.* (2017), these achievements were not attributable to the export control measures that had been put in place. Other factors along the value chains played a more important role, mostly the availability of large amounts of energy and water, a labour force with higher skills, capital inputs, and specialised knowledge to develop these downstream mineral processing industries. Fliess *et al.* (2017) also indicate the importance of proximity of the sales markets and the governance of infrastructure related to transport costs.

From the above examples, it can be inferred that the implementation of an export tax can have positive and negative consequences. An export tax can achieve the goal of decreasing the volumes of products exported to the foreign market; however, that in its own is not sufficient to create successful domestic downstream industries that produce value-added products. Overall, for an export tax to be successful, the following criteria have to be met:

- The exporting country has a significant level of market power.

- There are few economically viable substitutes for the goods from other supplying countries.
- The country has the capacity downstream, or the ability to invest in and develop downstream industries.
- The export tax is applied over the short- to medium term, accompanied by investment in the expansion of the local industry or beneficiation.
- The country has the necessary capabilities and knowledge, coupled with an enabling environment, for local processing activities.

South Africa's chrome sector meets the above criteria. It has significant market power, its chrome ore cannot easily be displaced, it has idle capacity downstream, and has a rich history of leaders in chrome smelting technology, as shown later in this report.

A policy brief published by TIPS (2020b) in 2020 further explains that South Africa has lost its global position as a leading ferrochrome producer, due to escalating electricity prices, and China has developed its ferrochrome capacity using South Africa's cheap chrome ores. China is now the world's largest producer. The decline in South Africa's ferrochrome industry has seen a number of smelters close down, firms entering business rescue or filing for liquidation, and consolidation within the industry. A similar trend is evident in the traditional chrome mining sector, with several mines going into business rescue in recent months due to not being sustainable in the low-priced UG2 environment.

An unpublished report by TIPS (2020a) further indicated that an export tax on chrome ore would greatly benefit South Africa. The reasoning is that the demand for ferrochrome is inelastic, although dependent on the demand for stainless steel. The report also indicates that South Africa is a market leader in the ferrochrome industry, and that buyers such as China have few options in buying it elsewhere. Therefore, even if an export tax is implemented, the demand for chrome would not decline significantly.

The report by TIPS (2020a) rightly indicates that tax as a single instrument for industrial development will not be effective. It will require additional industrial and trade policy tools used in conjunction with the tax, together with stable institutions, in a targeted approach to drive downstream processing in the ferrochrome industry. Trade policy options would also require export tax exemptions to be negotiated with the Southern African Development Community (SADC) in the African Continental Free Trade Area (AfCFTA)

and in the Economic Partnership Agreement (EPA) with the European Union (EU). Under SADC trade protocols, if the ore passes through the port of Maputo, Mozambique, as an export destination, it would be exempt from export taxes. Goods produced in South Africa and simply passing through Mozambique in transit to China will still be subject to the export tax, because the declared country of origin would still be South Africa.

Genesis Analytics contradicted the TIPS (2020a) report in their unpublished report of 2020. Genesis Analytics (2020) highlighted the potential impact that a decrease in exports due to an export tax could have on mining employment, especially in non-integrated mining. They also indicated a series of 'leakages' that would undermine the goal of increasing global ferrochrome prices, including the exercising of counter-foiling power by Chinese purchasers against South African chrome exporters, the absorption of the additional costs by the government-supported Chinese ferrochrome and stainless steel industries to retain market share, and retaliatory measures by the Chinese government against South African ferrochrome exports.

Genesis Analytics (2020) also argues that the benefits of an export tax will mostly accrue to South African ferrochrome producers in the international market, and that the majority of South African ferrochrome exports will not be directly advantaged by the tax.

The Genesis Analytics (2020) analysis predicts significant impacts on employment in South African non-integrated chrome mines, with no compensating increase in employment in integrated mines. This, together with no guarantee that the downstream industry will benefit from an export tax, may cause the tax not to achieve the intended outcome. The analysis also suggests that South Africa is not immune to competitive constraints, and that the introduction of a 30% export tax would materially impact the competitive structure of global supply.

The report (Genesis Analytics, 2020) also indicates that major retaliations from China may include the implementation of an import tariff on ferrochrome. In this regard, Interviewee 12 (September 2021), whose view was supported by Interviewee 13, said, *"China cannot substitute South Africa's chrome ore"*, due to the sheer size of it. It is possible that the stainless steel sector will ultimately choose to absorb part of the tax impact, due to the fact that stainless steel suppliers are vertically integrated with ferrochrome producers in China, and the proposed tax would be unlikely to shift their

purchasing behaviour away from local supply to South African ferrochrome producers.

The report (Genesis Analytics, 2020) further highlights the fact that the proposed tax may only diminish the competitiveness of those foreign ferrochrome producers that rely on South African chrome ore, and that only South African ferrochrome sales into countries like China and Indonesia are likely to directly benefit from the proposed tax.

In contradiction, TIPS, in 2021, issued a response to the Genesis Analytics (2020) report, in which it is argued that the export tax would be an incentive to local ore producers to sell their product locally, and for the chrome ore to be beneficiated locally, rather than incurring an export tax. Domestic ferrochrome producers would have a price advantage over ferrochrome importers who are reliant on South Africa's ore. The objective of the tax would be to create the conditions to add more value to chrome ore in South Africa and further develop the country's mineral wealth. The intended result of the export tax is therefore to improve the relative competitiveness of South African ferrochrome producers.

Besides the above two competing arguments, there have been several other voices raised in the media for and against the export tax on chrome exports. Non-profit organisation Save SA Smelters has been very vocal regarding the large number of jobs that are on the line if government fails to implement the export tax (*Mining Review*, 2021). Save SA Smelters argues that Chinese and Indonesian markets are growing, and that they will dominate the demand for ore and ferrochrome in the future. If the price disparity between China and the West continues, there will be no South African smelting industry left. The Lydenburg and Meyerton smelter shutdowns in 2020 resulted in thousands of job losses, and it is predicted that even more smelters will close, leading to more retrenchments. The main argument is therefore to stop the export of raw materials, so that these can benefit local production through local development of the industry. In the past, South Africa was a leader in the supply of steel, and Save SA Smelters argues that South Africa can potentially again be positioned as a country of choice for international investors in the steel and stainless steel value chain. The export tax can be used as a mechanism to establish such a local value chain.

Govender (2021) and others have argued that an export tax may not yield the expected benefits if electricity supply and cost to the industry are not addressed, and that a special

electricity tariff would be a better way to support the ailing industry. Others have even argued that a total export ban might be even more beneficial if local beneficiation is the end goal in developing the stainless steel industry in South Africa.

ChromeSA (2021) raised similar concerns regarding the implementation of an export tax, i.e. high and increasing electricity costs, uncertain electricity supply, high transport- and logistics costs, the poor logistical capacity of South Africa's ports and railways, and unregulated artisanal mining. ChromeSA's view is that imposing an export tax would be devastating to the primary chrome industry, and that much of the cost would be carried by the producers. This is because passing such cost on to customers will likely result in the loss of those customers to producers of chrome in other countries, who could then become more competitive than South African producers. UG2 producers would also experience negative impacts, as chrome ore plays a consistent and important role in revenue generation for the PGM mining companies and the communities in which they operate.

South Africa needs to be conscious that such a tax would, at best, provide a window of opportunity for the domestic sector to overcome its challenges, such as Eskom, and that it is not a long-term or even a medium-term solution. Additionally, it is important to consider how the export tax should be implemented. It would be best to implement it as an *ad valorem* tax, and it would be economically efficient if the process were to be kept simple, utilising existing legislative and operational frameworks, such as the new Customs and Excise Act of 2020.

This discussion shows that an export tax does not sever the link between domestic and global markets, but, rather, creates a wedge between domestic and international prices. This gives domestic consumers a cost advantage. Due to the vast differences between the cost of producing UG2 and producing traditional chrome ore, export tax rates or tariffs would have to differentiate between different seams. The determination may be based on chemical composition and/or source (reef or area where mined). The implemented rates of tax could be an *ad valorem* rate or a fixed rand amount per tonne per category of product (different seams would require different rates, due to the production-cost differential and the destructive effect of low-cost UG2 on the South African chrome industry) and/or destination of export.

To determine the trade effect of the proposed export levy on chrome ore, a partial equilibrium (PE) analysis of the trade effects of the proposed export levy on chrome ore on South African exports to China was conducted.

This study employed the SMART[2] (Software for Market Analysis and Restrictions on Trade) Model, given its strength in analysing the effect of a single market on disaggregated product lines. The PE model allowed estimation of the impact specifically on trade flows that would result from a change in trade policy.

The main advantage of the PE vs the computable general equilibrium (CGE)[3] approach, which analyses all markets simultaneously, is that relatively few data items are necessary. The only required data for a PE analysis are: trade flows, trade policy (e.g., tariffs), and values for some behavioural parameters (mainly elasticities). Another advantage is that it permits analysis at a relatively disaggregated level, so that the decision-maker can focus on a particular product (e.g., a specific tariff line). Moreover, PE models look at the market for one product at one time, ignoring cross-product and general equilibrium effects (such as changes in wages, GDP, aggregate demand, etc.) and how those variables may, in turn, affect the markets for chrome ores. If the shifts in the markets in question are small in relation to the overall economy, this is a somewhat reasonable simplification.

The assumptions of the SMART model for this study included:

- Base year: 2019 (latest year available in the model);
- Interventions such as export bans and taxation implemented by other countries were not considered in the simulation (the model is only able to simulate one scenario at a time).
- Infinite supply elasticity[4]
- Import demand elasticity: default value in SMART was empirically estimated for each country and every HS six-digit product (see Kee, Nicita & Olarreaga, 2008);
- Substitution elasticity between export partners: 1.5; and
- Product scope: chrome ores specified as HS Code 261000. This is the most disaggregated data available in the SMART model.

[2] For a detailed discussion on the use of the SMART partial equilibrium modelling tool, see, e.g., https://wits.worldbank.org/wits/wits/witshelp/Content/SMART/SMART%20Overview.htm

[3] In a general equilibrium setup, all markets are simultaneously modelled and interact with each other.

[4] Correlation analysis on data from 1990 to 2020 showed no statistically significant relationship between South Africa's export volumes and prices of chrome ore.

The simulation scenarios in the SMART model are specified from an importer perspective. Hence, for the purpose of this study, the export levy implemented by South Africa was specified as an export levy on chrome ores implemented by China. Table 6 shows the three scenarios used in the analysis.

Table 6: Scenarios of the model simulations

	Export levy
Scenario 1	20%
Scenario 2	30%
Scenario 3	40%

The simulation results from a market perspective are presented in Figure 9. The figure shows the total imports of chrome ore by China before and after the implementation of the export levy by South Africa, as well as the absolute and percentage change. It is evident that an export levy of 20% may result in a 17% decrease in Chinese imports. An export levy of 30% may lead to a decrease of 25%, and an export levy of 40% may result in a decrease of 34%, based on the assumptions and limitations of the model. The impacts of these three scenarios on China's imports of chrome ores are quite significant, and illustrate China's high reliance on chrome ore supply from South Africa.

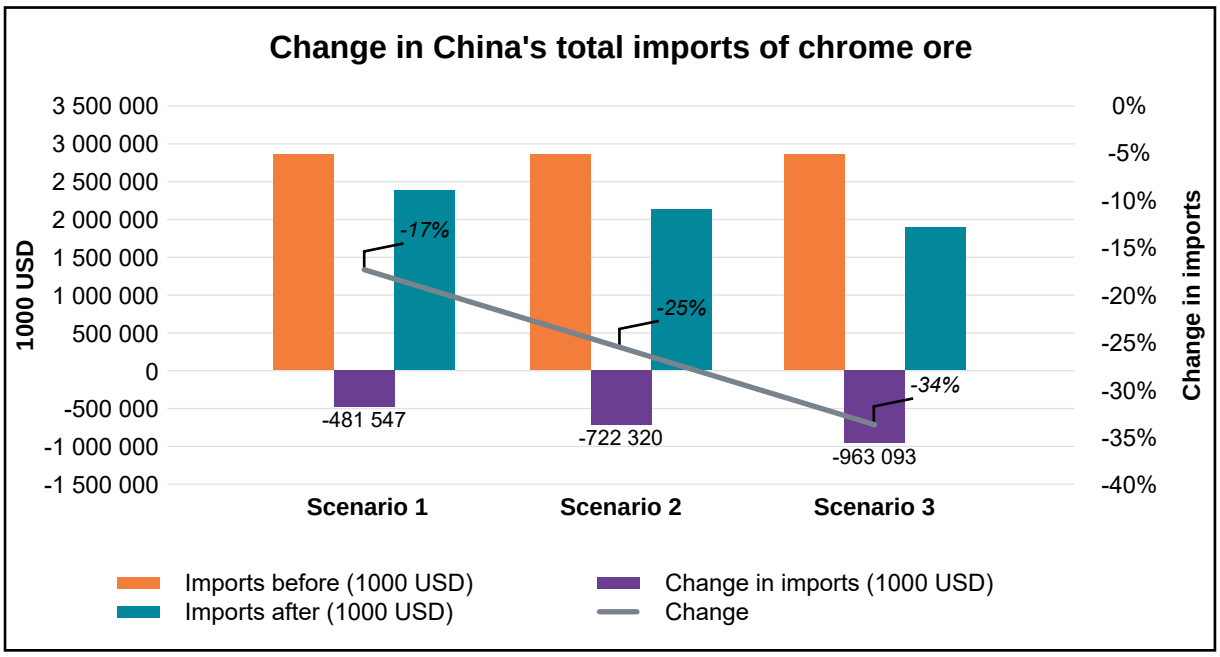


Figure 9: Simulation results of changes in China's imports of chrome ores
Source: Authors' own calculations based on SMART simulations (2021)

The next figure presents the likely impact of the three simulation scenarios on South Africa's exports of chrome ore to China. It is evident from the Figure that the assumed impact will be significant in all three scenarios, potentially ranging from 32% to 65% less exports with the material likely taken up domestically. Replacing the South African ore will be a challenge to China creating the opportunity to have China import the value added beneficiated product, ferrochrome, from South Africa.

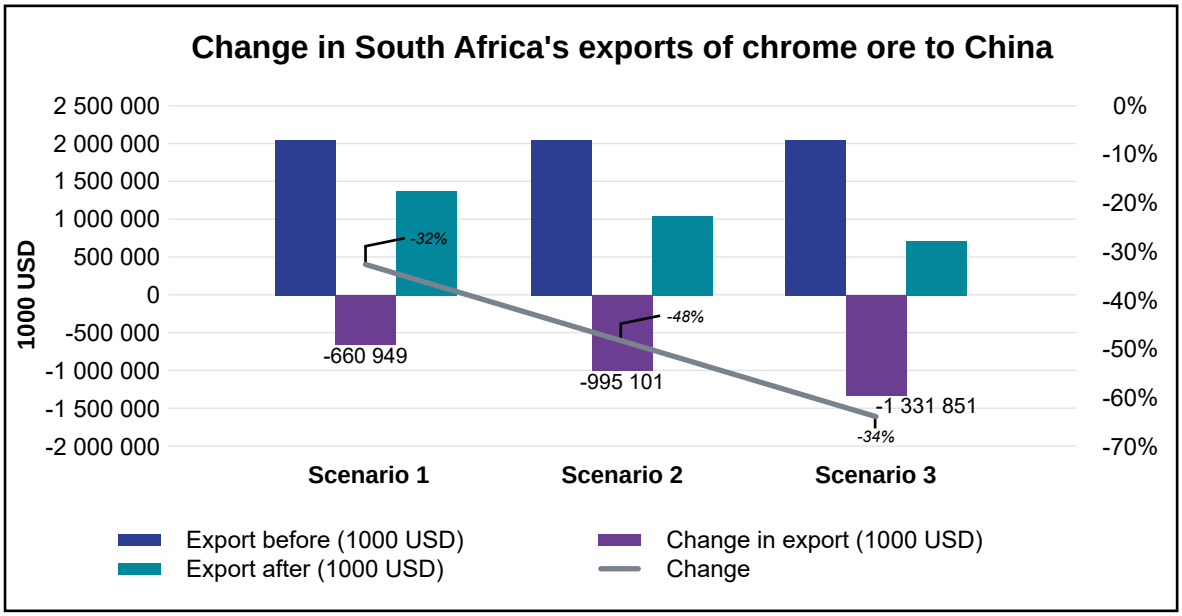


Figure 10: Simulation results of changes in South Africa's exports of chrome ores
Source: Authors' own calculations based on SMART simulations (2021)

The hypothetical impacts of the three scenarios on the local chrome industry are depicted in Table 7. The second column in the table shows the potential impact of the export levy on total chrome exports by South Africa. Since China is by far South Africa's most important export market, these changes are slightly lower than the percentages shown in Figure 9, ranging between decreases of 28% and 57%.

The third column shows the potential volumes of chrome ores that will become available on the local market because these will no longer be exported to China, due to the export levy. These volumes were calculated using the values of foregone exports by the average cost, insurance, and freight (CIF) price per tonne on the Chinese market. The fourth column shows the proportional impact of these additional volumes on total local supply of chrome ores, with increases ranging from 18% to 35%. (Note that the analysis assumes that South African smelters can absorb all the additional ores that will be available for the local market, should an export tax be implemented.)

The impact of the likely increase of local supply of chrome ores on the production of ferrochromium is depicted in the fourth column. The proportional effect of this increase on South Africa's total ferrochrome production is shown in the last column. Hence, an export levy of 20% on chrome ores will likely lead to a 53% increase in local ferrochrome production, a levy of 30% will potentially lead to an increase of 80%, and an export levy of 40% may lead to a production increase of 107%.

Table 7: Potential impact of the trade effects on the local chrome industry

	Potential decrease in total chrome ore export value (% change)	Potential volumes of chrome ore available for the local market (Kt)	Potential increase in chrome ore volumes available for the local market (% change)	Potential increase in ferrochrome production (Kt)*	Potential increase in total ferrochrome production (% change)
Scenario 1 20%	-28%	3 982	18%	1 731	53%
Scenario 2 30%	-43%	5 995	26%	2 606	80%
Scenario 3 40%	-57%	8 023	35%	3 488	107%

Note: *Chrome ore/ferrochrome production ratio: 2.3

Source: Authors' own calculations based on data from SMART Model, CRU, and DMR (2021)

The results must also be considered in conjunction with the desired policy goals, as explained in earlier in this section. If the goal is to direct more chrome and ferrochrome to the domestic market for further production of value-added products, an export tax can be one mechanism to create the desired effect, as the analysis clearly shows a significant potential reduction in exports to China with an increase in domestic ferrochrome production.

SOCIAL CONSIDERATIONS

The greatest threat to supply chain development through beneficiation is the rise of opportunistic entrepreneurs in the informal political economy, who operate beyond the reach of statutory prescriptions and the legal regime. Communities in peri-urban South Africa are rife with factors of instability that undermine families, local entrepreneurship, and economic development. The destruction often originates in policies with unintended consequences. As a comparative example, a reference could be made to the decline of the garment and textile sector of South Africa. With protectionism encouraging inefficiency, the failure to design and implement policies that would promote a competitive industrial environment led to the near destruction of South Africa's textile industry through unfettered imports from strictly controlled political economies. Sustainable development needs to be enshrined in and emanate from policy directives that promote local economic development and institutionalise an industrialisation value chain.

Value chains and beneficiation stabilise local political systems, allow communities access to socioeconomic mobility, and increase the prospects of a greater good negotiated between contending interests or adversaries.

Like many policy tools and instruments,

export taxes have proven to be extremely valuable to industrial development. Export taxes have supplied governments with the necessary development finance; however, it is at the discretion of every national government to decide which sector(s) of the economy to supply with revenue. Therefore, depending on where a government chooses to invest, the distributional effects may be disproportionate amongst different societal groups. However, any development of the CFcVC will have a trickle-down effect and multiplying impacts.

The composition of South Africa's trade with most parts of the world (see *Economic Considerations* section) is characterised by the export of raw materials and the import of manufactured goods. In reality, South Africa is also exporting potential jobs *en masse*. In practice, South African manufacturers have to pay import parity prices to the mining companies, causing our manufacturers to be uncompetitive. When this difficulty is added to the problem posed by cheap manufactured goods from China and India, South African manufacturing operates on a very uneven playing field, therefore the proposition of the export levy in this CFcVC space. As such, the ferrochrome industry and its value-chain beneficiation present a window of opportunity to develop niche markets. The isolation of extractive mining from the industrial value chain (see discussion on beneficiation or the lack of a specialised focus) also has consequences for labour policy. Mining companies are, for example, proposing to displace workers from mining into other activities. However, these workers need broad training to enable them to switch to other jobs, especially in a manufacturing set-up.

The industry has substantial multiplier effects on the rest of the economy, but it could contribute even more to the

development of other businesses as a knock-on effect. The ferrochrome industry needs to take a hard look at the potential for downstream processes if the country is to benefit from its chrome endowments. The export of raw ore has steadily risen over the past decade, and the multiplying benefits of value added to the value chain will develop a more conducive socio-economic environment through job creation, contributions to skills enhancement, diversification of the economy, and a move away from primary producer status towards manufacturing-based industrialisation and increasing foreign direct investment (as happened when Zimbabwe announced trade protection of its chrome resources). This will turn the comparative advantages of being resource-rich into a competitive advantage and enhance the creation of small and medium enterprises (Turok, 2013).

The Government Intervention in Mining Sector (SIMS) report of the ANC (Turok, 2013) examined international practice in Brazil, Chile, Venezuela, Botswana, Namibia, Zambia, China, Malaysia, Norway, Finland, Sweden, and Australia. This is viewed as one of the most comprehensive studies in this domain, and implores South Africa to break away from the notion that mining is an enclave industry that must be treated as a generous benefactor. In fact, mining exploits a country's endowment, which is ephemeral, and the potential multiplier effect thereof must be realised while it is thriving, not when it is in decline.

President Ramaphosa's stance on industrialisation has been supported by some of his key ministers. Mineral Resources Minister Gwede Mantashe argued in his budget speech that *"beneficiation ... was adopted as government policy in 2011"*, a reference to his own department's beneficiation strategy. In the introduction to South Africa's 10th iteration of the Industrial Policy Action Plan (IPAP), then Minister of Trade and Industry, Rob Davies, said, *"The key challenge to industrial policy is to incentivise investment in plant, technologies and skills that would have medium to long-term benefits to the economy."*

"...mining exploits a country's endowment, which is ephemeral, and the potential multiplier effect thereof must be realised while it is thriving, not when it is in decline"

TECHNOLOGICAL CONSIDERATIONS

The world's largest chrome reserves are located in the Bushveld Igneous Complex in South Africa. All chrome mining activities are located on the rim of this body, where the chromite-containing reefs are extracted and processed. Chromite-rich layered groups like MG1, MG2, and LG6 are mined by either open-cast or underground chromite mining, but, in recent years, an additional major source of chromite became available as the chromite-rich discarded tailings resulting from PGM operations mining the UG2 reef. The advantage of this source is that the material is already mined and milled to a very fine size (smaller than 75 microns) to enable PGM extraction — a significant saving in operating costs. In 2019, this source constituted 30% of all local chrome production (ICDA, 2019a, 2019b). The disadvantage is its inferior quality, especially in terms of chrome-to-iron ratios.

In some cases, LG, and possibly MG, ore is sufficiently rich in chrome content to allow shipment without any further processing. The reefs are usually of sufficient thickness to ensure that very little extraneous gangue[5] is mined from the mine floor or the roof to dilute the chrome product (McCarthy & Rubidge, 2005). However, in some cases (and in all cases for UG2), there is too much gangue present in the chromite product, which then needs to be removed to ensure a minimum chrome content.

Chromite beneficiation is a physical ore-dressing process that exploits the density difference of chromite (4.5 – 4.8 g/cm^3) and that of the surrounding gangue minerals (about 2.7 g/cm^3). The process to separate the two components is based on gravity, and is mostly done using mineral spirals. Mineral grains are separated into different density fractions by their reaction to the gravitational force while being transported in a thin film of flowing water around a spiral-shaped trough. To achieve sufficient separation, the ore is first crushed and milled to a size less than 2 mm (this size varies between different processes) to liberate (release) the chromite mineral grains from the gangue. In the case of the treatment of UG2 PGM tailings, the material is already sufficiently fine, due to the PGM extraction process, and it can simply be subjected to gravity separation to produce

[5] Gangue is a collective name for unwanted, valueless waste mineral materials to be discarded from the process.

a sufficiently rich chromite concentrate of more than 40% Cr_2O^3. This is the reason for the low cost of production of UG2 versus traditional chrome sources — the mining and milling costs have already been covered during the PGM production process.

Ferrochrome is mainly used as a precursor in stainless steel production, with about 94% of chromite production destined for this metallurgical application. Other uses for chromite are in the chemicals and refractories sectors. About 68% of the chromite concentrate destined for metallurgical applications is exported, and the rest is sent to local ferrochrome smelters (ICDA, 2019a, 2019b). In this regard, Interviewee 12, supported by Interviewee 13 (Category 5, September 2021) said, *"…with the installed capacity, 2020 is even more difficult … as electricity prices are killing ferrochrome smelting"*.

During the smelting process, the chromite (an oxide) is mixed with a flux (to lower the melting point) and a reductant, a carbon source consisting of coke, anthracite, or similar coal products. Fluxes typically include limestone, dolomite, and/or quartz. In the case of fine ore, the material can be pre-treated by briquetting, pelletisation, curing, and/or prereduction[6], and is then smelted using electric arc furnaces at temperatures ranging from 1 700ºC to 1 750ºC (Retief, 2021). A reduction reaction occurs, where the carbon from the reductant reacts with and removes the oxygen from the chromite as CO and/or CO_2 gas[7]. The remaining molten mix of iron and chrome is known as *ferrochrome*, and is separated from the molten slag[8]. Since the density of ferrochrome metal is higher than that of slag, it forms a distinct layer at the bottom of the furnace, and can be intermittently tapped off through tapholes. The slag, being lighter, rises to form a layer above the ferrochrome metal, and is tapped through the same hole afterwards. Slag can be used in applications like sandblasting or building materials, but is sometimes reprocessed to recover misplaced ferrochrome. About 2 to 2.5 metric tons of chromite ore are consumed to produce 1 tonne of ferrochrome (Department of Mineral Resources, 2017). Rates of chrome recovery, grade, and power consumption are highly process-dependent (see discussion of the different technologies for more detail).

[6] Ferrochrome is the metallic product from a (ferro)chrome smelter and is an alloy of mainly iron and chrome as a feedstock to stainless steel production. Contaminants include carbon and silicon.

[7] This depends on the technology used. See the next section on ferrochrome smelting technologies.

[8] Again, the type of off-gas produced depends on the technology used.

[9] Slag is a mixture of molten oxides formed by flux and gangue minerals.

Several different ferrochrome smelting technologies are used in South Africa, and there have been vast technological improvements over time (Basson *et al*., 2007; Beukes *et al*., 2010). Interviewee 12 (Category 5, September 2021), supported by Interviewees 13 and 29, stated that, *"Current furnaces are seeing fantastic efficiencies, but if there are no relevant policy changes, more smelters and furnaces are going to be closed. For every tonne of ore not processed, job losses will escalate".* In contrast to this, another CFcVC association (Interview 23), is still of the opinion that one of the challenges in the ferrochrome industry (besides the dominant electricity issue) is *"outdated technology"*.

The types of furnace used for ferrochrome smelting are (Basson *et al*., 2007; Beukes *et al*., 2010; Naiker, 2007; Naiker *et al*., 2006; Retief, 2021; Sager *et al*., 2010; Visser, 2006):

Open (or semi-closed) vs closed furnaces: Earlier furnaces were not covered, and caused severe pollution through off-gas and dust. Later furnaces are closed, and enable gas cleaning using bag filters. This yields higher energy efficiency, as less heat escapes the furnace through the open roof. A further advantage is that closed furnaces favour the formation of CO gas, rather than CO_2 gas. CO is combustible in air, and is used as an integrated heat source for drying, sintering, and pre-reduction, for example.

Submerged arc vs open slag-bath furnaces: Smelters have three distinct layers of material — the ferrochrome metal at the bottom, the slag layer on top of that, and a layer of unreacted charge feed floating on the slag layer. Traditional submerged arc furnaces operated with the electrodes submerged in the slag and charge layers, not touching the metal layer (see Figure 11). Power (in the form of heat) can only be generated from current flow through a high resistance, which is found in the slag layer. The electrical resistance in the metal layer is low, essentially causing a 'dead short' with little heat generation. Since the unreacted feed ore is fed from the top of the furnace, it can form an impermeable layer on top of the slag layer, creating a dense, impermeable crust preventing the escape of the generated gas, while also limiting the volume capacity. This limits the particle size of the feed, and there is a need to pelletise or briquet any fine feed. Three-phase alternating current (AC) is used in this design. Open-bath furnaces, however, operate with the electrode(s) near the surface of the furnace burden, causing a plasma arc similar to that of a welding machine (see Figure 11). This design is normally run with direct current (DC), but the recently adapted Brush Arc technology uses AC in an

open bath, resulting in lower capital- and operating costs and higher efficiencies. One advantage of an open slag-bath furnace is that the charge feed is introduced next to the electrode(s) near the walls of the furnace, not covering the reaction zone, and allowing the free escape of off-gas. This enables the use of a fine chromite (including in UG2), without the need for expensive agglomeration.

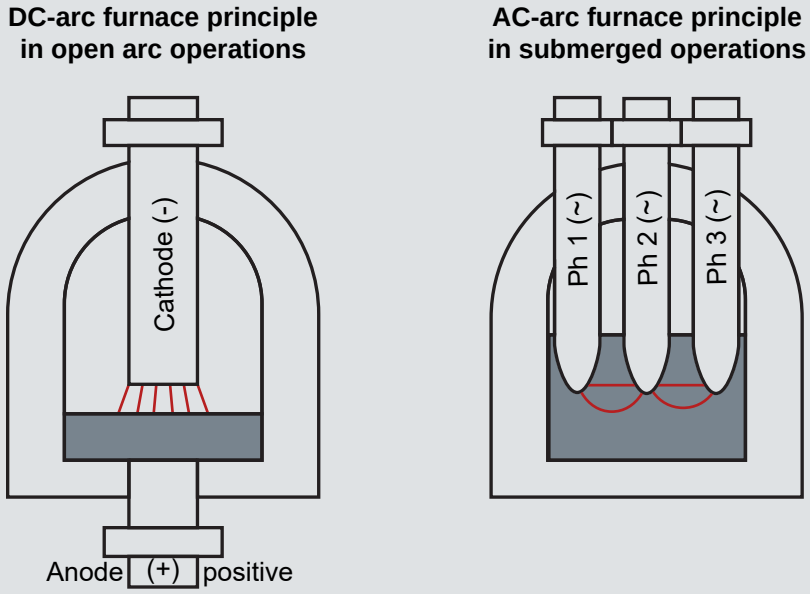


Figure 11: A comparison of DC open-arc furnace design (left) and AC submerged arc design (right)
Source: Sager *et al*. (2010)

Smelter operations in South Africa employ the following technologies (Basson *et al*., 2007; Beukes *et al*., 2010; Naiker, 2007; Naiker *et al*., 2006; Retief, 2021; Sager *et al*., 2010; Visser, 2006):

The **conventional process** entails feeding lumpy chromite, flux, and reductant to either open, semi-closed, or closed submerged arc furnaces. The off-gas is cleaned using bag filters before being released into the atmosphere. Its main disadvantages are the limited use of fine ores and a significant environmental impact.

To enable the processing of finer ores, the **Outokumpu process** combines milling, agglomeration with a binder, and sintering of fine ore (PSP) with closed submerged arc furnaces. Agglomeration and sintering are done using drums and steel grate belts, using the CO-rich furnace gas as a fuel. The off-gas is cleaned in wet scrubbers. Closed

furnaces reduce the impact on the environment, with less off-gas and escaping dust emitted into the atmosphere.

The development of **DC open-bath technology** enabled the utilisation of fine ore without agglomeration, and resulted in higher chrome recoveries. These furnaces can operate using anthracite only as a reduction, with no need for coke. Application in South Africa is limited to four furnaces, of which two are currently operating.

In using ***Premus technology*** (an improvement on the SDK technology), a feed consisting of fine chromite ore, binder, and reductant is milled, pelletised, and preheated before being fed into rotary kilns for pre-reduction, with furnace off-gas used as a fuel. The semi-reduced pellets are hot-fed directly to closed submerged arc furnaces. The furnace off-gas is cleaned in venturi scrubbers. The pre-reduction step means that less energy is needed in the furnace proper. Either anthracite or coke can be used as a reductant. Two large South African smelters are using this technology. Premus currently offers the lowest specific energy consumption of all existing technologies.

Brush Arc technology has been used in the steel industry for some time, and was recently adapted for use in ferrochrome smelting. It is an open slag-bath furnace utilising AC power, with three electrodes. No agglomeration is needed, as fine ore can be fed into the furnace as is. Anthracite is used as a reductant. It offers very good overall efficiencies, with a higher chrome recovery. While still only proven during an industrial-size test, this technology has the potential to be applied to all existing closed submerged arc furnaces in South Africa, which would significantly change the feed flexibility, techno-economics, and environmental impact of ferrochrome smelting.

Thus, South Africa, following its long history of ferrochrome production, is a leader in these technologies and their continuous improvement to be the most efficient furnaces in the world.

ENVIRONMENTAL CONSIDERATIONS

The general environmental effects of mining can occur at local, regional, and global scales, through direct and indirect mining practices. The effects can be negative, such as loss of biodiversity and the contamination of water by the chemicals emitted from mining processes. These mining processes also affect the atmosphere through the emission of carbon, which is detrimental to the quality of human health and biodiversity. However, in this section, it is also argued that, going forward, there are going to be tremendous opportunities for South Africa's mining of minerals to sustain the escalating local and global demand for going greener through renewables and decarbonisation of the sector and the economy as a whole.

The narrative of climate change is becoming increasingly important on global markets' production agendas, and carbon emissions will become increasingly regulated and monitored by the world's agencies. An accelerated transition to green energy resources is already under way. In an in-depth discussion of the transition to green energy on *KykNet Verslag* (6/10/2021), it was acknowledged that South Africa is one of the top 12 worst carbon-emission polluters. A delegation of Western diplomats recently visited South Africa to gain the state's targeted commitment to the 2030 and 2050 zero-emissions goals. The diplomats also remarked that foreign investment money will support these greener energy projects, and it was agreed that solar power and hydrogen fuel were the way forward, as

these are more sustainable. Meridian Economics (Slabbert, 2021:13) concur that developed economies would supply the financial investment into rapid transition to renewable energy projects, but noted that, if South Africa does not take up this challenge, they would migrate to other developing countries, such as Indonesia and India. The above occurs while Eskom and NERSA are involved in numerous legal battles — the most recent due to NERSA's rejection of Eskom's tariff application for the next three years. Eskom will appeal the decision by NERSA.

Although metals and minerals will certainly play a crucial role in the energy transition currently gaining momentum across the globe, mining operations will also need to play their part in mitigating climate change, while also securing long-term profitability and growth for the industry. The pressure on mining companies to decarbonise their operations is likely to increase going forward as more public and private stakeholders demand greater transparency and action as part of a broader set of environmental, social, and governance concerns. There are several potential initiatives by various national and international stakeholders to move toward achieving a zero-carbon mine, such as renewables and power purchase agreements to decarbonise electricity sources, innovations for capturing fugitive methane, and electrification of fleets, to name a few (Steyn, 2019). Many announcements have been made in this regard in the business media. Below are some examples.

- The ferrochrome business of diversified mining and marketing company Glencore uses a substantial amount of electricity, and is currently evaluating various clean energy projects.
- Another initiative is on-site projects looking at cogeneration and other alternatives, as well as bigger projects, where virtualpower purchase agreements are under consideration. Glencore revealed that the company was helping to develop other forms of energy in South Africa, including solar, and that it had engaged in strategic collaborations with companies able to supply solar energy. Glencore Alloys issued a prequalifying tender for companies interested in supplying alternative green electricity and storage solutions for its chrome and vanadium operations in South Africa.
- Richards Bay Alloys, Afarak's Mogale Alloys, and Glencore Alloys

have partnered with Swedish clean tech company Ripasso Energy to turn toxic gas produced by their ferrochrome furnaces into electricity for power-intensive operations.

- ArcelorMittal South Africa invested R138 million in a 10 MW off-gas in 2017, enabling it to generate 10% of its total electricity requirements.
- Sibanye-Stillwater did a feasibility study for a 150 MW solar photovoltaic project to supply power to its Kloof and Driefontein gold operations in Carltonville. This mining company is one of Eskom's top five private customers, contributing 2.5% of Eskom's sales annually.
- Since 2016, deliberations have abounded on projects that produce power from discarded coal. Glencore, for one, planned for generation of electricity at its Witbank coal operations to offset power usage at its Rustenburg smelters.

South Africa underestimates the positive effect that the current and expected wave of green fixed investment and renewable energy programmes countrywide could stimulate, a driver of growth that was not present in the 2015 to 2019 economic space. It is clear that South Africa's energy transmission strategy must be mapped out more clearly. Heavy energy users in South Africa have started moving away from relying on Eskom power. Alternative power supply projects are long-term in nature, and demonstrate commitment to South Africa by reducing carbon footprints and creating jobs.

The challenges in meeting the country's energy demands are well-documented. In response to the national energy crisis, the South African government, in early 2015, created the Energy War Room to urgently and systematically implement the Cabinet's 5-Point Energy Plan. This includes the rolling out of several energy- and energy efficiency programmes and initiatives, with a strong emphasis on gas-to-power technologies, off-grid renewable energy solutions, hydrogen energy, and oil and gas (including shale) exploration opportunities. To align with the other BRICS countries, South Africa adopted the strategy of being an independent power producer and producing power locally, in order to sustain its long-term growth ambitions. Investing in power generation infrastructure in the short term will add significantly to manufacturing capital costs, and thus impact competitiveness.

LEGAL CONSIDERATIONS

It is important to consider how the export tax should be implemented. The analysis shows that it would be best to implement it as an *ad valorem* tax, and that it would be economically efficient if it were kept simple and enforced through existing legislative and operational frameworks, such as the new Customs and Excise Act of 2020. The analysis shows that an export tax does not sever the link between domestic and global markets, but, rather, creates a wedge between domestic and international prices. This gives domestic consumers a cost advantage.

Due to the vast differences between the cost of producing Upper Group 2 Reef (UG2) and traditional chrome ore, it follows that export tax rates or tariffs would have to differentiate between different seams. The determination may be based on chemical composition and/or source (reef or area where mined). Rates of tax such as an *ad valorem* rate or fixed rand amount per tonne per category of product (different seams would require different rates, due to the production-cost differential and the destructive effect of the low-cost UG2 on the South African chrome industry) and/or destination of export. The export duties will apply to exports to all countries, except those benefitting from exemptions under trade agreements to which South Africa is a party. It will also be necessary to create new HS classification codes for the different forms of ferrochrome, as these does not exist in the current taxation framework of the South African Revenue Service.

CONCLUSION AND RECOMMENDATIONS

The full recommendations and details thereof can be found in the master document. The following is a summary.

South Africa will not overcome current problems related to improved economic growth — with a trickle-down effect on job creation — without renewed growth in investment. Therefore, the only remaining option is to create an environment for the private sector to invest in growth projects such as infrastructure development and production capacity, and to ensure employment growth. In this regard, the CFcVC provides a window of opportunity to accomplish this through a broad-based beneficiation channel, in collaboration with the special economic zones (SEZs) already in place.

The economic analysis shows that any investment decision to build or expand domestic ferrochrome production is dependent on several aspects, including the cost and supply of electricity and the cost of chrome ore for use in the production of ferrochrome. The demand for ferrochrome, in turn, is dependent on the demand for stainless steel.

The results must also be considered in conjunction with the desired policy goals. If goal is to direct more chrome and ferrochrome to the domestic market for additional value-added products, an export tax could be a viable mechanism to create the desired effect, as the analysis clearly shows a potential reduction in exports to China. An export tax does not sever the link between domestic and global markets, but creates a wedge between domestic and international prices. This gives domestic consumers a cost advantage. Due to the vast differences between the cost of producing UG2 and the cost of producing traditional chrome ore, export tax rates or tariffs would have to differentiate between different seams. The determination may be based on chemical composition and/or source (reef or area where mined). Rates of tax such as an *ad valorem* rate or a fixed rand amount per tonne per category of product (different seams would require different rates due to the production cost differential and the destructive effect of low-cost UG2 on the South African chrome industry) and/or destination of export need to be clearly stipulated. The export duties will apply to exports to all countries, except those countries benefitting from exemptions under trade agreements to which South Africa is a party.

It will also be necessary to create HS codes for the different forms of chrome that do not exist in the current taxation framework of the South African Revenue Service. This shortcoming also limited the data analysis that could be done up to this point, as current export and import data for chrome are only captured at a high level (as indicated in the *Economic Considerations* section of the report), and the data do not distinguish between UG2 and other levels of chrome. Therefore, South Africa would be allowed to implement an export tax on chrome ore on exports to China, with the proviso that it still needs to comply with the World Trade Organisation rules. Based on the research, differentiated taxation between the different chrome ore seams needs to be considered, typically between 30% to 40%, based on factors such as chemical composition, product cost, and logistical cost.

The report rightly indicates that the effectiveness of the tax as a single instrument for industrial development will not be effective. Development will require additional industrial and trade policy tools used in conjunction with the tax, stable institutions, and a targeted approach to effectively using the export taxes to develop downstream processing in the ferrochrome industry. Trade policy options would also require export tax exemptions to be negotiated with the SADC, the AfCFTA, and in the EPA with the EU. Hence, for an export tax to be successful, the following criteria must be in place:

- First, the exporting country should have a significant level of market power.
- Second, the exported goods should have few real substitutes from other supplying countries.
- Third, an export tax can only be used as an effective measure over the short- to medium term, as the expansion of the local industry or local beneficiation will not be dependent on the export tax alone, but also on the supporting environment (including solid institutions, infrastructure, a positive investment climate, and labour supply).
- Fourth, the country must acquire the necessary capabilities and knowledge, and create an enabling environment for local processing activities.
- Finally, the cost of electricity to high-intensity user groups (HIUGs) should be negotiated to more feasible preferential rates.

Overall, the results from the data analysis show that the implementation of an export tax can potentially result in a reduction in chrome exports from South Africa to China, mainly offset by an increase of domestic use leading to an increase in ferrochrome production.

In addition to differentiated export taxation on chrome ore as a short- to medium-term intervention, the following is recommended:

- Prioritise beneficiation
- Set a clear policy and regulatory regime for beneficiation
- Ensure that policy decisions are consistent with the long-term perspective
- Establish effective SEZs
- Research potential diversification of the CFcVC
- Renew the focus on energy supply relating to stability, production, and price path, also considering renewable and other sources of energy
- Improve processes and policies to make negotiated pricing between industry and NERSA clear and efficient
- Increase fixed capital investment into mining, especially exploration

The various CFcVC industry associations need to take up the above actions proposed by President Ramaphosa with his office as soon as possible. The contrasting points of view of the major CFcVC associations must be addressed by those involved as far as possible. The ultimate aim of the drive for a CFcVC is the further beneficiation of ferrochrome domestically into a fully fledged stainless steel industry. This requires market research as a matter of urgency.

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