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Dark Spots in the International Commodity Value Chain: The Case of Copper in Zambia¹

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Abstract

This paper investigates mineral export misinvoicing in Zambia as a channel of capital flight, with a focus on copper, gold, and gemstones. The analysis reveals major discrepancies between Zambia's recorded exports and imports as recorded by its trading partners. In the case of copper, a large share of exports recorded in Zambia as headed to Switzerland does not appear in Swiss imports. The 'missing copper' cannot be traced through analysis of trade between Switzerland and its major partners either. Gaps in the opposite direction are observed in Zambia-China trade, suggesting export underinvoicing, a common mechanism of capital flight. These do not offset the gaps observed in mirror trade statistics between Zambia and Switzerland, which remain a mystery. Similarly, whereas the primary destination recorded for Zambian gold exports is South Africa, these do not appear in gold imports recorded by South Africa. The gemstones sector is characterized by high informality that enables smuggling and export underinvoicing. Zambia must implement measures to curb misinvoicing of mineral exports and address structural opacity in the trade value chain if it hopes to maximize the gains from the exploitation of its mineral resources.

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1. Introduction

The problem of capital flight has been identified as a critical issue, especially for natural resource-rich developing countries, as it prevents them from leveraging these resources to finance their development agenda. Indeed, oil and mineral-rich African countries feature prominently on the top of the list of countries with the highest volume of capital flight as illustrated in various studies. As of 2018, nine out of the top 10 African countries with the highest amount of capital flight were oil and mineral-dependent countries (the exception is Morocco).⁴ Zambia is in the eighth position. Updated estimates put total capital flight from Zambia since 1970 at \$71.5 billion as of 2021. A detailed analysis of capital flight from Zambia, along with Cameroon and Ghana is presented in Ndikumana (2023).

The problem of illicit financial flows, of which capital flight is a subset,⁵ has generated interest among policy making institutions such as the African Union, the United Nations Economic Commission for Africa, the United Nations Conference on Trade and Development (UNCTAD) as well as in academia and policy-oriented think tanks. Researchers have sought to understand the extent and mechanisms through which illicit capital outflows occur, with the aim of informing the design and implementation of policies aimed at stemming the financial hemorrhage of African countries.

Trade misinvoicing, whereby the value of imported and exported goods is intentionally either underinvoiced or overinvoiced, has been identified as a major mechanism of illicit financial flows (UNCTAD 2016). Firms obtain foreign exchange and move capital out of the country by under-invoicing exports while importers gain access to unrecorded foreign exchange by over-invoicing imports. Empirical studies on African countries have established that trade misinvoicing constitutes a substantial part of the capital flight (Ndikumana and Boyce 2010; Ndikumana et al 2015; Ndikumana and Boyce 2022). A few studies have examined the problem of trade misinvoicing in individual developing countries. Examples include Lemi (2016) for Ethiopia, Kwaramba et al. (2016) for Zimbabwe, Mpenya et al. (2016) for Cameroon, and Mahmood (2013) for Pakistan. A multi-country study by UNCTAD (2016) examined the extent of trade misinvoicing for various commodities including copper for Zambia and Chile, cocoa for Côte d'Ivoire, oil for Nigeria and gold, iron ore, silver, and platinum for South Africa. The volume

⁴ The top 10 countries are, in ascending order of volume of capital flight: Nigeria, South Africa, Algeria, Morocco, Egypt, Angola, Côte d'Ivoire, Cameroon, Zambia, and the Republic of Congo (Ndikumana and Boyce, 2021).

⁵ Illicit financial flows is a broader phenomenon than capital flight. Beyond unrecorded flows, it also includes recorded outflows that are illicit because they originate from illicit activities, are transferred illegally, or are hidden offshore outside of the view of the regulator. See Ndikumana and Boyce (2015, 2020) for a detailed discussion of the distinction between the two phenomena.

edited by Ndikumana and Boyce (2022) contains in-depth analysis of export misinvoicing for the cases of Angola (oil), Côte d’Ivoire (cocoa) and South Africa (minerals).

This case study on Zambia builds on past studies on trade misinvoicing and extends the analysis by further refining the empirical methodology in important ways. Firstly, the UNCTAD (2016) study examined the extent of copper misinvoicing in Zambia, but the paper focused on copper ores (SITC 682 or HS 74) and excluded copper concentrates recorded under SITC 2831 (or HS 26). This study includes both the HS 74 and HS 26 categories to get a comprehensive measure of copper exports. Secondly, while previous studies (UNCTAD 2016; Ndikumana, et. al, 2015; Ndikumana and Boyce, 2010) applied a fixed CIF/FOB ratio of 10% in mirror trade data comparisons, as commonly done in literature, here we use product-level CIF/FOB ratios estimated by the OECD.⁶ These ratios are country, product, and time specific, enabling us to obtain a more accurate measure of trade misinvoicing.

Finally, while previous studies identify the major trading partners in trade misinvoicing, little work had been done to investigate what lies behind the observed large gaps in mirror trade statistics. This study examines triangular trade for countries where bilateral trade exhibits large trade gaps, to explore whether some of the Zambia’s recorded exports are subsequently sold to third parties. Evidence from such an analysis can provide useful input into the design of strategies to curb capital flight, combat corporate tax evasion, and repatriate illicit private wealth stashed in secrecy jurisdictions.

The paper proceeds as follows. Section 2 briefly reviews the evolution and significance of the mining industry in Zambia. Section 3 presents an overview of the literature on trade misinvoicing. Section 4 presents the methodology used to estimate commodity export misinvoicing. Sections 5, 6, and 7 present the results for the cases of copper, gemstones, and gold, respectively. Section 8 concludes.

2. Mining and the Zambian economy

2.1 Importance of the mining sector

Mining has been the mainstay of the Zambian economy since the colonial era. The exploration of mines intensified starting in 1889, and commercial mining began in 1928 when Rhodesia Selection Trust (an American company), and Anglo-American (a South African controlled firm) opened mines. Between the opening of the mines and 1954, the country produced approximately 4.8 million tons of copper, which was valued at £498 million. Copper production increased to 559,900 tons valued at £114.9 million in 1961 (Reeve, 1965). On the eve of independence, in 1963, copper production stood at 483,900 tons, and it peaked at 708,500 tons in 1969 before nationalization in

⁶ “International transport and insurance costs of merchandise trade”, https://stats.oecd.org/BrandedView.aspx?oecd_bv_id=itcs-data-en&doi=9c638cb6-en.

1973. Thereafter, copper output declined to 580,200 tons in 1970 and followed a downward trend throughout the 1980s, down to 376,900 tons in 1990. During the 1992-2002 mines privatisation period, production plummeted and averaged at 331,765 tons per annum. Following new investments in the mines induced by rising commodity prices, copper output rose substantially and peaked at 837,996 tons in 2020 (Zambia Statistical Agency database).⁷

During the late 1960s and early 1970s, mining contributed over 90 percent of the country’s foreign exchange earnings and more than 50 percent of government revenue (Ndulo, 1986; Sikamo et al., 2015). The industry accounted for over 20 percent of formal sector employment up to 1993; the share delined to about 10 percent between 2000 to 2020. Economic growth has closely followed the performance of copper mining. As copper production collapsed in the mid-1970s, economic growth also dropped. The revival of the mining sector between 2005 and 2013 catalyzed economic growth, averaging over 6 percent a year. Growth declined slightly over the 2014-2020 period as international commodity prices declined.

The mining sector is also a major recipient of FDI inflows, accounting for 57 percent of FDI in 2021 (Table 1). The sector generated 77 percent of foreign exchange earnings in 2021 (Bank of Zambia, 2022). Consequently, a decline in mineral prices, especially copper, creates stress on the balance of payments, causing exchange rate depreciation. The mining sector is also a key source of government revenue from tax and non-tax levies. Over the period 2020-2023, the mining sector has contributed an average of 40% to gross revenue collections.

Table 1: Share of foreign direct investment stock by sector over 2015 -2021 (percent)

	2015	2018	2021
Mining and quarrying	68.1	64.6	56.6
Manufacturing	11.9	11.7	20.1
Wholesale and retail trade	6.1	7.4	5.8
Agriculture, forestry and fishing	1.8	2.5	5.4
Deposit taking institutions	6.1	4.5	4.5
Real Estate activities	1.6	3.5	3.8
Construction	0.6	0.2	2.5
Other sectors*	3.7	5.2	1.2

Source: Bank of Zambia

Note: *Other sectors include electricity, accommodation and foods; Information and communication; Insurance and other financial institutions; Transport and storage; and others.

The contribution of the mining sector to GDP has increased substantially in recent years, standing at 19.2 percent in 2021 compared to the average of 14.7 percent during 2010-2014. However, the

⁷ Data requested from Zambia Statistical Agency.

sector's contribution to employment remains low as it relies on capital-intensive technology. Only 6.2 percent of formal sector workers were employed in the sector in 2021 (Ndikumana et al., 2023).

2.2 Mineral-rich, yet debt challenged

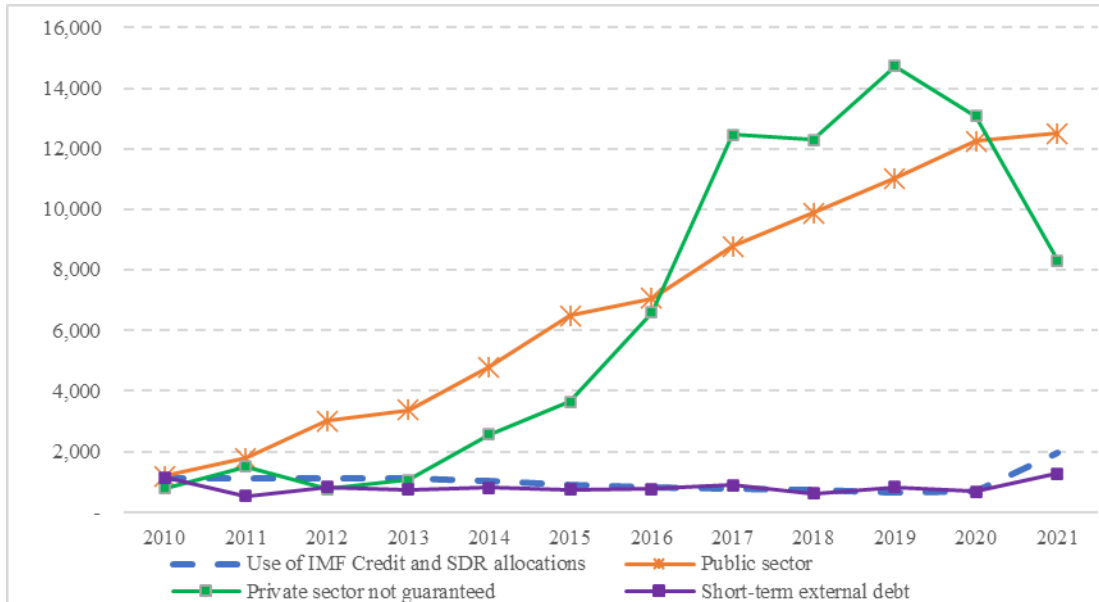
Despite its significant endowment in mineral resources, Zambia has been unable to meet its financing needs, which has forced the government to increasingly resort to external borrowing. External debt can be an important source of development finance and an ingredient in poverty eradication, to the extent that debt is invested well, and especially not used to fund capital flight. Studies by Ndikumana and Boyce (2010, 2003) and Ndikumana, Boyce and Ndiaye (2015) found that external debt accumulation can fuel capital flight. Figure 1 presents the trend of the public and private sector debt over the period 2010-2021 (also see Table A1 in the Appendix). Between 2016 and 2020, private sector debt was larger than public sector debt. A detailed evolution of the public debt is presented in Chikalipah (2021). From the mid-1980s, Zambia was in debt distress. The debt stock reached US\$9 billion in 2000, representing 254 percent of GDP. Most of this sovereign debt was owed to multilateral and bilateral lenders.

The country's debt stock was reduced thanks to debt relief under the Heavily Indebted Poor Countries initiative (HIPC) in 2000⁸ and MDRI in 2005. However, over the past decade, debt has rapidly accumulated, reaching US\$12.5 billion, equivalent to 154 percent of GDP in 2021, up from 22.5 percent of GDP in 2011. As a share of exports, external debt increased from 83% in 2015 to 328% in 2019 and 205 percent in 2021 (Figure 1). The rise in the debt stock, mainly owed to commercial lenders, resulted in increased debt service that absorbed over 42 percent of the national budget in 2018. By 2020, debt payments became unsustainable, and the country defaulted on its debt service.

Figure 1 also shows the evolution of the stock of private sector debt from 2010 to 2021 which closely followed the trend of public debt. Over the period 2010-2015, private sector debt expanded at modest pace. It rose from US\$794.3 million in 2010 to US\$3.6 billion in 2015, and thereafter accelerated to a peak of US\$14.7 billion in 2019 before declining to US\$8.3 billion in 2021. The rise in private sector debt is attributed to increased FDI, which is mainly directed towards the mining sector (56.6%) and to the manufacturing sector (20%) as shown in Table 1.

⁸ Zambia received \$237 million in debt relief in 2000 under the Highly Indebted Poor Countries ((HIPC) initiative, with the aim that these resources would be allocated to increasing social spending, reducing poverty and stimulating economic growth (IMF and IDA, 2000).

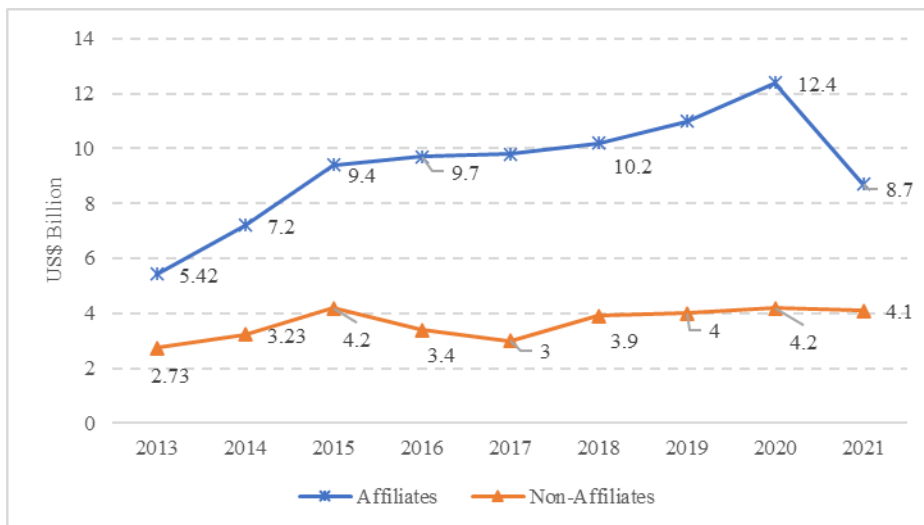
Figure 1: Trend of public and private sector debt, 2010-2021 (million, nominal US\$)



Source: World Bank

According to reports on foreign private investment and investor perceptions surveys by the Bank of Zambia, private sector investors (mostly in mining) borrow primarily from foreign affiliates (Figure 2). The loans from foreign affiliates increased from US\$9.4 billion (69.1 percent of total private sector loans) to a peak of US\$12.4 billion or 74.7 percent of the private sector loans in 2020. On average loans from foreign affiliates accounted for 72 percent of the total private sector loan portfolio between 2014 and 2021. In 2021, the mining sector accounted for the majority of the external debt stock, at 68.9 percent.

Figure 2: FDI by relationship from 2013 to 2021 (US\$ Billions)



Source: Authors' construction using data from the Bank of Zambia

According to the Bank of Zambia (2022), debt repayments mainly to foreign affiliates contributed to a decline in the FDI stock in 2021. The outflows from the mining sector exceeded new acquisitions by US\$351.7 million due to increased loan repayments to affiliates. Often the interest at which these firms borrow from their affiliates is not known to the state. Most mines did not declare profits for over 15 years. If they did, they never paid dividends to the state – which owns shares in most mining companies through Zambia Consolidated Copper Mines - Investments Holding (ZCCM-IH) – because they either reinvested or paid back loans owed mainly to their affiliates (Ndikumana et al., 2023).

In the period 2000 to 2021, all prominent mining companies in Zambia were affiliates of multinational firms with headquarters in other countries, and with different tax and legal jurisdictions. This ownership structure of mining firms as affiliates of multinational corporations facilitates abusive transfer pricing and tax optimization through intra-firm trade and financial transfers. Multinational corporations have affiliates in low-tax jurisdictions that borrow at low cost from the market and lend to their Zambia-based subsidiaries at relatively higher interest rates. This results in higher income tax deductions and profit shifted offshore. Lending and borrowing between affiliated entities are not regulated in Zambia. This enables shrewd investors to minimize taxes owed to the Zambian government. This is compounded by the fact that Zambia operates an open capital account regime whereby investors are not obligated to return export proceeds beyond what they need to cover their domestic operational costs. These policies prevent the country from fully benefiting from the exploitation of its mineral resources.

In 2023 the Government introduced the electronic Balance of Payments compilation framework to enhance efficiency of the foreign exchange market and improve the quality of Balance of Payments statistics. The framework makes it mandatory for all commercial banks to submit their daily foreign financial transaction reports to the Bank of Zambia through an electronic monitoring system. These include payments made to foreign parties by Zambian residents as well as payments received by Zambian residents from foreign parties irrespective of their value (www.boz.zm). The goal is to improve transparency in foreign exchange transactions and prevent the concealment of foreign exchange offshore by mining companies, which will ultimately increase the gains from mineral exports that effectively accrue to the country.

In 2023, the country had 14 large industrial mines and over 2300 artisanal mines. Among the artisanal, small and medium mining entities only 170 were declaring mineral loyalty. To address the low tax compliance among artisanal or small scale mines (ASM) the Zambian Revenue Authority (ZRA) established the Artisanal, Small and Medium Mining Unit in 2023, whose mission includes educating miners on issues of compliance with tax regulations. The ultimate goal is formalize these producers and boost tax collection from this segment of the mining sector.

All entities with mining licences carrying out artisanal or small scale mining, with an annual turnover of 800,000 ZMK or less are required to register and account for their tax payments under

the presumptive tax on ASM. In 2023 the tax rate for the ASM is 4% of the gross turnover less mineral royalty paid. ASM entities are not required to register for income tax .

As part of its development strategy, the government's target is an increase in annual copper production and exports from about 800,000 tons in 2021 to 3 million tons over the ten-year period between 2022 and 2033. To achieve this goal, the government has provided fiscal incentives such as the deductibility of mineral royalties from corporate income tax to the mining sector to attract FDI in both exploration and exploitation. At the same time, the mineral royalty regime for copper has been restructured with the tax applying on the incremental value in each adjusted price band as opposed to the aggregate value. In the 2023 budget, the number of tax bands has been reduced from six to four, with taxes being charged on the incremental value in each price range when the price crosses each price threshold. In 2022, the bands for the marginal tax rate ranged from 5.5 percent for prices less than US\$4,500 per ton to 10 percent for prices above US\$9000 per ton. These were changed to 4 percent for prices less than US\$4000 per ton to 10 percent for prices above US\$7000 per ton, with the taxable amounts being charged on the incremental value in each price range when the price crosses each mineral royalty tax price threshold. bands for mineral royalty collection range. This change was expected to reduce the tax burden on the mines and trigger an increase in copper production.

To strengthen regulation and oversight of the mining sector, the government established the Minerals Regulation Commission in 2023. The Commission oversees production reporting, mineral content analysis, and aims to curb illegal mining and illicit trade of minerals Furthermore, strategies to diversify mining beyond copper are being implemented. In 2020/2021, the national gold and precious minerals mining strategy was designed, with the aim of reorganizing and formalizing the small-scale mining of gold and gemstones. The strategy seeks to build capacity and provide capital support to informal miners. For the gold sector, the Zambia Gold Company (under the state-owned Zambia Consolidated Copper Mine Investment Holding Public Limited Company (ZCCM-IH)) has been established to purchase gold from small-scale miners, with the objective of better tracking gold production and exports, and maximizing the repatriation of the proceeds of gold exports.

3. Relevant literature on trade misinvoicing

The economic literature has investigated the issue of trade misinvoicing, mainly as a channel of capital flight. The focus has been on estimation methodologies, analysis of the motives and determinants of trade misinvoicing, with the aim of shedding light on strategies to deter trade misinvoicing as a means of curbing illicit capital flows (Classen and Naude, 1993; Tandon and Rao, 2017; UNCTAD, 2016; Yalta and Demir, 2010). The evidence in the literature shows that countries lose substantial amounts of resources through trade mis-invoicing. For example, Yalta and Demir (2010) investigated the extent of trade mis-invoicing for Turkey vis-à-vis its major trading partners for the period 1970 to 2007 and found that exports were underinvoiced while

imports from China were over-invoiced. Jha (2014) found an increasing trend of trade mis-invoicing estimated at US\$186 billion between 1988 and 2012 in India. Similar evidence of large trade mis-invoicing has been uncovered by Fisman and Wei (2009) between Egypt and USA. The study by Mahmood and Azhar (2001) on Pakistan and its 14 key trading partners revealed that exporters over-invoiced exports by US\$ 2.4 billion over 10 years.

Total trade misinvoicing for a sample of 33 African countries amounted to \$588 billion over the 1970-2018 period (Ndikumana and Boyce, 2021). Net outflows via export underinvoicing, whereby exporters understate the true value of their exports so as to retain some of the proceeds offshore, amounted to \$1.09 trillion over this period. Imports overinvoicing is similarly a mechanism for capital flight, allowing importers to obtain extra foreign exchange to be sent and retained abroad. Import underinvoicing to evade customs duties is also common, however. In net terms, the latter exceeded the former in this period, with net misinvoicing of \$505.7 billion.

Studies on individual African countries have found large volumes of trade mis-invoicing. For example, Rustomjee (1991) estimated that exports from South Africa were underinvoiced by an average of 21% over the period 1970-1988. Ndikumana and Boyce (2022) analysed the magnitudes of capital flight, adjusted for trade mis-invoicing for Angola, Côte d'Ivoire and South Africa from 1970 to 2018. They estimated the net trade mis-invoicing outflows at US\$133.5 billion for South Africa over 1998-2018 and \$14.9 billion for Côte d'Ivoire. Lemi (2016) estimated that between 2008 and 2016 Ethiopia lost US\$6-36 billion through trade misinvoicing with advanced economies, and US\$15-78 billion with emerging countries.

In the case of Zambia, existing studies show that trade misinvoicing is a major conduit of capital flight. Ndikumana and Boyce (2018) estimated that from 1970 to 2018, Zambia lost \$31 billion through trade misinvoicing, with \$41 billion through import overinvoicing partially offset by \$10 billion in export overinvoicing. UNCTAD (2016) found substantial misinvoicing of copper exports, whereby exports declared by Zambia exceed the value of imports declared by its trading partner. As the top declared destination of Zambian copper is Switzerland, these discrepancies may be partly attributed to the merchanting by Glencore, a Swiss trading firm, which also owned shares in Mopani Copper Mine until it sold them to the Zambian government in early 2021.

The literature has identified several motivations for trade misinvoicing, including evasion of customs duties and circumventing capital controls (Patnaik et. al., 2012; Buehn and Ichler, 2010; Boyce and Ndikumana 2022). The argument is that high import duties, taxes and restrictions on capital account transactions induce firms to underinvoice their merchandise as a way of evading these costs. Overinvoicing of imports and underinvoicing of exports also enables firms to access to foreign exchange through illegal means, especially in contexts of shortage of foreign exchange and restricted access to hard currency (Ndikumana and Boyce, 2018).

Firms may also be tempted to overinvoice exports in situations where exports are incentivized through export promotion schemes such as duty drawbacks enabling firms to maximize profits (Epaphra, 2015; Lemi, 2017; Spanjers and Solomon 2017, Henry, 2016). For export overinvoicing to make economic sense for the firm, the gains from export promotion incentives would have to exceed the costs of acquiring the extra hard currency beyond the true value of exports (which would be surrendered to the central bank).

Another reason for export misinvoicing is to avoid the cost associated with administrative barriers and unstable economic policy and political environment that could trigger state expropriation of private assets and weak regulation and poor enforcement of rules (UNCTAD, 2016; Patnaik, et. al., 2012; Ndikumana and Boyce, 2018). Hence, in a context plagued by bureaucratic hurdles, including lengthy paperwork and delays in administrative authorizations, traders tend to resort to corruption and under-invoicing to expedite clearance (Buehn and Ichler, 2010; Patnaik et al., 2012; Berger and Nitsch, 2012).

Transit trade has also been cited as an explanation of observed gaps in mirror trade statistics. If a transit country is incorrectly recorded as a destination country, this generates discrepancies due to asymmetric recording between the source and final destination of the exports. However, one important question is why exports would be recorded as destined for a country that is only a transit station or trading hub. This is in violation of international conventions and norms of recording international trade transactions to which all countries officially adhere.⁹

4. Methodology for estimating export misinvoicing

To estimate the extent of export misinvoicing, we use the methodology initially developed by Bhagwati (1964) and subsequently refined and applied in subsequent studies (Chang et al, 1997; Ndikumana and Boyce, 2010, 2015, 2022; Ndikumana et al, 2015; Yalta and Demi, 2010; UNCTAD, 2016). The estimation technique is based on the principle of double entry in cross-border trade whereby the exporter's statistics are mirrored in the importer's books. While trade misinvoicing can be estimated for exports and imports, this study focuses on misinvoicing of exports of minerals, specifically copper, gold and gemstones as a channel of capital flight from the country.

The computation algorithm considers that exports from a country must match the imports of its trading partner once adjusted for the cost of insurance and freight (*c.i.f*). Thus for Zambia as exporting country (*z*) of a mineral product (*k*) (copper, gold, gemstones) to a partner (*j*) at time *t*, export misinvoicing of the mineral product (noted as *DX*) is calculated as follows:

⁹ See UN DESA (2011).

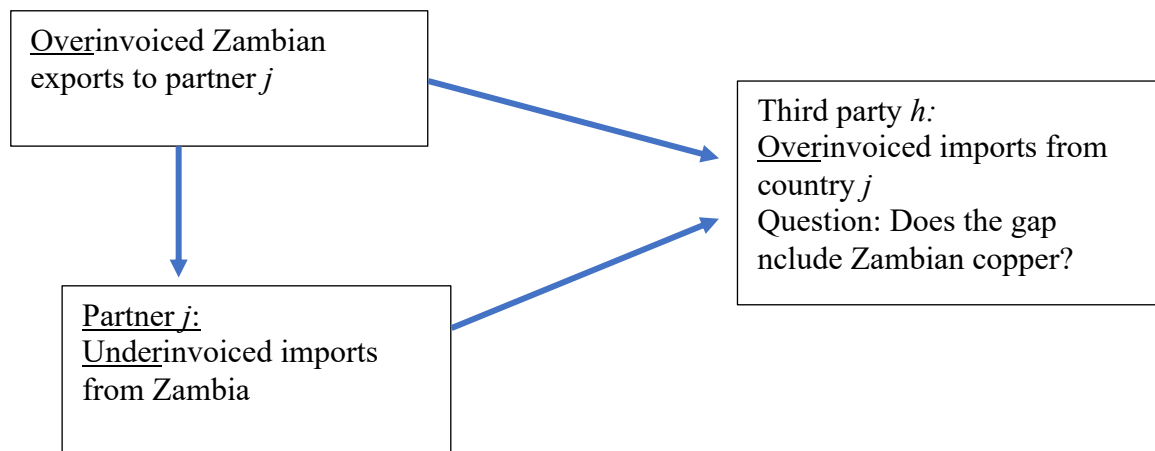
$$DX_{zt}^k = M_{jt}^k - (1 + cif)X_{zt}^k \quad (\text{Eq. 1})$$

where M is the value of imports declared by the partner, X is the value of exports declared by Zambia, and cif is the ratio of cif to FOB value of exports representing the cost of insurance and freight. A positive value of DX represents export underinvoicing or unrecorded capital outflows through exports, while a negative value reflects export over-invoicing resulting in unrecorded capital inflows.

The estimation of bilateral misinvoicing is based on the principle that every transaction is recorded twice: once from the perspective of the reporter (Zambia) who declares the export, and second from the perspective of its partner j the importer. However, one weakness of the estimation based on the comparison mirror trade statistics is the possibility of generating large export misinvoicing, largely false positives, in instances where the reported destination in Zambia's books is a trading hub (such as Switzerland) rather than the final point of sale (Lepissier, 2021). Commodities are often re-exported to a third country without being recorded in the hub-hosting country. To capture this scenario, this paper undertakes a triangular trade analysis to explore the possibility that mineral commodities sold to partner country j with large trade gaps with Zambia may have been sold to third-party countries as schematically presented in Figure 3.

The reconciliatory process entails implementing equation 1 for trading partner j , and its own key trading partners (h) that may have a direct or no direct trade links with Zambia. The objective is to examine whether trade between countries h and j as well as with their respective partners may explain the discrepancies in mirror trade statistics between Zambia and partner j . Specifically the idea is to see whether some of the commodities seemingly registered as heading to partner j ends up in third-party country h .

Figure 3: Triangular trade from Zambia’s perspective: case of export overinvoicing



Source: Authors’ construction

Data sources

We use two datasets to estimate export misinvoicing: The OECD International Trade by Commodity Statistics database¹⁰ containing estimates of the cost of insurance and freight (*c.i.f*) for bilateral trade at the product level; the United Nations Commodity Trade (Comtrade) database containing data on export and import flows classified following the United Nations nomenclature for trade classification – the harmonized system (HS) and standard international trade classification (SITC). For copper we extracted data at four-digit level codes HS 2603 containing copper ores and concentrates and HS7401 to HS 7419 containing articles made of copper for the period 1995 to 2021. For gold, we considered non-monetary gold reported under codes 7108, 7109, and 7012. Gemstones are recorded under codes 7103 and 2616.

One challenge associated with the analysis of mirror trade data is the presence of unmatched or orphaned transactions, whereby Zambia reports exports to a partner, while the latter’s books show no imports from Zambia or vice versa. To minimize bias arising from such mismatches in reporting, such observations with unmatched flows are eliminated when calculating export misinvoicing. In an accompanying exercise, we attempt to explore the fate of unmatched flows through triangular trade analysis. The reconciliatory process entails implementing equation 1 for Zambia’s trading partners that exhibit large discrepancies in mirror trade and their key trading partners that may have a direct or indirect trade linkage with Zambia (as depicted in Figure 3).

¹⁰ https://www.oecd-ilibrary.org/trade/data/international-trade-by-commodity-statistics/international-transport-and-insurance-costs-of-merchandise-trade-oecd_9c638cb6-en

5. The ‘missing copper’

5.1 Copper export misinvoicing

Table 2 reports Zambia’s copper exports to the top 10 destinations from 1995 to 2021 ranked by the cumulative value of exports over the study period. The data shows that Zambia’s copper exports increased substantially over this period, from US\$893 million in 1995 to US\$8.5 billion in 2021. This growth was largely stimulated by favorable international commodity prices and increased private sector investment in mining. Zambia’s exports are concentrated in a few countries, with the top three export destinations – Switzerland, China, and Singapore, accounting for 94 percent of the total exports in 2021.

Table 2: Zambia’s top ten copper destinations for selected years from 1995 to 2021 (million, nominal US\$)

Countries	1995		2010		2014		2021	
	Amount	%	Amount	%	Amount	%	Amount	%
Switzerland	0.00	0.0	2,980.8	59.3	4,260.4	58.7	4,549.1	53.6
China	0.2	0.0	1,293.8	25.8	1,728.4	23.8	1,948.2	23.0
Singapore	59.9	6.7	0.0	0.0	265.5	3.7	1,489.8	17.6
South Africa	6.1	0.7	226.2	4.5	195.0	2.7	48.6	0.6
United Kingdom	3.2	0.4	105.3	2.1	64.8	0.9	0.0	0.0
United Arab Emirates	0.0	0.0	175.6	3.5	133.2	1.8	0.1	0.0
Thailand	128.7	14.4	5.0	0.1	0.0	0.0	0.0	0.0
Saudi Arabia	112.6	12.6	23.9	0.5	0.0	0.0	0.0	0.0
Egypt, Arab Rep.	0.0	0.0	49.2	1.0	0.0	0.0	0.0	0.0
India	84.3	9.4	0.0	0.0	25.2	0.3	0.7	0.0
Total top 10 partners	395.0	44	4,859.80	96.8	6,672.5	91.90	8,036.5	94.80
World	892.9	100	5,022.9	100	7,252.1	100	8,481.8	100

Source: Comtrade

The data presented in Table 2 show a shift in Zambia’s copper export destination from countries like India, Saudi Arabia and Thailand in the 1990s to new markets in China, Singapore and Switzerland from the early 2000s. Copper mines were privatized in the late 1990s and early 2000s. The privatization brought in new private investors from Western and Asian Countries. The question is whether the increase in private mine ownership may have exacerbated export misinvoicing.

The data in Table 3 presents the cumulative value of exports to the major partners including years with unmatched observations or orphaned trade flows. Zambia reports more copper exports to these countries than their respective reported imports from Zambia. Most of the copper is reported to be exported to Switzerland, while the latter reports virtually no copper imports from Zambia. The situation is also observed for copper recorded in Zambia as shipped to Singapore, South Africa and the United Kingdom, albeit at a much smaller scale.

Some countries report receiving more copper from Zambia than the latter has exported there. The largest discrepancies are in trade with China. Such gaps are also observed in trade with the United Arab Emirates, Thailand, Egypt, Saudi Arabia and India.

Table 3: Copper trade as reported, including observations with unmatched reporting from 1995 to 2021 (million, constant 2021 US\$)

Partner	Amounts (million constant 2021US\$)			Share (percent) in:	
	Partners' imports	Zambia' exports	Difference (cif-adjusted)	Partners' Imports	Zambia's Exports
China	41,203.2	21,329.5	18,332.8	41.7	19.2
Egypt	4,153.2	1,327.6	2,713.6	4.2	1.2
India	5,638.5	1,037.5	4,528.5	5.7	0.9
Saudi Arabia	6,423.0	1,476.1	4,825.2	6.5	1.3
Singapore	561.1	5,706.7	- 5,544.7	0.6	5.1
South Africa	3,318.4	4,696.2	- 1,725.2	3.4	4.2
Switzerland	0.0	58,508.0	-62,350.9	0.0	52.6
Thailand	3,300.9	1,692.7	1,478.0	3.3	1.5
United Arab Emirates	8,675.9	1,764.1	6,762.7	8.8	1.6
United Kingdom	190.5	4,916.6	- 5,094.7	0.2	4.4
Total 10 partners	73,464.9	102,455.0	-36,726.6	74.4	92.1
World	98,798.5	111,282.4	-19,978.0	100.0	100.0

Source: Authors' computations

As indicated earlier, in estimating export misinvoicing we account for the cost of insurance and freight, and we exclude observations with unmatched or orphaned flows. The results are presented in Table 4. The results show both underinvoicing and apparent overinvoicing of copper exports. Copper exports to China are underinvoiced to the tune of \$18.4 billion (constant 2021 US\$) over the period 1995-2021. Evidently, the underinvoicing of copper exports to China is a genuine problem for in Zambia.

There is also underinvoicing of copper exported to the United Arab Emirates (\$6.9 billion), India (\$4.1 billion) and Saudi Arabia (\$3.2 billion). The discrepancies are marginal in the case of exports to Thailand and Egypt.

Table 4: Copper export misinvoicing, considering only matched reporting over 1995- 2021 (million, constant 2021 US\$)

Partner	Partner's imports	Zambia's exports	Export misinvoicing
China	41,097.6	21,329.5	18,361.7
Egypt	2,187.9	1,300.0	775.5
India	5,218.5	1,037.5	4,108.8
Saudi Arabia	4,564.4	1,270.9	3,186.6
Singapore	435.8	5,705.9	-5,639.8
South Africa	3,318.4	4,696.2	-1,725.0
Switzerland	0.0	3,064.1	-3,254.1
Thailand	2,089.9	1,692.7	263.6
United Arab Emirates	8,675.9	1,628.2	6,910.9
United Kingdom	185.9	3,031.6	-3,075.6
Total 10 partners	67,763.1	44,756.7	19,912.6
World	98,798.5	111,282.4	-19,755.9

Source: Authors' computations

The gaps relative to some partners deserve some attention as they suggest apparent export overinvoicing whereby they report less copper imports than the amounts of exports reported by Zambia to these countries. This is the case for Switzerland. Accounting for c.i.f., Zambia's exports to Switzerland exceed the latter's recorded imports by \$3.2 billion over 1995-2021. Such discrepancies cannot be justified by standard motives of export misinvoicing. So, what is behind those large gaps in copper trade statistics between Zambia and Switzerland? A plausible reason is the fact that Switzerland is a major trading hub hosting companies involved in "merchanting" of primary commodities. A Swiss company may buy copper from Zambia and store it in bonded warehouses on the London Metal Exchange (possibly for a relatively long time) before reselling it to a final destination, without the copper ever entering Switzerland (Lépissier 2021; Schuster and Davis, 2020). Upon reselling the copper, it is not recorded as a re-export from the UK (LME). Such arrangements create gaps when one attempts to track copper export flows from the source to the destination using mirror trade statistics.

Furthermore, experts in the mining business also observed that mining firms engage in activities that enable them to fetch higher returns on copper exports than reported in benchmark LME official reports. First, while the value of exports is recorded at the border crossing based on the LME price, exporters can speculate on prices by storing the copper in warehouses for some time, offloading it on the market once the price increases. Interviews with mining industry operators reveal that some Swiss merchants, that operate in Zambia such as Glencore (until its exit in 2021), which are also shareholders in the mines, had built this capacity over the years. The discrepancies in mirror trade statistics also arise when sellers hedge the sale by buying futures or options that allow them to lock-in a certain price while the physical deal is closed at the spot price at the time of delivery (Östensson, 2018). The lag between the time of export and the time of reporting at the destination

blurs the trade flows, making it difficult to reconcile the values of goods at the source and at the destination.

Mineral traders can also engage in practices aimed at maximizing their profits that could result in export discrepancies. Mining managers interviewed by the authors further stated that the reconciliation of mirror trade data requires knowing three important elements. The first element is the exact quantity sold by the mining company to the importing country. Second is the timing of the sale relative to the dates of imports from Zambia, and finally the price at which the copper is sold to the export market by the exporter. This is because exporters such as Glencore could store copper in warehouses and export it later. Warehousing allows large exporters to speculate in international commodity markets and enables them to operate with little or no profits in the short run. The opacity in the flow of exports is further compounded by intra-company trade that allows exporters to under-declare the values of copper exported to related entities.

Another issue with mirror trade statistics is that copper mines tend to smelt different copper grades, obtained from different mines and even from other countries, to produce more refined and higher quality copper used in pharmaceuticals and other specialized industries. This kind of copper is sold at higher prices than recorded in national statistics, which are based on LME prices, resulting in statistical discrepancies. In the case of Zambia, mining firms import copper ores from the Democratic of Congo for smelting, which they then export together with copper from their own mines. This copper may be recorded by the importing country such as China as originating from either Zambia or Congo DR. Thus, the transparency of trade statistics may be compromised as the copper originating from the Congo DR can erroneously be marked as originating from Zambia.

5.2 Triangular copper trade analysis

The results presented above showed that although Zambia reports exporting over 54 percent of its copper to Switzerland, the later reports no imports of copper from Zambia, but declares high values of copper exports to third countries. This suggests that Switzerland reroutes Zambian copper to third-party countries that may exhibit symmetric gaps in trade statistics with Zambia or those without strong trade links with Zambia that trade with Switzerland. In this case, all major destination markets for copper from Switzerland (Swiss companies) are potential sources of the gaps in mirror copper trade statistics between Zambia and Switzerland.

Table 5 shows the results of the analysis of copper trade between Switzerland and its major trading partners. The main destination of copper exported by Switzerland is Germany. Over the 1995-2021 period, Germany accounted for 43.6 percent of Switzerland's exports and 40.1 percent of total imports reported by its partners. The other noteworthy partners are Austria, France, Italy and the United States, which together account for 64 percent of total imports and 75.6 percent of Switzerland's exports over the same period.

The analysis of the mirror trade data shows that Germany declared a larger amount of imports than what Switzerland declared as exports. Adjusting for the cost of freight and insurance yields a gap of \$702 million. For the other countries, it's the other way around: they declare less imports from Switzerland than the latter declares as exports to them. The cumulative excess imports for the four partners is \$816 million.

The first question arising from these results is whether those gaps could account for the observed discrepancies in Zambia-Switzerland copper trade statistics. It is possible that the gap with Germany could indeed include some of the copper recorded by Zambia as exported to Switzerland that is not recorded by the latter as imports. A possible scenario is that the German importer knows for sure that they bought the copper from a Swiss entity, but the Swiss entity does not record it as its copper export given its awareness that it originated from Zambia. In that scenario, Zambia's copper exports would have been routed through Switzerland, but ending up in Germany, where the Zambian origin is not recorded. It is difficult to assess the likelihood and the share of copper associated with such scenarios from the aggregate statistics.

How about the gaps with the other four countries? The gaps could explain the Switzerland-Zambia gap if importers in these countries are able to identify the cargo as containing Zambian copper, and hence recording it as being imported from Zambia (rather than Switzerland), while Swiss traders record it as their own export. In this scenario, Switzerland would have served as a transit or merchanting station for Zambian copper that is sold to the final destination as Swiss copper.

It is difficult to know how much of the Zambia-Switzerland trade gap reflects these observed discrepancies between Switzerland and its main trading partners. In particular it is important to note that there are statistical gaps in copper trade between Switzerland and other copper exporters as well. So, it is not possible to know, from aggregate statistics, the share that is accounted for by Zambia's 'missing copper.' The Zambia-Switzerland copper trade gap remains an unsolved mystery.

Table 5: Switzerland's copper exports, including unmatched reporting only from 1995 to 2021 (million, constant 2021 US\$)

	Total (million, constant 2021 US\$)			Shares of total (%)	
	Partner's imports	Switzerland's exports	Export misinvoicing	Partner's imports	Switzerland's exports
Austria	1,313.3	1,544.6	-254.3	6.1	8.5
France	1,347.0	1,459.9	-125.0	6.2	8.0
Germany	8,701.6	7,944.3	702.0	40.1	43.6
Italy	1,728.1	1,846.0	-141.2	8.0	10.1
United States	793.1	994.2	-295.5	3.7	5.5
Total top partners	13,883.1	13,789.0	-114.0	64.0	75.6
World	21,687.2	18,232.8	3,378.1	100.0	100.0

Source: Authors' computations

6. Trading in gemstones

6.1 Exports of gemstones

Zambia is endowed with substantial reserves of gemstones, notably emeralds, amethyst, tourmalines and recently discovered sugilite. The mining of gemstones began before independence in 1964 by private investors in the Kafubu area of the Copperbelt. However, in 1971, as part of the nationalization program, the government took over the sector under the Mining Development Corporation (Sliwa and Nguluwe, 1984). The discovery of higher-quality gems by local people fueled illegal artisanal and small-scale mining. To curb illegal mining, the government established a restricted mining zone (in Lufwanyama) and forcibly removed the population from there. A new state-owned agency, the Reserved Minerals Corporation, was given monopoly over mining and prospection rights (Sliwa and Nguluwe, 1984). By 1980, Kagem Mining Ltd. (owned by Reserved Minerals at 55% and by Hagura at 45%, an Indian-Israeli corporation) was authorized to conduct exploration and mining in the Kafubu area. A privatization agreement was signed between the mining company Hagura and the Government of Zambia in May 2001 (Mashikinyi, 2020). In 2022, the government had 25% of the shares in Kagem mine, which is the largest emeralds mine in the world. In addition to Kagem, there are a few other large privately owned gemstone mines like Gemcanton, Grizzly and Chatete. There is also Kariba Minerals, which is owned by Zambia Consolidated Copper Mines – Investment Holdings Plc (ZCCM-IH), a holding company for the state’s mining interests.

The wider gemstones subsector remained at the periphery of the country’s development strategy. Large formal firms exist alongside a large number of informal small-scale (registered and unregistered) miners, and foreign buyers, which creates a fertile ground for export smuggling and misinvoicing, which is an important channel of capital flight. The gemstone sector is not significantly contributing to the Zambian economy because significant portions of gemstone revenues are not accounted for due to smuggling (Cross et al., 2010). It is estimated that in 2010, the government issued about 500 ten-year gemstone mining licenses of which 345 were emerald mining licenses. But the sector also has many small-scale artisanal miners, a large fraction of which are unregistered.

Most of the artisanal miners are Zambian, often backed by foreign traders (MCTI, 2020). This is because the Mines and Minerals Development Act No. 11 of 2015 restricts artisanal mining rights to citizens or a cooperative wholly owned by citizens. The same Act requires that small-scale mining licenses be given to citizen-owned, citizen-empowered or citizen-influenced companies (Banda and Chanda, 2021). Zambian-owned artisanal small mining entities, which are mainly informal, tend to be backed by supporters or sponsors that give them mining equipment, contingency money and any other relevant inputs needed for mineral exploitation and mining. The sponsors then buy the gemstones from these artisanal small mining enterprises that they support.

In 2020, the Ministry of Commerce, Trade and Industry formulated an export diversification strategy for gold and gemstones. The problems in the gemstone sector identified in the strategy include a large number of illegal traders, crime in mining areas, smuggling resulting in loss of government revenue, environmental degradation and fragmentation of farming land. The strategy targets building capacity and amalgamation of ASM to minimize fragmentation and promote value addition in gold and gemstones. The strategy also encourages the use of appropriate, affordable and safe technology through the dissemination of appropriate information, provision of extension services and technology demonstrations. Furthermore, the government commits to working with miners associations and facilitating access to funding. The strategy projected that the contribution of gold and gemstones to GDP would rise to 1% by 2025 compared to less than 0.1% in 2022.

6.2 Gemstone auctions

Most of the large gemstone producers have well-established trading arrangements. They tend to sell their production either through auctions or directly to hand-picked established clients, such as Ashok Jewelers of India. The auctions are mainly conducted abroad and at times within the country. For example, Kagem undertakes quarterly auction sales mainly in Singapore or India and at times within Lusaka. The government-owned Kariba Minerals used to auction its amethyst in India, but it later resorted to using established networks after regulatory changes in India. The majority of artisanal small miners sell in the informal markets to local and foreign traders that finance their operations. The gemstone mining arrangements provide a fertile ground for smuggling and capital flight since the unregistered miners are not able to sell their minerals through formal markets.

6.3 Misinvoicing of gemstone exports

This section presents estimates of gemstone export misinvoicing using the methodology described in Section 4. Zambia is among the world's top producers and exporters of quality emeralds and other gemstones alongside Colombia, Brazil, Ethiopia,¹¹ and Zimbabwe (Geology.com; Mashikinyi, 2020). The country's gemstone exports increased from US\$38.7 million in 2010 to US\$101.4 million in 2021. Table 6 presents exports to and imports from the top 10 partners, including unmatched reporting. The top 3 partners account for 72 percent of all gemstone imports from Zambia: India (38%), Singapore (16%) and the United States (18%). The largest discrepancies are observed in trade with the United States and India, which are also the largest buyers of Zambian gemstones. While the United States recorded \$492.9 million worth of gemstone imports from Zambia, the latter registered only \$25 million of gemstone exports to the US. The corresponding numbers for India are \$1 billion (imports) and \$590 million (exports).

¹¹ A large amount of high quality opal was discovered in Wegal Tena, Wolo Province (Rondeau et al., 2010).

The reverse outcome is observed in the case of trade with South Africa and the United Kingdom, which recorded less imports than Zambia’s reported exports of gemstones. However, the absolute amounts are much smaller than the gaps recorded for India and the United States.

Table 6: Trade of gemstones, including unmatched reporting: Cumulative value over 1995- 2021 (million, constant 2021 US\$)

	Partner’s imports		Zambia’s exports		Difference	
	Value ('000\$)	percent	Value ('000\$)	Percent	Raw	cif-adjusted
India	1040.6	38.1	590.4	42.5	450.2	407.4
Singapore	442.9	16.2	333.2	24.0	109.6	92.0
Hong Kong, SAR	124.3	4.6	122.1	8.8	2.1	1.4
Switzerland	48.6	1.8	49.2	3.5	-0.6	-3.0
South Africa	30.7	1.1	58.6	4.2	-27.9	-28.2
United Kingdom	29.3	1.1	45.7	3.3	-16.3	-17.3
United States	492.9	18.0	25.0	1.8	467.9	467.7
Thailand	124.7	4.6	24.7	1.8	100.0	100.0
Israel	35.5	1.3	25.6	1.8	9.9	8.6
United Arab Emirates	96.3	3.5	48.1	3.5	48.1	48.1
Top 10 partners	2465.7	90.3	1322.7	95.3	1143.0	1076.9
World	2730.8	100.0	1387.9	100.0	1343.0	1273.0

Source: Authors’ computations

To estimate export misinvoicing, we eliminate the years/observations with unmatched flows in mirror trade data. The results over the period 1995-2021 are presented in Table 7. The results show substantial underinvoicing of gemstone exports destined to India (\$404.7 million) and the United States (\$415.9 million). Underinvoicing is also observed, albeit to a lesser extent, for gemstones exported to Thailand (\$66.9 million) and the United Arab Emirates (\$44.4 million). We note, however, that some exports to Singapore, South Africa and the United Kingdom cannot be traced in these partners’ imports statistics. For the group of 10 top partners considered in the table, Zambia has lost a cumulative amount of \$829 billion through export misinvoicing of gemstones from 1995 to 2021. Considering all partners (the world), the cumulative loss amounts to \$1.2 billion.

Table 7: Gemstone export misinvoicing over 1995-2021, considering only matched reporting (millions, constant 2021 US\$)

	Partner's imports	Zambia's exports	Export misinvoicing
India	1,040.6	590.4	407.7
Singapore	222.1	261.9	-54.5
Hong Kong, SAR	124.3	122.1	-6.5
Switzerland	24.6	25.2	-2.5
South Africa	30.6	58.6	-33.4
United Kingdom	23.7	45.7	-25.3
United States	442.8	25.0	415.9
Thailand	93.3	24.7	66.9
Israel	35.4	18.1	16.2
United Arab Emirates	93.4	45.0	44.4
Total for top partners	2,130.8	1,216.7	828.9
World	2,730.8	1,387.9	1,244.1

Source: Authors' computations

The trading partners where significant discrepancies in gemstone trade statistics are recorded share the characteristic of hosting auction centers (India and Singapore) and/or serving as major trading hubs for precious metals (South Africa and the United Kingdom). This raises the question of whether the merchanting hosted in these countries may induce, enable or facilitate mis-recording of the quantity and value of gemstones from Zambia. In the case of South Africa and the United Kingdom, the results may reflect the fact that some gemstones reported in Zambia's books as exported to these countries are warehoused there, not reported as imports, and later sold to other countries. This is similar to the phenomenon observed for Zambian copper exports to Switzerland discussed in Section 5.

One important factor that facilitates and induces gemstone export misinvoicing is the fact that the sector is informal and fragmented. It hosts a large number of small and medium enterprises that sell their output in the informal markets often through multiple middlemen. The system allows producers to auction their output abroad to buyers from various countries. The gemstones cross the border without a reference price for tax purposes. These features of the sector make it hard to trace the quantity and value of the gemstones sold out of Zambia.

7. On the 'gold trail'

7.1 Gold: a sector with an unexploited potential

Although gold mining has existed since the pre-independence period, the sector has remained peripheral to Zambia's development strategies. For most of the post-independence period, gold mining has been dominated by informal artisanal small-scale gold mining (ASGM). These producers lack access to affordable capital, have limited infrastructure in the mining areas and

have poor geological knowledge of the sector. Prior to the 2010s the government showed little interest in organizing the sector as it focused on copper, gemstones and other traditional exports. As a result, the government missed the opportunity to collect substantial fiscal revenue from gold trade. The sector has been associated with environmental degradation due to unregulated exploitation. The influx of foreign gold traders has generated little or no tangible contribution to wealth creation and poverty reduction in local communities (GRZ, 2020).

Recently, there has been a spate of gold re-discoveries, with an estimated 300 findings in Luano, Vubwi, Lundazi, Mwinilunga, Mpika, Rufunsa and Petauke districts. The areas are mainly dominated by ASGM with only one large formal gold mine, the Kanshishi gold mine in Northwestern Province. However, many other mines such as Mopani Copper Mine produce and export smaller quantities of gold as a by-product of copper mining. Most of the gold produced by small scale miners is sold in the informal markets to foreigners, mainly Chinese, Russians and Indians that patronize the gold panning sites (Hilson, 2020). This unregulated trading environment is conducive for capital flight through smuggling and export underinvoicing.

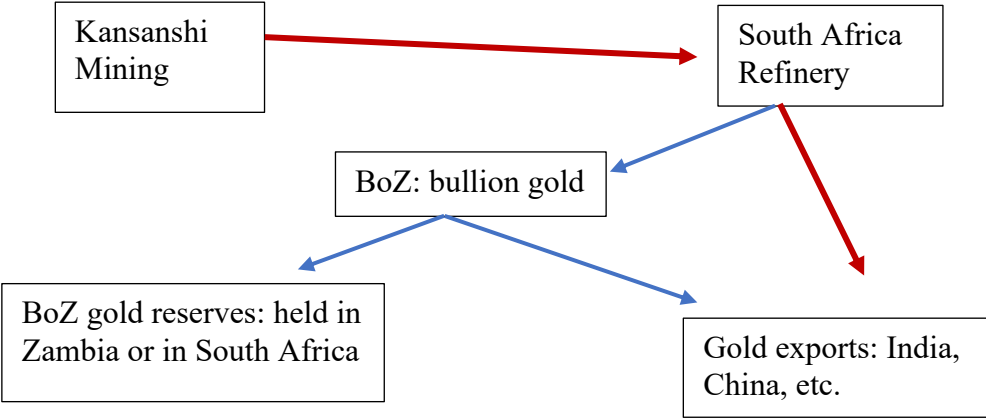
The government has recently embraced the ASGM as a vehicle for attaining social-economic development. To curb illicit gold exports and improve revenue generation from the sector, the government developed a basic framework for guiding ASGM formalization. In its earlier form, which was quickly reversed, the framework was framed as a taxation-driven formalization strategy. The government recognized that the existing licensing schemes were not suitable for the rapidly growing and evolving ASGM. As a result, it updated the Mines and Minerals Development Act of 2015 by adding a “gold panning certificate” as a requirement for ASGM, which can only be issued to citizens or cooperatives comprising of citizens only. Certificate holders are required to pay mineral loyalty and other taxes, maintain production and financial reports, and comply with the environmental management requirements. Policymakers perceive the certificate to be “user-friendly and useful in legalizing anarchic pockets of gold rush activity” (Hilson, 2020). The certificate was promoted as not only affordable but also as a tool to enhance trust and security of tenure for ASGM.

In 2020, the government developed a national export diversification strategy for gold and gemstones. The strategy classified gold as a strategic mineral of interest (Ministry of Commerce Trade and Industry (MCTI) and Ministry of Minerals and Mines Development (MMMD), 2020), and it mandated the Zambia Consolidated Copper Mines Investment Holdings (ZCCM-IH) to explore and develop the gold sub-sector to ensure maximum benefits for the state and the Zambian people. The ZCCM-IH is expected to buy gold from the ASGM and other gold mining entities, with the aim of eliminating middlemen and facilitating the sale of gold through formal markets to enhance revenue collection and formalize the sector.

Moreover, since 2020, gold has been adopted as a strategic reserve by the Bank of Zambia. Thus, the Bank has been buying gold from formal suppliers, specifically Kansashi gold mine. The gold

from ASGM continues to be mainly traded in the informal markets. Figure 4 illustrates the organization of gold production and sale and the players involved. As Zambia does not have refinery capacity, once the gold is purchased by the Central Bank, it is shipped to the Rand Refinery Limited (RRL) in South Africa for refining.

Figure 4: The flow of gold produced in Zambia

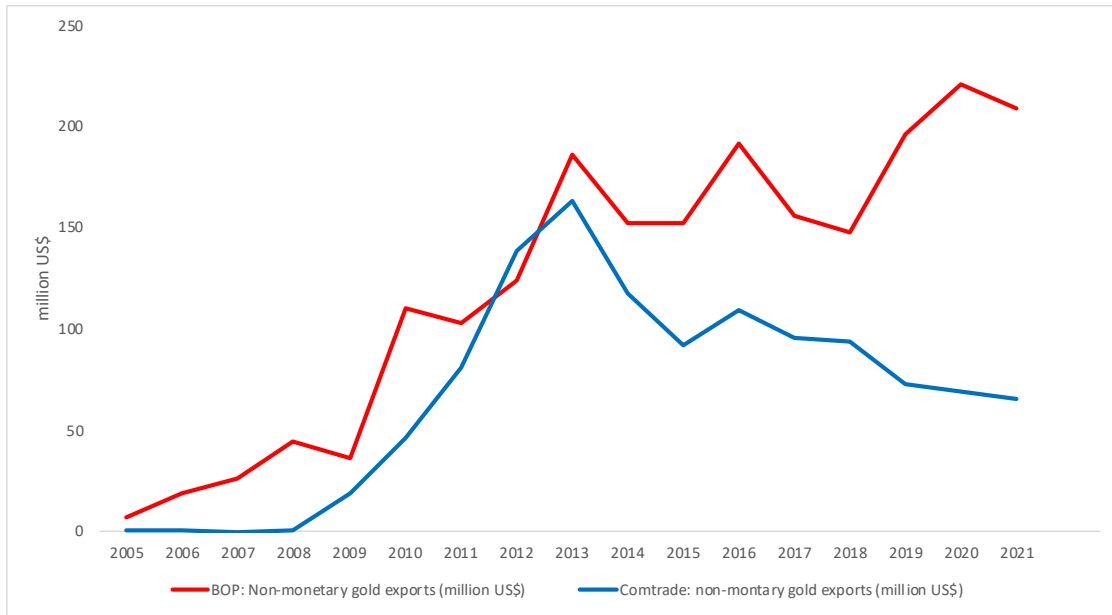


Source: Authors’ construction

According to interviews with Bank of Zambia officials, the Bank’s gold is shipped out for refinery by the mining houses which also export their own gold. The gold shipped to the refinery in South Africa by the Bank of Zambia is not recorded in South Africa’s trade statistics. The refined gold can be retained in South Africa for safe keeping or could be exported to other countries by or on behalf of the Bank of Zambia.

Figure 5 shows the trend in Zambia’s gold exports as reported in the Balance of Payments and Comtrade. Two important observations emerge from the data in the figure. The first is a remarkable increase in gold exports starting from 2008. According to BoP data, gold exports increased from US\$44 million in 2008 to US\$185.6 million in 2013. By 2020, Zambia’s official gold exports had reached US\$220.5 million. The second observation is a growing discrepancy between the value of gold exports reported in the BoP and those in Comtrade, starting in 2013. In that year, the BoP reported \$22 million more than Comtrade; the gap reached \$139 million in 2021.

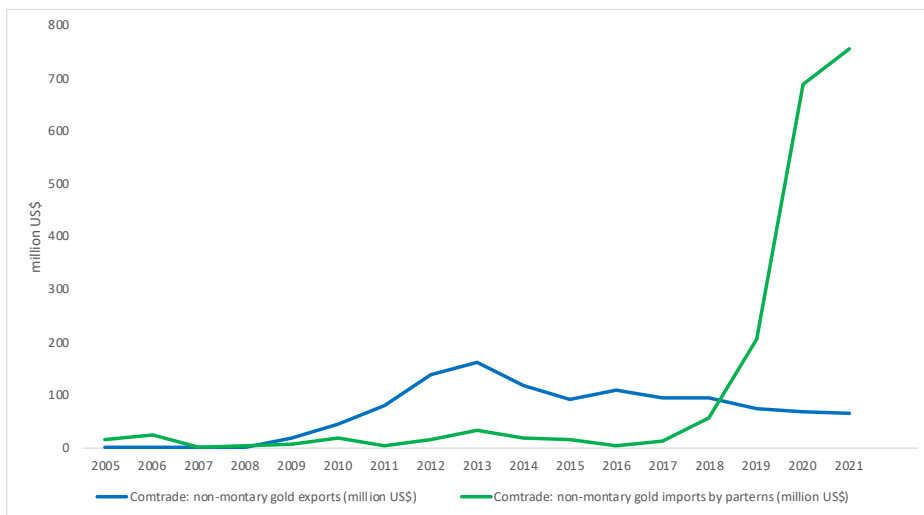
Figure 5: Trend of official gold exports: BOP and Comtrade (million, nominal US\$)



Source: Bank of Zambia database and Comtrade

Figure 6 presents the value of gold reported as exports by Zambia and imports by its partners in Comtrade. The first feature of the data is that between 2008 and 2018, the figure shows a peculiar situation whereby Zambia’s exports at FOB value are higher than its partners gold imports at CIF value. This means that a large amount of Zambia’s gold are not reported as imports by any partner. This reflects the situation with gold routed through South Africa. Secondly, the value of gold imports by partners reported in Comtrade skyrocketed from 2019, jumped from \$52 million in 2018 to \$204.9 million in 2019, jumped from \$52 million in 2018 to \$204.9 million in 2019. The value more than tripled the next year, reaching \$688 million, rising again to \$754 million in 2021.

Figure 6: Figure 6: Gold: Zambia's exports and partners' imports (million, US\$)



Source: Comtrade database

These large discrepancies in gold exports raise important questions as to their sources and motivations. One possible source is an underestimation of the true value of gold exports in Zambia’s records as a substantial amount of gold is exported through informal markets. Discrepancies also arise from the fact that formally mined gold is exported to foreign refineries, and that the value reported in the national statistics is assessed at the point when the gold bearing bars cross Zamian border. If variations in gold value after the refining stage is only reported to the mining company and not the revenue authority, this would result in discrepancies between the value of gold recorded at the source and the value recorded at the destination by importers. This may explain the substantial gap between the value of gold imports declared by importing countries and that reported as Zambia’s exports. The undervaluation of gold at the source implies a loss of fiscal revenue. The question that remains is what causes the dramatic increase in the gap between partners’ imports and Zambia’s exports from 2018. This issue deserves further investigation.

7.2 Gold export misinvoicing

The analysis of gold export misinvoicing is based on data from Comtrade using the HS codes 7108. Table 8 presents Zambia’s gold exports to its two markets, South Africa and the United Arab Emirates. The data show that South Africa is recorded as the destination of almost all Zambia’s gold exports, with only a limited amount being exported to UAE. However, South Africa records virtually no imports from South Africa. The asymmetry in the recording of gold exports through South Africa is a common trend among African countries,¹² as South Africa has large gold processing capacity and serves as a transit for gold trading. This complicates the task of tracking gold trade, making it difficult to assess the accuracy of the reporting of exports, government revenue collection and repatriation of export earnings, which are critical tools for leveraging mineral resources in the development process.

Table 8: Destinations of Zambian gold (billion US\$)

Country	2001	%	2010	%	2015	%	2021	%
South Africa	8.2	46.3	46.4	100.0	91.9	100.0	65.67	99.9
United Arab Emirates	3.82	21.7		0.0	0.0	0.0	0.062.4	0.1
World	17.60	100.0	46.4	100.0	91.9	100.0	65.7	100.

Source: Authors’ computations using data from Comtrade

Table 9 presents cumulative values of gold exports and imports over the period 2001-2021 including unmatched reporting with the two main destinations, South Africa and UAE. The results show large discrepancies between the values of gold exports declared by Zambia and the amounts of gold imports recorded by the two partners. In the case of South Africa, while Zambia declared \$1.3 billion of gold exports, South Africa recorded only \$227 thousand of gold imports from Zambia. One wonders then where the \$1 billion worth of Zambian gold exports went. Trade with

¹² See the case of Ghana in Ndikumana and Cantah (2023).

the UAE shows the opposite scenario, with \$1.8 billion of gold imports recorded in the UAE while Zambia only shows \$19.8 million of gold exports to that destination. These discrepancies point to export misinvoicing as a conduit for capital flight, which is documented in Table 10.

Table 9: Zambia’s Gold trade as reported including unmatched reporting: Cumulative amounts over 2001-2021 (million, constant 2021 US\$)

	Partner’s imports	Zambia’s exports	Raw difference	cif-adjusted difference
South Africa	0.2	1,352.8	-1,352.6	-1,411.3
United Arab Emirates	1,827.7	19.8	1,807.9	1,806.8
World	1,972.5	1,388.2	584.3	516.5

Source: Authors’ computations

Table 10 presents estimates of export misinvoicing using only observations with matched reporting by Zambia and its trading partners. The results show that most of Zambia’s gold exports are not matched with the destination indicated at the origin. Comparison of partner data taking account of the cost of insurance and freight reveals significant underinvoicing of gold exports to the UAE to the tune of \$1.6 billion. This suggests that Zambia is a losing substantial amount of tax revenue and foreign exchange earnings through the manipulation of gold exports to the UAE. The discrepancies have exploded since 2018. Panel (b) of Table 10 presents the results for only 2019-2021. During the 3-year period, the UAE recorded \$1.5 billion of gold imports, while Zambia reported \$196 million of gold imports. This implies gold export misinvoicing of \$1.5 billion. Relative to the rest of the world, estimated gold export misinvoicing stands at \$1.4 billion for the 3 years.

Table 10: Zambia’s gold trade as reported including matched reporting only: cumulative amounts over 2001-2021 (million, constant 2021 US\$)

<i>Panel a: 2001-2021</i>	Partner’s imports	Zambia’s exports	Export misinvoicing
South Africa	0.2	113.5	-118.0
United Arab Emirates	1,642.2	7.8	1,634.0
World	1,972.5	1,353.1	544.8
<i>Panel b: 2019-2021</i>	Partner’s imports	Zambia’s exports	Export misinvoicing
South Africa	0	0	0
United Arab Emirates	1,548.2	0.2	1,548.0
World	1,690.1	215.7	1,464.3

Source: Authors’ computations

7.3 Gold trade and the UAE hub

As Zambia does not have gold refineries, it relies on the Rand Refinery Limited in South Africa where Zambia-based mining houses dispatch the entire gold produced for refining and sale. The refined gold is then sold to third parties by the mining houses. Since Zambian gold is not recorded by South Africa as an import, and it is not recorded as an export or a re-export going out South Africa, this creates major accounting problems, obscuring the gold value chain.

A question emerging from these statistics is the destination of the gold that has been registered by Zambia at the origin as exported to South Africa which is not recorded as import by South Africa. As the UAE is the main buyer of Zambian gold, is the gold coming out of Rand Refinery Limited thereafter exported to the UAE where it is reported as Zambian gold? How would the UAE importers know that it is Zambian gold that they are buying from South Africa? Answering these questions would require detailed investigation down to the transaction level.

As a first attempt to explore the role of the UAE as a possible destination of Zambian gold routed through South Africa, we examine gold trade between South Africa and the UAE. Table 11 presents the cumulative value of gold trade between South Africa and the UAE in constant 2021 US\$ from 2001 to 2021. The figures in the first row include all years including unmatched trade flows, while those in the second row exclude observations with unmatched flows. The results show that the UAE reports more gold imports from South Africa (\$11.5 billion) than the latter's reported exports to the former (\$35.6 million). This suggests that South Africa possibly serves as a transit for gold originating from other countries, including Zambia, and destined to the UAE. The question then is what true market value is assigned to Zambian gold routed through South Africa that ends up in the UAE, and what fraction of the value accrues to Zambia? What benefits does Zambia draw from gold trade going through South Africa in terms of fiscal revenue and repatriation of foreign exchange? These are fundamental questions that have critical development implications that deserve to be investigated, which requires improved transparency in the handling and reporting of gold trade throughout the entire value chain.

Table 11: Gold trade between South Africa and the United Arab Emirates over 2001-2021 (million, constant 2021 US\$)

	UAE's imports	SA's exports	cif-adjusted difference
All years, including unmatched flows	11,559.1	35.6	11,522.3
Only years with matched flows	729.6	35.6	692.8

Source: Authors' computations

8. Conclusions

The Zambian economy remains heavily dependent on mining, which exposes it to frequent, and often strong shocks associated with fluctuations in prices and demand for minerals. Thus, economic growth, macroeconomic balances, foreign exchange reserves and exchange rates have been highly correlated with movements of minerals prices and exports. At the same time, the country has not been able to fully benefit from mining exploitation in terms of government revenue and foreign exchange earnings because of structural weaknesses in the regulation of a sector that remains heavily dominated by multinational corporations. Moreover, the fact that multinational firms operating in the mineral sector are headquartered in countries with different tax and legal jurisdictions, with links to secrecy jurisdictions, facilitates abusive transfer pricing and tax optimization through intra-firm trade, lending and borrowing.

This paper analyzed trade statistics to investigate the extent of minerals export misinvoicing as a channel of capital flight, focusing on copper, gemstones and gold. In the case of copper, the analysis reveals major discrepancies between Zambian recorded exports and imports as recorded by its trading partners. While Zambia records Switzerland as the primary destination of its copper exports (52.6%), Switzerland reports virtually no copper imports from Zambia. Further analysis reveals that the observed large gaps cannot be explained by discrepancies in copper trade between Switzerland and its main trading partners. The reverse situation of export underinvoicing is observed with some partners, led by China, which is the second destination of Zambia's copper exports (19%). However, the gaps do not offset each other: on balance, over \$19.9 billion (constant 2021 \$) of Zambia's copper exports cannot be traced in partners' import statistics. The paper discusses some possible explanations for the observed gaps. Ultimately, the discrepancies in Zambia-Switzerland copper trade remains a mystery.

While Zambia is endowed with substantial reserves in gemstones (emeralds, amethyst, tourmalines, and sugilite) the subsector has remained at the periphery of the national strategy for mining sector development. It remains dominated by informal mining and is highly exposed to export smuggling. The analysis of mirror trade statistics reveals substantial discrepancies in trade with the United States and India, which are also the largest buyers of Zambian gemstones. Our estimations show a cumulative loss of \$1.2 billion in export underinvoicing over the period 1995-2021.

Gold trade statistics exhibit substantial discrepancies between gold exports recorded in Zambia and gold imports recorded by its trading partners. While Zambia's records show South Africa as the primary destination of its gold (\$1.3 billion over 2021-2021), the UAE is the top importer of Zambian gold (\$1.8 billion) according to partner data in Comtrade. One possible piece of the puzzle may be the role played by South Africa as a regional gold refinery hub. Indeed, while

Zambia records South Africa as the top destination of its gold exports, South Africa's statistics show virtually no gold imports from Zambia. Further detailed analysis suggests that the gold going through South Africa may end up in the United Arab Emirates, which is an important importer of gold from South Africa. These recording asymmetries make it impossible to track gold trade to assess the accuracy of the reporting of gold exports, government revenue collection, and repatriation of export earnings, which are critical tools for leveraging mineral resources in the development process.

The analysis of export misinvoicing of minerals reveals structural deficiencies in the reporting of transactions along the value chain. These deficiencies suggest that the country is not collecting the full value of its mineral endowments especially in terms of government revenue and foreign exchange earnings. The evidence calls for deep reforms in the mining sector to improve efficiency, transparency and accountability for all involved parties in all transactions from investment, production, exporting and foreign exchange repatriation.

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Appendix

Table A1: Trend of Zambia's external debt, 2010-2021 (million US\$)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total external debt	4,252.9	4,968.1	5,721.7	6,292.3	9,191.8	11,778.5	15,221.0	22,954.5	23,526.3	27,254.2	26,689.5	24,045.9
Use of IMF Credit and SDR allocations	1,117.0	1,136.7	1,126.1	1,110.3	1,011.1	906.9	812.8	793.6	714.8	666.5	678.3	1,968.8
Long-term external debt	1,985.8	3,303.3	3,773.5	4,432.3	7,361.6	10,132.0	13,646.1	21,259.9	22,188.9	25,752.4	25,334.7	20,811.0
Public sector	1,191.5	1,785.8	3,010.9	3,375.0	4,795.5	6,487.2	7,060.0	8,785.7	9,888.3	11,016.8	12,260.5	12,497.7
Bondholders			750.0	750.0	1,750.0	3,000.0	3,000.0	3,000.0	3,000.0	3,000.0	3,000.0	3,000.0
Commercial banks & others					250.0	265.3	296.5	1,558.5	2,218.6	2,402.9	2,731.0	2,658.9
Private sector not guaranteed	794.3	1,517.5	762.6	1,057.3	2,566.1	3,644.8	6,586.0	12,474.2	12,300.6	14,735.6	13,074.3	8,313.3
Short-term external debt	1,150.1	528.1	822.1	749.7	819.1	739.6	762.1	901.0	622.5	835.2	676.4	1,266.1
External debt stocks to exports (%)	52.7	52.7	54.4	54.2	83.0	143.1	203.2	250.8	235.0	328.2	310.6	204.9
External debt stocks to GNI (%)	22.5	22.3	22.8	23.4	34.6	56.5	74.9	92.8	90.8	119.0	151.6	124.7

Source: World Bank, International Debt Statistics database