



Trade Misinvoicing in Primary Commodities in Developing Countries:

The cases of Chile, Côte d'Ivoire, Nigeria,
South Africa and Zambia



UNITED NATIONS
UNCTAD

New York and Geneva, 2016

Acknowledgement:

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This publication has been externally edited.

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UNCTAD/SUC/2016/2

1. Introduction

The problem of trade misinvoicing has generated increasing attention in the research and policy communities. It is an issue that has gained particular traction through the current debates on illicit financial flows, since trade misinvoicing continues to be used as a key mechanism of capital flight and illicit financial flows from developing countries.¹ This study aims to contribute to research and policy debates by providing empirical evidence on the magnitude of trade misinvoicing in the particular case of primary commodity exports from five natural-resource-rich developing countries: Chile, Côte d'Ivoire, Nigeria, South Africa and Zambia. This sample comprises four resource-dependent developing countries and a more diversified resource-rich middle-income country (South Africa). It covers a representative sample of products in the three main categories of primary commodities: oil and gas; minerals, ores and metals (copper, gold, iron ore, silver and platinum²); and agricultural commodities (cocoa). The inclusion of two copper exporters in the sample makes it possible to compare and contrast patterns of copper misinvoicing between two countries and over time.

Estimates of trade misinvoicing have been based, traditionally and primarily, on bilateral trade data published in the Direction of Trade Statistics (DOTS) of the International Monetary Fund (IMF), which provides aggregate values of imports and exports between a country and its trading partners. More recently, there has been growing interest in investigating trade misinvoicing at more disaggregated levels, at sector and product levels, and by trading partner. This interest is motivated by two major factors. First is the presumption that some products may be more prone to trade misinvoicing than others based on their idiosyncratic characteristics. Second, there may be variations among trading partners with regard to transparency and enforcement of trade recording rules that may generate differences in trade misinvoicing across partners. The analysis at the product and partner levels is made possible by the existence of disaggregated data published in the United Nations Commodity Trade Statistics (UN Comtrade) Database,³ which provides time series on imports and exports broken down by product, country and trading partner. Such an analysis produces valuable insights about the sources, directions and patterns of trade misinvoicing.

The study describes in detail how to use UN Comtrade data to identify major products and leading partners in order to guide the analysis of trade misinvoicing. It describes the statistical model for estimation of export misinvoicing at the product and partner levels. In the case of Nigeria, which exports oil and gas while also relying on imported oil products, the study also investigates the extent of oil import misinvoicing for this country.

The data show heavy concentration of exports both by product and by partner. With the exception of South Africa, the export baskets of the other countries in this sample – Chile, Côte d'Ivoire, Nigeria and Zambia – exhibit a heavy dependence on two or three primary commodities; South Africa has a more diversified export basket, though it is also rich in natural resources. These stylized facts illustrate the relevance and appropriateness of the sample selected for this study on trade misinvoicing in primary commodities.

¹ The issue of illicit financial flows has been integrated into the United Nations development financing framework. Target 16.4 of the Sustainable Development Goals specifically states: “By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime.” (See <https://sustainabledevelopment.un.org/?menu=1300>.)

² Note that UN Comtrade classifies silver, platinum and other metals of the platinum group into one category (SIC code 681).

³ The UN Comtrade Database “is a repository of official trade statistics and relevant analytical tables. It contains annual trade statistics starting from 1962 and monthly trade statistics since 2010” (<http://comtrade.un.org/>).

The results from the analysis show substantial levels of trade misinvoicing in all five countries covered by the study, but the patterns vary substantially across countries, products and trading partners. Some interesting patterns and contrasts emerge. At the product level, while trade in copper exhibits pervasive and large amounts of overinvoicing in Chile, the results for Zambia show substantial underinvoicing, as well as considerable overinvoicing in trade with Switzerland and the United Kingdom. Iron ore and gold exports from South Africa exhibit systematic underinvoicing. Relatively little gold appears in South Africa's export data, although the country's trading partners record substantial amounts of gold imports from South Africa. Exports of oil from Nigeria and silver and platinum from South Africa show mixed results – both underinvoicing and overinvoicing. At the partner level, the Netherlands presents the most peculiar case, with systematic export overinvoicing in trade with all the countries in the sample and for all the products. In other words, exports registered as going to the Netherlands cannot be traced in the Netherlands' bilateral trade data. In contrast Germany's trade with all the countries and products in the sample exhibits export underinvoicing. The results generally show a close correlation between export concentration by destination and the extent of trade misinvoicing.

The next section provides a review of the literature on the main mechanisms and motivations of trade misinvoicing. Section 3 describes the method of compilation of the data and presents some stylized facts. Section 4 presents the methodology used for estimation of trade misinvoicing. The results by country, product and partner are presented in section 5. Section 6 concludes with a summary of the results and some policy recommendations.

2. Mechanisms and motives for trade misinvoicing

2.1 Trade misinvoicing in the literature

Various economists have highlighted systematic discrepancies in bilateral trade data starting in the 1960s. Bhagwati (1964) pointed out substantial trade misinvoicing in the case of Turkey. Naya and Morgan (1969) provided similar evidence of export misinvoicing in the case of South-East Asian countries.

Interest in the issue of trade misinvoicing increased in the 1980s in the context of research on capital flight. The practice was identified as a major mechanism through which developing countries lose valuable capital (Lessard and Williamson, 1987). Indeed, the empirical literature has established that trade misinvoicing represents a substantial share of total capital flight from developing and emerging economies. For example the study by Ndikumana et al. (2015) provides evidence for African countries, (Beja, 2006, 2007) for Asian countries, and Jha and Truong (2014) and Kar (2010) for India. And a number of other studies cover broad samples of countries from all developing regions (Kar and Cartwright-Smith, 2010; Kar and LeBlanc, 2013; Kar and Spanjers, 2014). The significance of trade misinvoicing has drawn attention to the issue of tax evasion by transnational corporations (TNCs) and their role in fuelling the outflow of unrecorded capital from developing countries. This study contributes to this line of inquiry by documenting the extent of trade misinvoicing in primary commodities, a sector that is dominated by TNCs.

So far, studies have relied on aggregate trade data, unlike the present analysis that explores misinvoicing at the country and primary commodity level. We have no knowledge of similar studies. The level of disaggregation in this study could be of particular interest to many commodity-dependent developing countries (CDDCs) that derive most of their export revenue from a limited number of primary commodities, generally one or two. Therefore, understanding the extent to which CDDCs' main exports are affected by trade misinvoicing and identifying the partners with which this occurs sheds light on a practice that may contribute to fuelling illicit financial flows out of developing countries.

2.2 Motives for trade misinvoicing

A review of the literature reveals three main categories of motives for exporting and importing firms to engage in trade misinvoicing (Buehn and Eichler, 2011; Patnaik et al., 2012): (i) financial motives; (ii) circumventing exchange and customs controls; and (iii) minimizing the administrative burden.

The financial motive is driven by a trader's bid to maximize profit. This category includes tax evasion, where traders intentionally understate the value of exports and imports to minimize tax liabilities. In that case, import and export misinvoicing would be more prevalent in countries with high import quotas and high taxes on imports. Bhagwati (1964) found evidence of substantial import underinvoicing applied on products facing high tariffs. McDonald (1985) found a positive correlation between misinvoicing and export taxes in trade between developing and developed countries. Epaphra (2015) confirmed this finding in the case of the United Republic of Tanzania, where the extent of import misinvoicing is higher for products facing higher tax rates. Fisman and Wei (2004) found a close correlation between import tax rates and the extent of "missing imports", suggesting under-reporting of imports as well as possible misreporting of products to take advantage of differences in tax rates across products. Similarly, Yeats (1990) found that the extent of trade misinvoicing varies across product categories, which may be an indication of the role of differential treatment of products in terms of quotas and tariffs. Buehn and Eichler (2011) present further evidence of a positive link between trade misinvoicing and quotas and tariffs.

Firms may also engage in trade misinvoicing to take advantage of tax incentives aimed at promoting exports. In such contexts, exporting firms seek to maximize profits by overinvoicing their exports.

The second motive for trade misinvoicing is to circumvent currency controls. In this case, the existence of exchange rate distortions and foreign exchange controls creates a black market premium that traders will seek to exploit to their advantage. Thus traders engage in import overinvoicing and export underinvoicing to generate extra foreign exchange to be used to purchase domestic goods with a premium. Evidence of a correlation between the black market premium and import overinvoicing can be found in Bahmani-Oskooee and Goswami (2003), Barnett (2003), and Biswas and Marjit (2005).

Finally, trade misinvoicing occurs with the smuggling of imports and exports, driven by the motive to circumvent bureaucratic hurdles, including lengthy paperwork and delays in administrative authorizations and controls, in order to speed up execution and settlement of transactions. This practice is likely to be more prevalent in countries with high levels of corruption in the public sector. In such a context, firms engage in smuggling to avoid red tape, while smuggling is also encouraged and facilitated by corrupt public officials who are supposed to implement and enforce trade and customs regulations. The literature provides some empirical evidence of a positive correlation between corruption and trade misinvoicing for high-value goods (Fisman and Wei, 2007), a relationship confirmed even in studies on larger sets of export products (Berger and Nitsch, 2012).

In practice trade misinvoicing, in general, takes place simultaneously with correctly recorded and licit trade. In fact firms may engage in both legal and illegal trade so that the former helps disguise the latter. This makes it difficult for authorities and statistical analysts to detect misinvoicing where trade volumes are high. Thus, to gain a more accurate picture, the analysis of trade misinvoicing requires using disaggregated data enabling transactions to be tracked at both product and partner levels.

2.3 The case of primary commodity exports from developing countries

From the above discussion it is clear that trade misinvoicing in primary commodities is an important topic for research and policy purposes. As mentioned earlier, there is some evidence in the literature to indicate that trade misinvoicing may vary by product category based on product characteristics. For instance, high-value, low-weight products, such as gold, diamonds and other precious commodities, may be more vulnerable to misinvoicing and smuggling. Similarly products not governed by a standardized international pricing regime are more subject to misinvoicing and smuggling, as are goods produced through highly informal production practices, such as artisanal mining.

There are also other features of primary commodities that make them more prone to trade misinvoicing. The first is that governments have a high degree of discretionary control in the management of the natural resources sector. This provides considerable economic and political power to those in charge of managing the sector, which opens up avenues for rent-seeking, thereby undermining controls and regulations that govern the exploitation and export of primary commodities. Second, large TNCs in the extractive industries have strong financial and market power which enables them to exert pressure on host governments in order to circumvent government controls and regulations. Moreover, the complex organization of TNCs makes it hard for governments in resource-rich developing countries to monitor their operations. Most of these TNCs are large conglomerates that have branches and affiliates located in several countries. This facilitates exports through intra-company trade as well as profit shifting through transfer pricing.

Intra-firm trade constitutes a large, albeit varying, share of trade in developed economies.⁴ This increases the temptation and opportunities for export underinvoicing to minimize tax liabilities by disguising export earnings. Export overinvoicing may also be important where tax incentives aimed at encouraging export-oriented industrialization are substantial.

Finally, extractive industries are exposed to trade misinvoicing due to the large volumes of exports involved. This is because many natural-resource-rich developing countries have limited regulatory and administrative capacity to manage and monitor such large and complex trade volumes, thus providing an opportunity for trade misinvoicing.

2.4 Trade misinvoicing is not just the result of some statistical errors

It may be argued that trade misinvoicing is merely a reflection of imperfections in export and import data arising from incorrect recording, delays in reporting and/or differences in pricing mechanisms. However, existing empirical evidence demonstrates that the estimated levels of trade misinvoicing do not reflect mere statistical noise in the data. While it is possible that recorded import and export data might be affected by statistical errors, these errors would not persist and have a trend over time. The series of the errors would be zero-mean-reverting. Empirical evidence shows not only large values, but also persistent, and in some cases upward trending levels of trade misinvoicing. A number of recent studies (e.g., Ndikumana et al. (2015), and Baker et al. (2014)) have provided evidence of large and persistent trade misinvoicing in African countries. And a recent study for India shows a clear upward trend in trade misinvoicing since 2000 (Jha and Truong, 2014). A similar phenomenon is found in other Asian countries (Beja, 2006, 2007; Kar, 2010).

Moreover, delays in reporting of trade statistics would not be so systematic as to generate persistent trade misinvoicing, particularly given that most studies have used annual data. The impact of periodic recording delays is likely to be minimal on annual series; and the estimated effect of these delays on cumulative trade misinvoicing over a long time period is likely to be even smaller.

It is nonetheless important to recognize that there is an unavoidable degree of imperfection in trade statistics, as for any macroeconomic data. These imperfections are likely to be more pronounced in developing countries than in developed countries. Therefore, statistical discrepancies may be amplified in trade among developing countries (for evidence on intra-Asian trade, see Naya and Morgan (1969)). It is for these reasons that the estimation of trade misinvoicing typically considers trade with developed countries as a benchmark, based on the assumption that developed countries' data are less prone to substantial measurement and recording errors. Thus total misinvoicing is obtained by scaling up the volume of trade misinvoicing with developed countries with the inverse of the share of this group in the particular developing country's total trade. (See Ndikumana and Boyce (2010), for an elaborate description of the methodology).

This study focuses on trade between the selected commodity-exporting countries and their developed-country trading partners. As will become evident, these partners account for the bulk of trade of the developing countries under consideration in this study. However, given the increasing volume of trade of these commodity-exporting countries with some emerging countries, especially Brazil, the Russian Federation, India and China (BRICs), some of these countries are also included in the sample of trading partners, as appropriate. This is especially the case for China, India and the Republic of Korea.

⁴ The increase in intra-firm trade in the context of globalization has been documented since the 1990s. See, among others, Dicken (2007); Dignam and Galanis (2009); Hübner et al. (2000); Lanz and Miroudot (2011).

3. Data sources and highlights

3.1 Data sources and data compilation procedure

The five countries covered in this study are representative of the broad spectrum of natural-resource-rich countries and cover key primary commodities: oil and gas; minerals, ores and metals; and agricultural commodities. The study covers four resource-dependent developing countries – Chile, Côte d’Ivoire, Nigeria and Zambia – as well as a more diversified yet resource-rich economy, South Africa. The data are from the UN Comtrade Database, which is publicly available at <http://Comtrade.un.org/data/>. UN Comtrade has the unique advantage of containing export and import data by product disaggregated at the 4-digit SITC level. In addition to values of imports and exports, the database also contains information on weight, which can be used to derive implied unit prices.

Nonetheless, the UN Comtrade Database has some limitations. It covers a shorter time span than the IMF’s Direction of Trade Statistics (DOTS), starting in the 1980s in general. For most countries, Comtrade series start in the 1990s. Most importantly, partly because of its density, UN Comtrade is more time and labour-consuming than the DOTS in terms of data extraction,⁵ downloading and organizing of the series to be used in the estimation of trade misinvoicing.

The compilation of the time series used for estimation of export misinvoicing involves the steps described below. A similar process is used to compile data for estimating import misinvoicing.

- Step 1: To determine the main export commodities that are the subject of the export misinvoicing estimation, the first step consists of extracting and downloading exports of all commodities to the world (as trading partner).⁶ The leading products are determined using the product’s share in cumulative exports over the period reported in UN Comtrade.⁷ In this study, the average shares over the period 2010–2014 are used to determine the leading export products.
- Step 2: Once the leading products are determined, the next step is to extract series for exports of these products by the country under study to all its trading partners over the sample period. The partners (importers from the country under study) are then ranked based on average shares in cumulative exports over the investigation period. The aim is to assemble a sample of trading partners that represents a high proportion of total exports from the country under study, preferably over 90 per cent. Only partners with a meaningful length of time series are included in the sample.
- Step 3: Next, export series for the identified products to the identified leading trading partners for the period reported in UN Comtrade are extracted.
- Step 4: Import data by the identified leading partners from the country under study are then extracted. These series are compared to the country’s exports to estimate export misinvoicing.
- Step 5: The last step is to organize the data so as to compare exporter data and partner data for the computation of trade misinvoicing. This requires generating a panel that combines exporter data and partner data. This step is labour-intensive as it involves filling gaps with missing cells where no data are reported. This is because when there are no reported exports or imports in a particular year, this particular year-country

⁵ Faster download is available through a Premium Site License obtained by subscription.

⁶ Note that for imports, “the world” does not appear in UN Comtrade as a trading partner (importer). Therefore estimates for the annual total imports are obtained as the sum of imports by all individual partners.

⁷ If the product (or products) to be investigated is (are) pre-determined, this first step is not needed. In that case, the process will start with step 2.

observation does not appear in UN Comtrade. This is a particular inconvenience in the use of UN Comtrade. In other databases such as the DOTS, the year-country observation would be reported with a missing value for the particular variable, which makes it possible to generate time series and panel data sets without any manual manipulations of the original data. Note that any manual manipulation of the original data runs the risk of contamination of the data due to possible mistakes by the researcher.

For the five countries covered in this study, the UN Comtrade Database contains information over the 1990–2014 period for Chile, 1995–2014 for Côte d’Ivoire and Zambia, 1996–2014 for Nigeria, and 2000–2014 for South Africa. The case of Nigeria is peculiar: Due to the absence of data for 2004 and 2005, the results are presented for two sub-periods, 1996–2003 and 2006–2014, in addition to cumulative values for the entire period 1996–2014.

Using the process described above, the following products were identified for the sample countries (numbers in brackets are SITC codes):

- Chile: the copper group comprising processed copper [682] and copper ores and concentrates, copper mattes and cement [283].
- Côte d’Ivoire: cocoa [072].
- Nigeria: the oil and gas group [33] comprising: crude petroleum oils, oils from bitumen materials [333]; natural gas, whether or not liquefied [343]; petroleum oils or bituminous minerals > 70 per cent oil [334].
- South Africa: silver, platinum, other metals of the platinum group [681]; iron ore and concentrates [281]; gold, non-monetary (excluding gold ores and concentrates) [971].
- Zambia: Copper [682]

The next subsection presents some highlights from the data before providing a statistical estimation of trade misinvoicing in the subsequent section.

3.2 Highlights from the data

Like other resource-rich developing countries, the countries in this sample exhibit a heavy concentration of exports in a few dominant primary commodities. Table 1 and figure 1 present the shares of the top primary commodities exported as a percentage of total merchandise exported over the entire period. In the case of Nigeria, oil, gas and related products make up 92 per cent of total merchandise exports. In Zambia and Chile, copper alone constitutes 66 per cent and 54 per cent of total merchandise exports, respectively. South Africa has a substantially more diversified export basket, where the top export product group (the silver, platinum, and other metals of the platinum group) represents only 9 per cent of total merchandise exports. Moreover, the top 10 products account for only 52 per cent of South Africa’s total exports. Côte d’Ivoire’s export basket is relatively less concentrated than that of the other developing countries in the sample, although it is still heavily dominated by cocoa, which accounts for 32 per cent of its total exports.

The concentration in export commodities is compounded by concentration in export destinations or trading partners. Indeed, one trading partner accounts for more than half of some countries’ total exports of a primary commodity. For example, about 62 per cent of South Africa’s iron ore, its second most important export commodity, in value, goes to one partner, China. In the case of Zambia, 51 per cent of its leading export commodity, copper, is exported to Switzerland. This pattern of concentration is evident also in the other countries in the sample, though to a lesser extent.

In the case of South Africa, the data for gold exports show major discrepancies between the values reported by South Africa (exports to partners) and the values reported by its trading partners (as gold imports from South Africa). According to South Africa's data, the top partner, India, accounts for only 4.6 per cent of its total gold exports. However, India's data show a share of 35 per cent. This is a sign of significant gold export misinvoicing, which is the subject of investigation in the remainder of the paper.

The strong concentration of exports in a few products and destinations exposes resource-rich developing countries to adverse effects of demand and price shocks in international commodity markets. This was illustrated during the global economic crisis when primary commodity exporters suffered a stronger growth contraction than their resource-scarce counterparts. The recent decline in commodities prices, especially of oil, has translated into relatively larger downward revisions of growth forecasts for resource-dependent economies compared to non-resource-dependent economies.⁸

⁸ See *IMF (2016) Regional Economic Outlook: Sub-Saharan Africa – Time for a Policy Reset (April 2016 edition)*.

Table 1: Shares of top export commodities of sample countries in their total exports (per cent)

Country	Top product	Top 3 products	Top 5 products	Top 10 products	Top product	Top 2nd product	Top 3rd product
Chile	53.7	59.8	67.7	76.4	[682] Copper	[283] Copper ores and concentrates; copper mattes, cement (<i>Share = 20.5% of total exports</i>)	[057] Fruits and nuts (excl. oil nuts), fresh or dried
Côte d'Ivoire	31.8	54.0	65.9	81.2	[072] Cocoa	[334] Petroleum oils or bituminous minerals > 70% oil (<i>Share = 13.2% of total exports</i>)	[333] Petroleum oils, oils from bitumen materials, crude
Nigeria	78.8	92.4	94.6	97.3	[333] Petroleum oils, oils from bitumen materials, crude	[343] Natural gas, whether or not liquefied (<i>Share = 8.6% of total exports</i>)	[334] Petroleum oils or bituminous minerals > 70% oil
South Africa	9.1	23.6	34.7	52.0	[681] Silver, platinum, other metals of the platinum group	[281] Iron ore and concentrates (<i>Share = 7.9% of total exports</i>)	[971] Gold, non-monetary (excl. gold ores and concentrates)
Zambia	66.2	71.4	75.5	82.7	[682] Copper	[121] Tobacco, unmanufactured; tobacco refuse (<i>Share = 2.6% of total exports</i>)	[522] Inorganic chemical elements, oxides & halogen salts

Source: Author's calculations using UN Comtrade Database.

Note: Shares are calculated as the ratio of exports to total exports over the period 1995–2014. The data for South Africa cover a shorter period (2000–2014). For Nigeria the data start in 1996 and there are no data for 2004 and 2005.

Table 2: Shares of sample countries' top trading partners (export destination) in their total exports (per cent)

	Chile: copper [682]	Cote d'Ivoire: cocoa	Nigeria: oil	South Africa: iron ore	South Africa: silver and platinum	South Africa: gold (SA data)	South Africa: gold (partner data)	Zambia: copper [682]
Top partner	25.7	31.3	29.8	61.7	33.9	4.6	34.6	51.3
Top 3 partners	46.5	58.9	49.5	79.8	71.9	7.5	65.4	74.9
Top 5 partners	61.1	69.7	60.7	86.7	91.6	8.8	86.1	82.7
Top 10 partners	83.2	84.3	77.8	95.4	99.5	9.2	97.5	91.3
Top 15 partners	91.6	93.5	85.8	98.9	99.8	9.3	99.4	95.4

Source: Author's calculations using data from UN Comtrade Database.

4. Methodology for estimating trade misinvoicing

Trade between two countries A and B is said to exhibit export misinvoicing when the value of exports from country A to its trading partner country B, as reported by country A, is significantly different from the value of imports by country B from country A, as reported in country B's data. Conventionally, exports are recorded according to their free on board value (FOB), while the reported value of imports includes cost, insurance and freight (CIF). Under normal circumstances, the following equality would hold:

$$\text{Country B's imports from country A} = \text{Country A's exports to country B} + \text{freight and insurance} \quad (1)$$

In practice, however, the data reveal substantial differences between the amount on the left and that on the right of the above equation. Systematic differences are interpreted as export misinvoicing. The difference can be positive or negative relative to country A's values. There is export underinvoicing in country A when the value of its exports (as reported in its data) plus insurance and freight is lower than the value of its trading partner B's imports as reported in country B's data. The reverse situation reflects overinvoicing of exports.

Import misinvoicing is defined in a similar fashion, except that it refers to imports by country A from country B. There is import overinvoicing when country A's data show higher values of its imports from B than country B's reported exports to country A (plus insurance and freight). Import underinvoicing occurs in the reverse scenario, implying that imports by country A from partner B have been underreported; this may reflect import smuggling into country A. There are two possible scenarios in this case. The first is technical smuggling, whereby the value of imports is deliberately underestimated, possibly to avoid import duties and taxation, as discussed in section 2 earlier in the paper. The second scenario is pure smuggling, whereby imported goods are simply not recorded at all at entry into the country. Empirically, it is difficult to distinguish between these two scenarios by looking at the aggregate trade data. Moreover, it is important to note that, unlike unrecorded exports, imports that are smuggled into the country do not amount to a net loss to the country, given that the goods are consumed in the country. However, these imports must be paid for; therefore they must have a counterpart in terms of use of foreign exchange, even though the transactions are not traceable in the country's official balance-of-payments statistics. For these reasons, import smuggling reduces the estimated amount of capital flight from the country, while import overinvoicing increases it. A detailed discussion of import misinvoicing in the context of estimation of capital flight can be found in Ndikumana et al. (2015) and Ndikumana and Boyce (2010).

The literature on capital flight and trade misinvoicing has thus far used aggregate national imports and exports in the computation of trade misinvoicing. This study estimates trade misinvoicing at the product level and by partner.

For country i , product k , and partner j at time t , export misinvoicing (noted as DX henceforth) is calculated as follows:

$$DX_{ij,t}^k = M_{ji,t}^k - \beta * X_{ij,t}^k \quad (2)$$

Where M_{ji} represents imports by country j from country i according to country j 's data, X_{ij} is exports by country i to country j as reported by country i , and β is the freight and insurance factor. This factor is expected to vary across countries especially when taking into account the distance to export markets as well as market factors affecting transport costs and insurance. However, due to

lack of country-specific data, a value of 1.1 is used following the practice in the literature (Baker et al., 2014; Ndikumana and Boyce, 2010; Ndikumana et al., 2015).

A positive value of DX in a given year reflects export underinvoicing; a negative value implies export overinvoicing. Following the discussion in section 2 on the motives for trade misinvoicing, export underinvoicing is the most expected scenario, reflecting the incentives of exporting firms to stash foreign exchange abroad to settle transactions or to pay for smuggled goods, or to avoid foreign exchange controls or administrative bottlenecks. However, export overinvoicing may also occur, which, among others, may reflect an attempt by firms to benefit from tax incentives established to promote export-oriented industrialization. It is therefore not possible to predict the sign of DX *a priori*.

Similarly, for a country i , product k , and partner j , import misinvoicing (labeled DM) in a year t is measured as follows:

$$DM_{ij,t}^k = M_{ij,t}^k - \beta * X_{ji,t}^k \quad (3)$$

where M_{ij} is the value of imports by country i from country j as reported by country i , X_{ji} is the value of exports by country j to country i as reported by country j , and β is the freight and insurance factor, which is assumed to be 1.1 as indicated above.

A positive value for DM represents import overinvoicing, which may be motivated by a desire to secure extra foreign exchange to buy goods abroad or take advantage of a favourable black market premium to buy goods locally. A negative DM implies import underinvoicing, reflecting technical smuggling or pure smuggling, or a combination of the two.

Total export misinvoicing and import misinvoicing are calculated by replacing country k with the world in the above equations. It may also be calculated by considering misinvoicing relative to a group of countries, such as developed economies as the benchmark, and then scaling up the obtained value with the inverse of the share of this group of countries in country i 's total exports and imports, respectively.

The analysis in this study focuses on export misinvoicing, given that, in general, primary commodity exporters do not import the same products in significant amounts. The exception is oil, where oil- and gas-producing developing countries may not have local refining industries and therefore must import refined oil. This is the case for Nigeria, for example. For this reason, the paper presents both oil export misinvoicing and oil import misinvoicing in Nigeria.

To enable comparability over time and across countries, the estimates are converted into real values by deflating nominal values using the United States gross domestic product (GDP) deflator with 2014 as the base year. The series for the GDP deflator are obtained from the IMF's International Financial Statistics.

5. Results by country

This section presents and discusses the estimated amount of trade misinvoicing by country and product. A table summarizing the results for the main trading partners to illustrate patterns and disparities in underinvoicing and overinvoicing is presented in annex table A1. The section starts with copper exports, showing the contrasts between Chile and Zambia.

5.1 Chile: Copper export misinvoicing

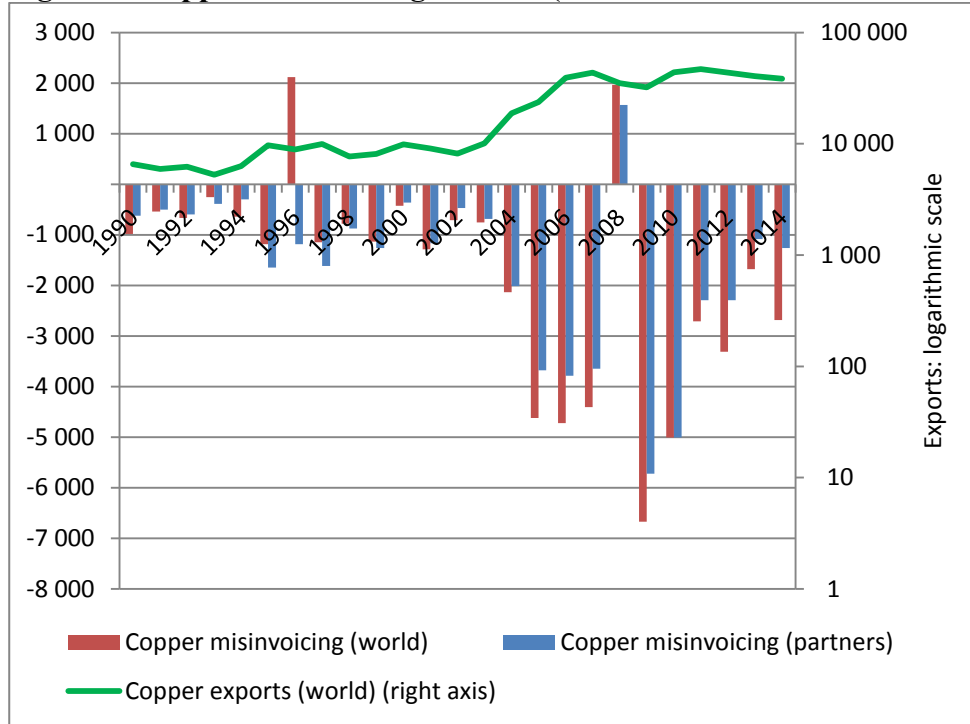
The results for Chile cover the period 1990–2014 for the two leading export sub-products of the copper group (see table 3). The partners selected in the analysis are determined following the methodology described in section 2. However, Switzerland is also included in the sample, as it appears to be a major channel of trade misinvoicing in the other countries in the sample. The sample of leading trading partners considered accounts for 91.4 per cent of Chile's total copper exports, with 90.8 per cent of total exports of copper ores and concentrates (SITC 283) and 84.4 per cent of copper products in the non-ferrous metals category (SITC 682). The leading trading partners are China, which accounts for 23.7 per cent of Chile's total copper exports over the period, followed by Japan (13 per cent) and the United States (8 per cent).

The results show export overinvoicing (negative values) for all trading partners except France, Germany and Spain. Whereas trade with Germany exhibits substantial export underinvoicing worth \$9.4 billion in net terms, the values are small for France and Spain. Therefore, it is reasonable to conclude that export overinvoicing is the most predominant phenomenon in Chile's copper trade. The following are some noteworthy results by trading partner:

- Trade with the Netherlands exhibits the largest amount of export overinvoicing of \$16 billion, even though the country accounts for a relatively small share (5.3 per cent) of Chile's total exports of copper products [682]. This means that the bulk of Chile's copper exports to the Netherlands are not reported in the Netherlands' trade data even though they are reported in Chile's trade data.
- Chile's leading trading partners also exhibit large overinvoicing of copper exports. In the case of China, there is both export underinvoicing for the refined copper products [SITC 682] worth \$3.4 billion, and export overinvoicing for copper ores [SITC 283] worth \$4.2 billion, resulting in net overinvoicing for the two products combined of \$791 million.
- Chile's trade with Japan, the second leading trading partner, exhibits large overinvoicing of copper exports for both sub-groups: \$4.1 billion [282] and \$1.8 billion [682], respectively, with total export overinvoicing of \$5.9 billion.

The cumulative amount of copper export misinvoicing for the sample of Chile's major trading partners tracks the trend of total misinvoicing with all partners as illustrated in figure 1. There is export overinvoicing in all the years but two (1996 and 2008). The results also show that the absolute value of copper export misinvoicing has increased in tandem with total copper exports (represented by the solid line on the graph). The evidence points to a need to establish a mechanism for better tracking the effective destination of Chile's copper exports.

Figure 1: Copper misinvoicing in Chile (Millions of constant 2014 dollars)



Source: Author's computation using UN Comtrade data.

Table 3: Chile: Copper export misinvoicing (millions of constant 2004 dollars) and partners' shares in copper exports (per cent), 1990–2014

Country	Export misinvoicing			Partner's share in copper exports (per cent)		
	Copper ores and concentrates [283]	Copper products [682]	Total [282 + 628]	Copper ores and concentrates [283]	Copper products [682]	Total [282 + 682]
Belgium		-3 151.3	-3 151.3		1.4	0.9
Brazil	-1 154.3	-1 732.1	-2 886.4	6.6	5.8	6.1
Canada	-193.4	-807.1	-1 000.5	0.8	1.7	1.4
China	-4 173.3	3 382.3	-791.0	23.1	24.0	23.7
France		147.7	147.7		6.3	4.1
Germany	-1 001.8	10 405.6	9 403.8	5.1	1.7	6.8
India	-2 959.4	-75.4	-3 034.9	10.7	0.2	3.9
Italy		-2 272.2	-2 272.2		8.6	5.6
Japan	-4 139.3	-1 796.4	-5 935.7	31.8	3.0	13.0
Mexico	-90.4	-651.7	-742.1	0.3	2.2	1.5
Netherlands	-16 085.4		-16 085.4	5.3	3.4	
Rep. of Korea	-375.2	-1 723.5	-2 098.6	8.0	7.9	7.9
Spain	1 260.2	-339.6	920.6	3.9	1.2	2.1
Switzerland	-168.0	-706.8	-874.7	0.1	0.2	0.2
United Kingdom		-5 502.3	-5 502.3	0.0	2.6	2.6
United States	67.3	-7 059.4	-6 992.1	0.4	12.2	8.1
World	-17 130.9	-27 247.8	-44 378.0	100	100.0	100.0
All partners	-12 927.7	-2 7967.7	-40 895.0	90.8	84.4	91.4

Source: Author's computation using UN Comtrade data

5.2 Zambia: Copper export misinvoicing

The results for Zambia (see table 4 and figure 2), a country that is also heavily dependent on copper exports, differ drastically from those of Chile. In contrast to widespread export overinvoicing in Chile, Zambia's results show copper export underinvoicing, with the notable exceptions of trade with Switzerland and the United Kingdom which exhibits export overinvoicing of \$31.8 billion and \$4.4 billion, respectively. Trade with Singapore, South Africa and the United Republic of Tanzania also exhibits export overinvoicing, albeit a relatively smaller proportion compared to Switzerland.

The results show a very high concentration of exports to two countries with the highest export misinvoicing. Switzerland and China accounted for an accumulated \$31.8 billion of export overinvoicing and \$5.6 billion of export underinvoicing, respectively. Together, these trading partners account for 67.7 per cent of Zambia's total copper exports. Of Zambia's total copper exports to China, underinvoicing amounted to \$5.6 billion, or 61 per cent, representing 10 per cent of Zambia's total copper exports over the 1995–2014 period. Copper exports to Switzerland present a peculiar case, as no such exports are recorded in Switzerland at all.⁹ Excluding Switzerland, Zambia recorded systematic export underinvoicing starting in 2005, with a cumulative \$12 billion in export underinvoicing over the 1995–2014 period. The peculiar feature of trade with Switzerland deserves to be explored further, especially at a more disaggregated, company level. It is possible that exports are recorded as destined to an importer in Switzerland when the importer does not reside there, as would be the case with transit trade. Therefore, it would be important to investigate the effective destination of Zambian copper marked as exported to Switzerland that never arrives in that country.

Zambia's trade with other trading partners also exhibits substantial export underinvoicing. The results for trade with Italy show \$2 billion of copper export underinvoicing compared to only \$16 million of exports reported in Zambia's data. The respective values for trade with the Republic of Korea are \$3.9 billion in export underinvoicing and \$358 million of declared exports. Most of the copper exports to these countries are not recorded in Zambia's official statistics.

There was a notable switch in destinations of copper exports in 2004. Up to that year, South Africa and the United Kingdom were the two most important trading partners. However, as illustrated in figure 3, from 2005 to 2006, their combined share of Zambia's total copper exports fell from 44.9 per cent to 8.7 per cent. Since then, China has taken over as the dominant trading partner, with its share rising from 9.4 per cent in 2003 to 55 per cent in 2006, and peaking at 63 per cent in 2011. Switzerland's share has also tapered off in the context of China's emergence.

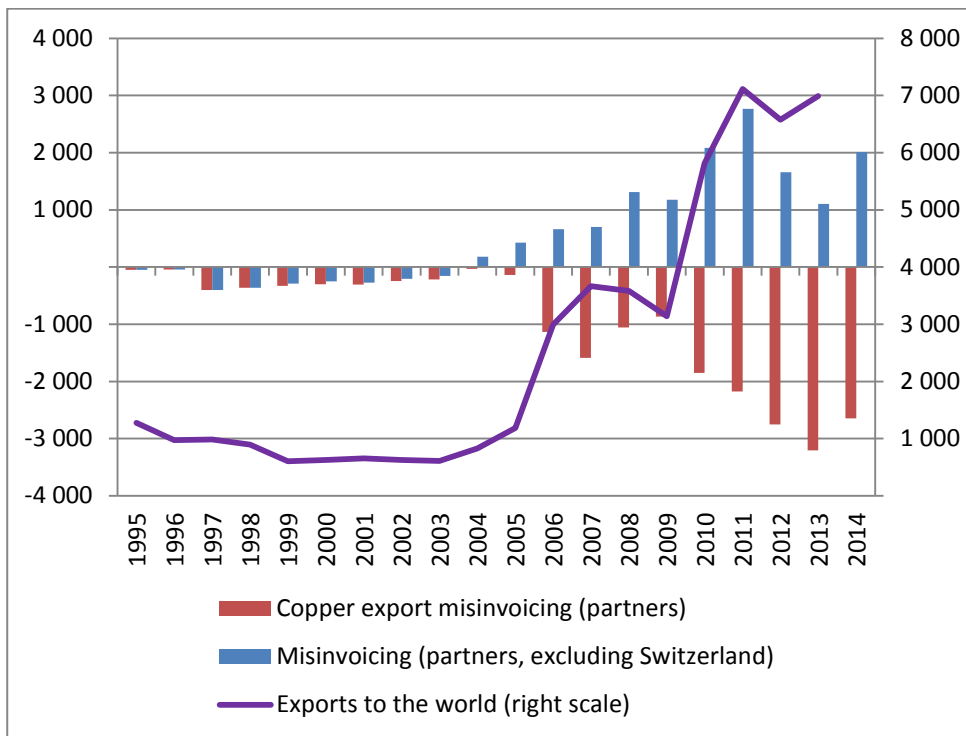
⁹ This is reflected in the following: $\text{abs}(-\$31,765\text{m}) = 1.1 * \$28,878\text{m}$.

Table 4: Zambia: Copper exports and misinvoicing (millions of constant 2004 dollars) and partners' shares in copper exports (per cent), 1995–2014

Partner	Copper exports and misinvoicing		Partners' share in Zambia's total copper exports
	Exports	Export misinvoicing	
China	9 225.9	5 644.5	16.4
Egypt	10 69.3	1 180.8	1.9
India	547.6	691.8	1.0
Italy	15.7	2 036.5	0.0
Japan	767.6	168.7	1.4
Rep. of Korea	357.6	3 923.5	0.6
Malaysia	516.2	73.0	0.9
Saudi Arabia	1 217.6	2 939.2	2.2
Singapore	538.6	-272.1	1.0
South Africa	3 061.9	-1 516.0	5.4
Switzerland	28 877.7	-31 765.4	51.3
Thailand	1 338.0	839.6	2.4
United Arab Emirates	1 143.9	1 290.2	2.0
United Rep. of Tanzania	638.9	-585.0	1.1
United Kingdom	40 91.3	-4 360.4	7.3
Partners	53 407.79	-19 711.1	94.8
World	56 335.3	-17 295.5	100
Excluding Switzerland			
Partners	24 530.9	12 054.3	
World	27 458.4	14 469.8	

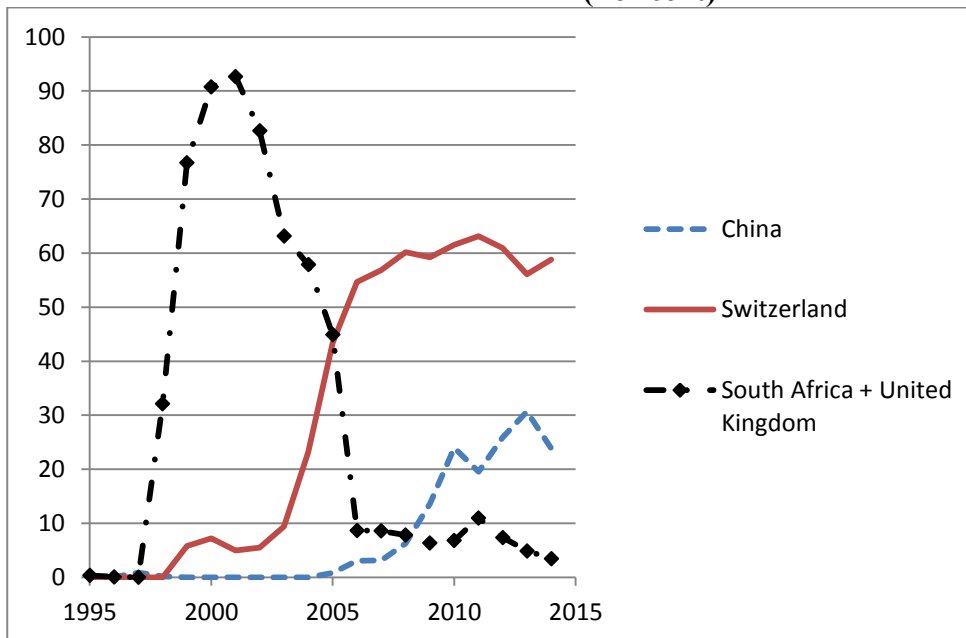
Source: Author's computation using UN Comtrade data.

Figure 2: Zambia: Copper export misinvoicing (Millions of constant 2014 dollars), 1995–2014



Source: Author's computation using UN Comtrade data.

Figure 3: Partners' shares in Zambia's total copper exports, 1995–2015 (Per cent)



Source: Author's computation using UN Comtrade data.

5.3 Nigeria: Oil export misinvoicing

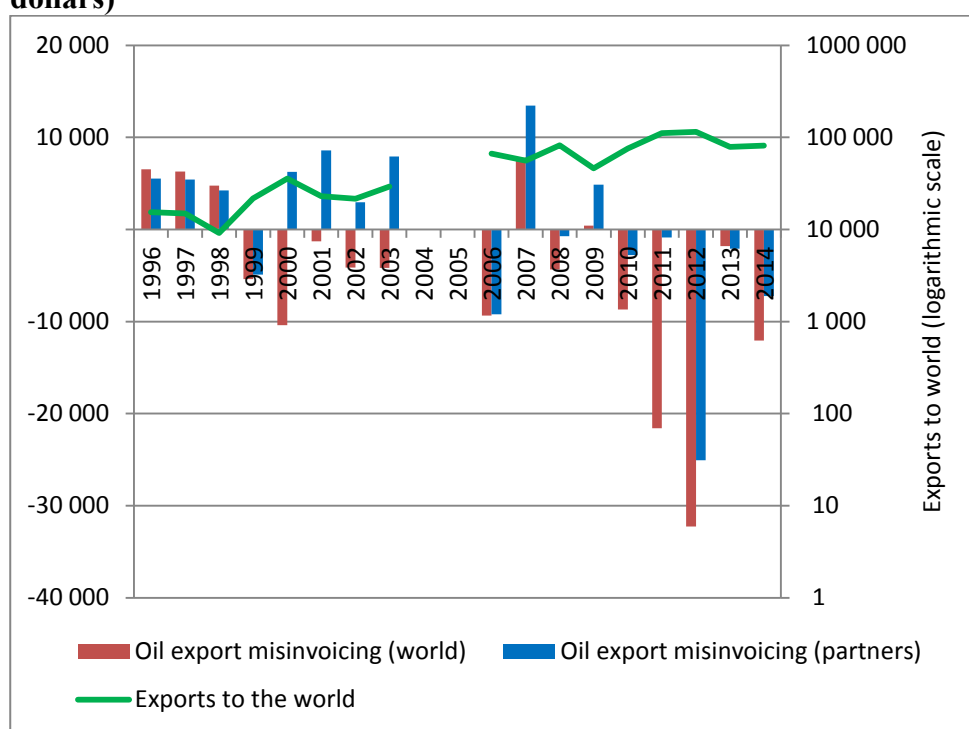
As indicated earlier, there are no data on imports and exports for Nigeria in the UN Comtrade Database for the years 2004 and 2005. However, the IMF Direction of Trade Statistics database contains complete data series, including these two years. The results for Nigeria are therefore divided into two sub-periods, 1996–2003 and 2006–2014 (table 5 and figure 4).

The pattern of oil export misinvoicing changed over time, switching from a regime of export underinvoicing over the 1996–2003 period to export overinvoicing from 2006 to 2014 (figure 5). In the first period, in Nigeria's trade with its 17 major trading partners, there was estimated export underinvoicing amounting to a total of \$35.9 billion. This represented 32 per cent of its cumulative oil exports to this group of partners. Over the second period, 2006–2014, on the other hand, there was an estimated \$29.7 billion worth of overinvoicing of its oil exports to those 17 trading partners. But due to the much higher levels of oil exports during this period, this figure represents only 4.9 per cent of Nigeria's cumulative oil exports to this group of trading partners. This leads to the finding that there was not only a switch in the direction of export misinvoicing, but also the relative intensity of misinvoicing diminished in the second period. Nonetheless, export overinvoicing remains an important issue for the Government of Nigeria which it needs to address as part of a broader strategy to manage its oil wealth.

Turning to the analysis by trading partner, the results show that trade with 5 out of the 17 major trading partners exhibits export underinvoicing, while with the others it shows export overinvoicing. The largest amount of underinvoicing is in trade with the United States (\$69.7 billion) and Germany (\$23.9 billion). Switzerland presents a peculiar case where trade with Nigeria exhibits large export underinvoicing (\$6.9 billion, or 6.6 per cent of cumulative underinvoicing), although the country accounts for an insignificant share of total exports (less than 0.1 per cent, according to Nigerian data). The results are also different from Switzerland's trade with Zambia, which is characterized by large copper export overinvoicing. In the Nigerian case, the results imply that a substantial amount of oil exports to Switzerland is not recorded in Nigeria, or that the exported quantities or values are highly undervalued. In the case of Zambia, the situation is reversed: copper exports headed to Switzerland do not seem to reach that country.

Trade with Italy and the Netherlands exhibits very high levels of export overinvoicing, with a total of \$25.1 billion and \$20.5 billion respectively. This practice is also pervasive in Nigeria's trade with Brazil, Canada, France, Ghana, India, the Republic of Korea and South Africa.

Figure 4: Nigeria: Oil exports and export misinvoicing, 1996–2014 (Millions of constant 2014 dollars)



Source: Author's computation using UN Comtrade data.

Table 5: Nigeria: Oil export misinvoicing by trading partner, (million, constant 2014 \$) and partners' share in Nigeria's total oil exports (Per cent), 1996–2014

Partner	Oil export misinvoicing			Partner's share in Nigeria's total oil exports		
	1996–2003	2006–2014	1996–2014	1996–2004	2006–2014	1996–2014
Brazil	-398.9	-3 485.4	-3 884.3	4.6	8.3	6.6
Canada	-1 348.7	-6 994.1	-8 342.7	1.8	2.4	2.1
China	-16.0	-4 703.9	-4 719.9	0.5	1.3	0.9
Côte d'Ivoire	-550.9	-611.3	-1 162.1	3.2	2.6	2.9
France	-1994.6	-10719.9	-12 714.6	6.3	4.8	5.5
Germany	3324.6	20585.0	23 909.7	1.3	1.3	1.3
Ghana	-552.8	-5 248.6	-5 801.4	1.8	1.2	1.4
India	-10 286.1	1518.2	-8 767.9	9.2	11.9	10.6
Italy	-5 137.4	-19 985.0	-25 122.4	4.6	3.9	4.2
Rep. of Korea	-214.4	-2 429.1	-2 643.6	2.1	0.5	1.2
Netherlands	-2 425.0	-18 108.1	-20 533.0	2.9	5.3	4.2
Portugal	398.0	-1191.5	-793.5	3.0	1.4	2.1
South Africa	-533.5	-3588.1	-4 121.6	0.9	3.7	2.4
Spain	982.4	-106.6	875.8	7.7	5.5	6.5
Switzerland	2 935.2	3 971.9	6 907.1	0.0	0.1	0.0
United Kingdom	483.3	2 899.4	3 382.7	0.2	2.3	1.3
United States	51 298.5	18 456.0	69 755.0	19.9	29.4	24.9
Partners	35 963.8	-29 740.0	6 223.4	69.9	85.7	78.3
World	-7 800.6	-81 902.0	-89 702.5	100	100	100

Source: Author's computation using UN Comtrade data.

5.4 Nigeria: Oil import misinvoicing

While Nigeria is a leading producer and exporter of oil, it also depends on oil imports owing to its lack of a domestic oil processing industry. This study, therefore, also examines the extent of oil import misinvoicing in Nigeria (see table 6 and figure 5).

The results show systematic and substantial import underinvoicing into Nigeria (figure 6). Cumulative oil import underinvoicing amounted to \$45.6 billion over the 1996–2014 period. Such underinvoicing was significantly worse during the 2006–2014 period compared with the 1996–2003 period. While the cumulative amount of oil smuggling was \$3.4 billion in the earlier period, it was \$42.2 billion in the second period.

Analysis at the partner level also reveals noteworthy patterns over time and by different partners. The results set the Netherlands apart from other trading partners, in that its trade with Nigeria exhibited very large oil import underinvoicing of \$24 billion over the period. Most of this misinvoicing occurred in the 2006–2014 period (\$23.7 billion).

Table 7 summarizes the results for oil export and oil import misinvoicing vis-à-vis the leading partners. When comparing Nigeria's oil exports to and imports from the Netherlands, the peculiarity of this trade with the Netherlands stands out even more. On the export side, it appears that the bulk of oil exported by Nigeria to the Netherlands never reaches its destination. On the import side, oil exported by the Netherlands to Nigeria appears to never reach its destination either. Trade between the two countries has generated cumulative trade misinvoicing amounting to \$44.6 billion over the 1996–2014 period. This deserves close scrutiny in the country's efforts to stem the practice of trade misinvoicing.

The results in table 7 also show substantial and simultaneous oil export underinvoicing and oil import overinvoicing in trade with Germany, Spain and Switzerland. Net export and import misinvoicing is positive in trade with Germany, Spain, Switzerland, the United Kingdom and the United States. In these cases, trade misinvoicing may result in net capital outflows from Nigeria. In the case of trade with the United States, the cumulative outflows amount to a staggering \$66.8 billion. Germany and Switzerland follow with \$24.1 billion and \$7.3 billion. An investigation into the mechanisms and direction of trade misinvoicing as a channel for capital flight should focus on these major outlets of misinvoicing of oil exports from Nigeria. Underinvoicing of oil imports also deserves attention, as it is even more prevalent than oil export misinvoicing, occurring with 12 out of Nigeria's 17 major trading partners.

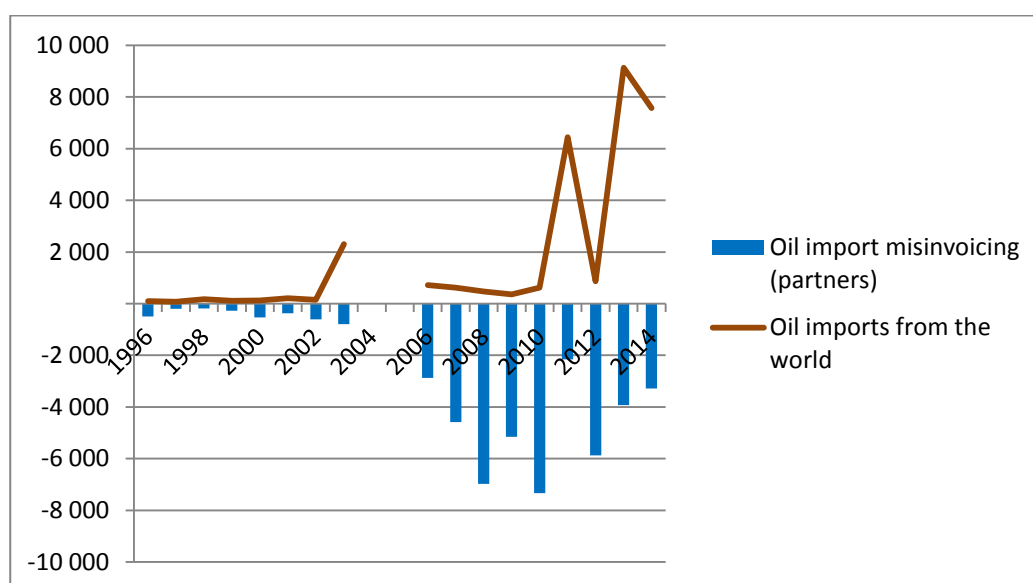
Table 6: Nigeria: Oil import misinvoicing, (million, constant 2014 \$) and partners' share in Nigeria's oil imports (Per cent), 1996–2014

Partner	Oil import misinvoicing			Partner's share in Nigeria's oil imports		
	1996–2003	2006–2014	1996–2014	1996–2003	2006–2014	1996–2014
Brazil	-500.9	-3 022.5	-3 523.4	1.8	0.8	1.3
Canada	-7.5	-32.8	-40.3	0.2	0.0	0.1
China	-82.5	185.8	103.3	0.6	3.1	1.9
Côte d'Ivoire	-555.0	-5 810.2	-6 365.2	3.9	1.7	2.7
France	-775.4	-4 069.2	-4 844.6	8.0	7.9	8.0
Germany	38.4	156.2	194.6	11.8	2.8	7.0
Ghana	-32.0	84.0	52.0	0.0	0.4	0.2
India	-45.9	-259.3	-305.2	0.1	3.5	1.9
Italy	-155.7	-424.9	-580.7	4.2	5.1	4.7
Netherlands	-454.0	-23 685.4	-24 139.4	6.9	6.5	6.7
Portugal	-36.1	-312.4	-348.5	1.0	0.6	0.8
Rep. of Korea	17.3	-166.4	-149.1	1.2	0.1	0.6
South Africa	-120.8	-373.6	-494.4	0.4	0.9	0.6
Spain	-523.1	978.4	455.2	6.8	2.7	4.7
Switzerland	52.4	304.3	356.7	3.6	4.2	3.9
United Kingdom	-193.3	-2 829.0	-3 022.3	10.2	4.2	7.0
United States	-96.9	-2 855.9	-2952.8	12.4	16.3	14.5
Partners	-3 471.1	-42 132.7	-45 603.9	83.3	54.6	55.5
World	NA	NA	NA	100	100	100

Note: The average share excludes 2002. There is a large drop in the share in 2003 due to a large increase in imports (from \$143.8 million in 2002 to \$2.3 billion in 2003).

Source: Author's computation using UN Comtrade data.

Figure 5: Nigeria: Oil imports and import misinvoicing, (Millions of constant 2014 dollars), 1996–2014



Source: Author's computation using UN Comtrade data.

Table 7: Nigeria: Net oil export and import misinvoicing, 1996-2014 (Millions of constant 2014 dollars)

Oil export misinvoicing plus oil import misinvoicing			
Partner	1996–2003	2006–2014	Total 1996–2014
Brazil	-899.8	-6 507.9	-7 407.7
Canada	-1 356.2	-7 026.8	-8 383.0
China	-98.5	-4 518.1	-4 616.6
Côte d'Ivoire	-1 105.9	-6 421.4	-7 527.3
France	-2 770.0	-14 789.1	-17 559.1
Germany	3 363.0	20 741.3	24 104.3
Ghana	-584.8	-5 332.6	-5 749.4
India	-10 332.0	1 258.9	-9 073.1
Italy	-5 293.1	-20 409.9	-25 703.1
Netherlands	-2 879.0	-41 793.4	-44 672.4
Portugal	361.8	-1 503.9	-1 142.0
Rep. of Korea	-197.2	-2 595.5	-2 792.7
South Africa	-654.3	-3 961.7	-4 616.0
Spain	459.3	871.8	1 331.1
Switzerland	2 987.6	4 276.2	7 263.9
United Kingdom	290.0	70.4	360.4
United States	51 201.7	15 600.6	66 802.2
Total	32 524.7	-71 957.2	-39 432.5

Source: Author's computation using UN Comtrade data.

5.5 Côte d'Ivoire: Cocoa export misinvoicing

Cocoa exports by Côte d'Ivoire exhibit heavy geographical concentration, with the top two partners accounting for nearly 50 per cent of the country's total exports: the Netherlands with 31.3 per cent and the United States with 18.3 per cent.

The trade misinvoicing estimations (table 8 and figure 6) show systematic cocoa export underinvoicing, occurring in trade with 10 partners over the period 1995–2014. However, the aggregate results are heavily influenced by Germany and the Netherlands. Trade with the Netherlands generates a cumulative amount of \$4.9 billion in export overinvoicing, or \$248 million per year. Spain is the only other trading partner in the sample with export overinvoicing, though the value is relatively small (an annual average of \$2 million). If the Netherlands were excluded, the results would show overall export underinvoicing for the sample in every year, and the cumulative amount of export underinvoicing for the sample over the period 1995–2014 would more than double, amounting to \$8.7 billion.

The results indicate that 29 per cent of cocoa exports from Côte d'Ivoire to the Netherlands do not show up in the Netherlands' books. It would be worth investigating trade records in Côte d'Ivoire to identify whether it is a problem of recording of destination of exports or pure smuggling. It is possible that exports may be recorded as destined to an importer in the Netherlands who in fact does not reside there, in which case the shipment would not be registered in the Netherlands' trade statistics.

Trade with Germany generates substantial export underinvoicing with the largest cumulative amount of \$4.5 billion or \$182.5 million per year. The amount of export underinvoicing is higher than the amount of exports to Germany, as recorded in Côte d'Ivoire's data (\$3.6 billion). In Germany's books, imports of cocoa from Côte d'Ivoire totalled \$8.6 billion over the 20-year period. Trade with France also exhibits a relatively large amount of cocoa export underinvoicing. The cumulative amount of \$1.4 billion represents 28 per cent of Côte d'Ivoire's exports of cocoa to France over the period.

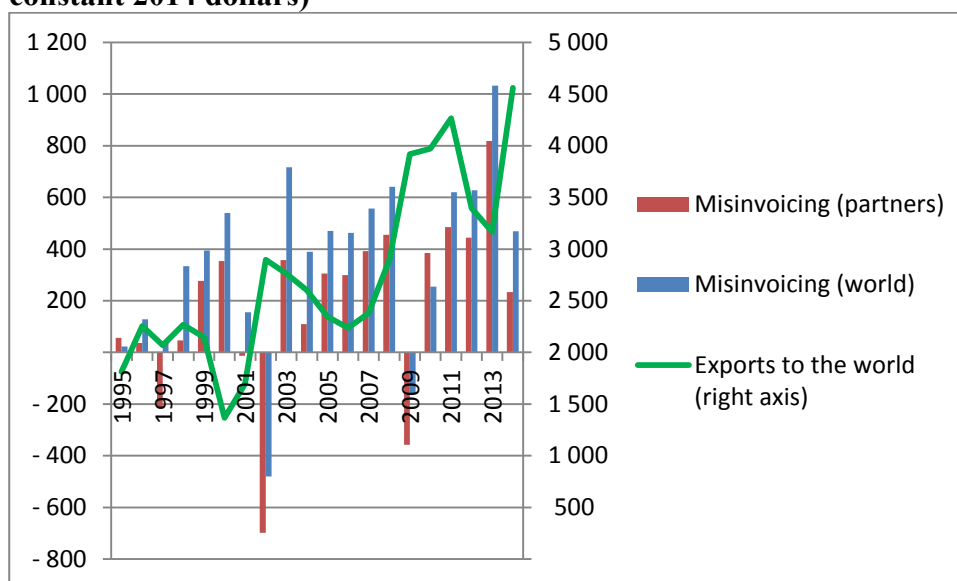
The United States is the second largest importer of cocoa from Côte d'Ivoire, but, contrary to the Netherlands, the results show relatively little evidence of export misinvoicing. Over the 20-year period, cocoa trade between the United States and Côte d'Ivoire generated \$492 million of export underinvoicing, representing 4.8 per cent of total cocoa exports to the United States.

Table 8: Côte d'Ivoire: Cocoa exports and export misinvoicing (Millions of constant 2014 dollars) and Partners' share in Côte d'Ivoire's total exports (Per cent), 1995-2014

Partner	Cocoa exports	Cocoa export misinvoicing	Share in exports (Per cent)
Belgium	2 313.8	290.3	4.2
Canada	705.8	1 249	1.3
China	220.4	56	0.4
France	5 123.2	1 451.4	9.3
Germany	3 643.5	4 563.2	6.6
Italy	1 712.7	237.2	3.1
Malaysia	1 053.4	12.5	1.9
Netherlands	17 198.9	-4 971.9	31.3
Spain	1 608.3	-42.6	2.9
Switzerland	17.3	234.8	0.0
United States	10 088.5	492.3	18.3
United Kingdom	1 637.2	198.1	3.0
Total	45 323.1	3 770.4	82.4

Source: Author's computation using UN Comtrade data.

Figure 6: Côte d'Ivoire : Cocoa exports and export misinvoicing, 1995–2014 (Millions of constant 2014 dollars)



Source: Author's computation using UN Comtrade data.

5.6 South Africa: Silver and platinum export misinvoicing

The results for South Africa vary substantially by commodity. The estimation of trade misinvoicing for the silver and platinum group are reported in table 9 and figure 7. Silver exports have increased substantially since 2005 (figure 7). The average annual exports of silver and platinum were three times higher over the period 2006–2014 than during the period 2000–2005: \$9.2 billion compared with \$3.4 billion using South African data; and \$11.5 billion compared with \$5.7 billion using partner data.

The data show systematic export underinvoicing throughout the period. However, the amounts of misinvoicing are relatively small, representing generally less than 10 per cent of total exports. Two years stand out as peculiar exceptions: in 2000 and 2002, underinvoicing of silver and platinum exports to South Africa's top nine trading partners amounted to 97 per cent and 98 per cent of total exports respectively. Another year that recorded substantial export underinvoicing was 2014, at 17 per cent of total exports. Except for these three years, export misinvoicing was low compared with total exports. Nonetheless, the cumulative amount of \$19 billion in export underinvoicing is significant. Thus, efforts should be made to reduce trade misinvoicing in the silver and platinum sector.

Analysis at the trading partner level reveals a heavy concentration of exports. Using partner data, Japan and the United States account for 54.2 per cent of South Africa's total silver and platinum exports; adding China (11.5 per cent) yields 65.7 per cent of those exports.

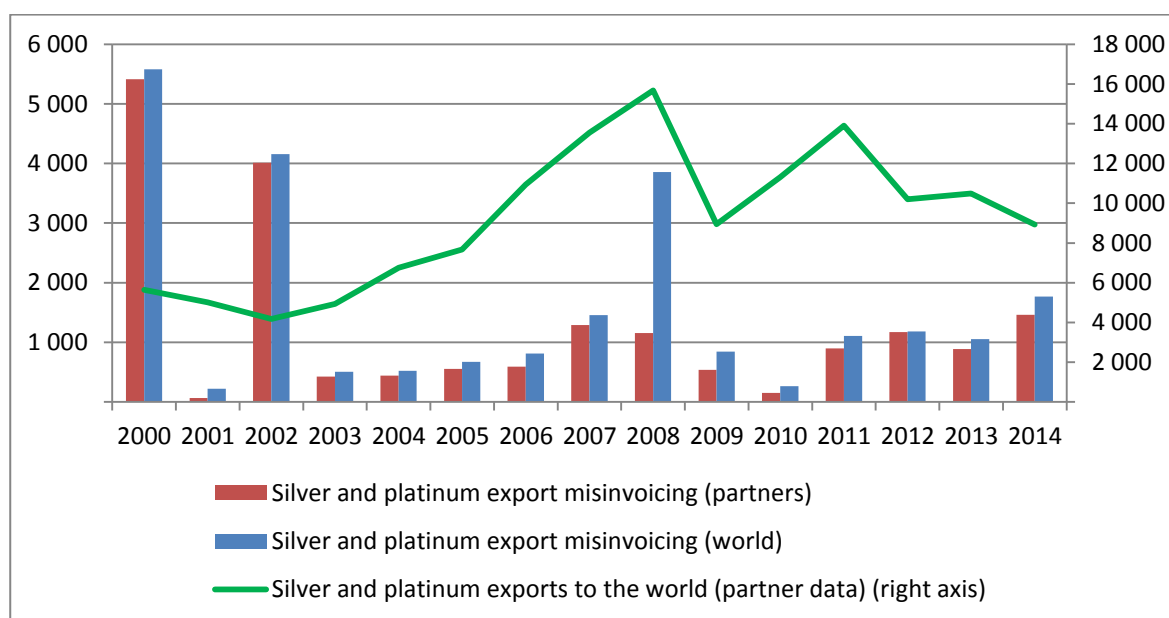
Trade with these three dominant trading partners also accounts for the lion's share of silver and platinum export misinvoicing. Trade with China generates particularly high export underinvoicing, amounting to \$13.9 billion, and with the United States, it amounts to \$6.8 billion. There is also evidence of overinvoicing in exports to Hong Kong, (SAR China) (\$1.8 billion), to Switzerland (\$6.3 billion) and to the United Kingdom (\$4.8 billion). With respect to its nine major trading partners, South Africa saw a cumulative amount of export underinvoicing of \$19 billion over the 15-year period starting in 2000. This represents 97 per cent of total export misinvoicing vis-à-vis the world (\$24 billion), and 13.8 per cent of the country's cumulative exports of silver and platinum to the world over the same period.

Table 9: South Africa: Silver and platinum exports and export misinvoicing (Millions of constant 2014 dollars) and partners' share in South Africa's total exports (Per cent), 2000-2014

Economy	Silver and platinum exports and export misinvoicing			Partner's share in South Africa's total silver and platinum exports	
	Exports (South African data)	Exports (Partner's data)	Export misinvoicing	Exports (South African data)	Exports (Partner's data)
China	1 889.3	15 934.1	13 855.8	1.8	11.5
Germany	8 080.9	10 745.1	1 855.9	7.8	7.8
Hong Kong (China)	3 677.3	2 265.4	-1 779.6	3.5	1.6
Italy	536.8	3 642.9	3 052.5	0.5	2.6
Japan	35 118.8	41 949.6	3 318.9	33.9	30.4
Rep. of Korea	1 774.6	5 061.9	3 109.9	1.7	3.7
Switzerland	15 742.4	10 994.2	-6 322.5	15.2	8.0
United Kingdom	12 399.3	8 778.3	-4 860.9	12.0	6.4
United States	23 705.5	32 914.5	6 838.4	22.9	23.8
Partners	10 2925	132 286.1	19 068.5	99.2	95.8
World	103 738	138 122.2	24010.4	100	100

Source: Author's computation using UN Comtrade data.

Figure 7: South Africa: Silver and platinum exports and export misinvoicing ((Millions of constant 2014 dollars), 2000–2014



Source: Author's computation using UN Comtrade data.

5.7 South Africa: Iron ore export misinvoicing

Iron ore exports from South Africa exhibit the most extreme geographical concentration among the countries and products investigated in this study. China accounts for 61.7 per cent of total iron ore exports, followed by Japan with 13 per cent (table 10).

South Africa's iron ore exports, which rose steadily and rapidly until 2010, were accompanied by an equally rapid increase in export underinvoicing (table 10 and figure 8). But there was a drastic change in the pattern after 2010, from systematic export underinvoicing to systematic export overinvoicing. With respect to South Africa's seven leading export destinations, there was a cumulative amount of export underinvoicing of \$5.6 billion over the period 2000–2010, or \$512 million per annum. In contrast, over the period 2011–2014, the country recorded \$1.3 billion in iron ore export overinvoicing or \$338 million per annum. This pattern was driven primarily by trade with the Netherlands and Japan which exhibited substantial export overinvoicing during the period 2011–2014. If these two countries are excluded, export overinvoicing was recorded only in 2010, to the tune of \$68.8 million.

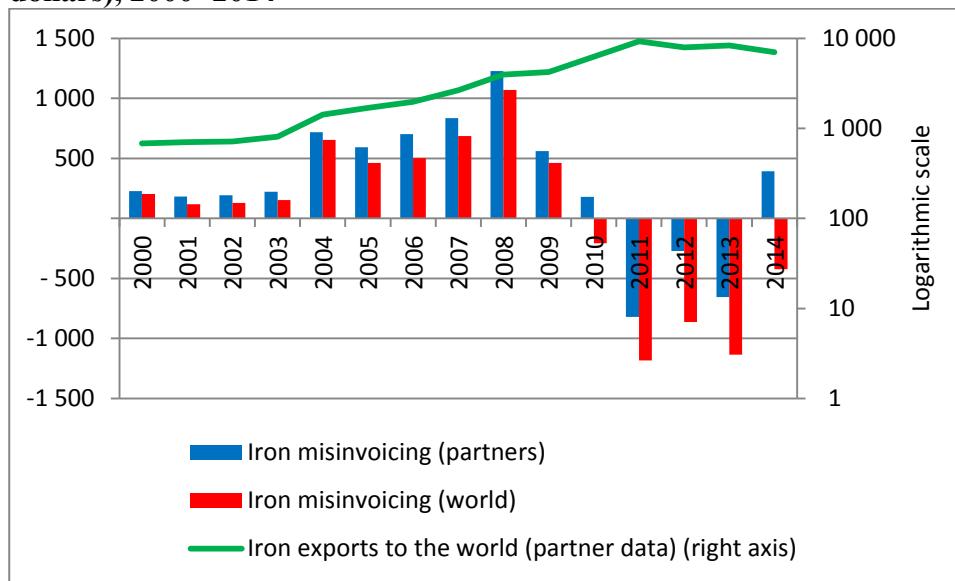
Except for the Netherlands, in trade with all the other major trading partners, there was net export underinvoicing. Along with the Netherlands, the top two trading partners, China and Japan, accounted for the bulk of export misinvoicing: export underinvoicing for China (\$3 billion) and Japan (\$1 billion), and export overinvoicing for the Netherlands (\$1.4 billion).

Once again, trade with the Netherlands is distinct from the other trading partners as it exhibits substantial export overinvoicing. The results indicate that a large proportion of iron ore exports from South Africa to the Netherlands, as reported by South Africa, does not appear in the Netherlands' data, and does not appear to have ever docked in the Netherlands. Further investigation of these large discrepancies with these leading trading partners may yield valuable insights into the causes and mechanisms of trade misinvoicing in the iron ore subsector.

Table 10: South Africa: Iron ore exports and export misinvoicing (Millions of constant 2014 dollars) and Partners' share in South Africa's total exports (Per cent), 2000-2014

	Iron ore exports (by volume) and misinvoicing			Partner's share in SA's total iron ore exports	
	Exports (SA data)	Exports (Partner data)	Export misinvoicing	Exports (SA data)	Exports (Partner data)
China	31 922.0	38 146.0	3 031.9	61.7	66.3
Germany	2 645.5	3 197.1	287.0	5.1	5.6
Italy	1 015.6	1 171.4	54.2	2.0	2.0
Japan	6 712.3	8 402.1	1 018.6	13.0	14.6
Netherlands	1 658.8	452.2	-1 372.5	3.2	0.8
Rep. of Korea	1 900.0	3 049.7	959.7	3.7	5.3
United Kingdom	1 496.5	1 948.0	301.8	2.9	3.4
Partners	47 350.7	56 366.5	4 280.7	91.5	98.0
World	51 733	57 527.1	620.8	100	100

Figure 8: South Africa: Iron ore exports and export misinvoicing (Millions of constant 2014 dollars), 2000–2014



Source: Author's computation using UN Comtrade data.

5.8 South Africa: Gold export misinvoicing

Like iron ore and silver and platinum, gold exports from South Africa also exhibit substantial geographical concentration. Its four top trading partners, together, account for 77 per cent of the country's total gold exports. According to data recorded by South Africa's trading partners, India is the leading destination, accounting for 35 per cent of total gold exports, followed by Hong Kong (China) (17.6 per cent), Italy (13.4 per cent) and the United Kingdom (12.1 per cent). The most striking feature of the gold sector in South Africa is the huge discrepancy between the amounts recorded in that country's official trade statistics and those reported in its trading partners' records. According to South Africa's data, the country's cumulative gold exports were \$34.5 billion from 2000 to 2014, whereas according to partner data for that period they were more than three times higher, at \$116.2 billion. This is indicative of massive export underinvoicing as illustrated in figure 9, which shows that the volume of exports (using partner data) and export underinvoicing are virtually identical. Total misinvoicing of gold exports to South Africa's leading trading partners totalled \$113.6 billion over the 15-year period.

The case of gold exports from South Africa is peculiar in that there is a perfect correlation between gold export underinvoicing and the volume of exports as reported by the country's trading partners (table 11). Gold traded with the leading partners also exhibits the highest amount of underinvoicing: India (\$40 billion), Germany (\$18.4 billion), Italy (\$15.5 billion) and the United Kingdom (\$13.7 billion). The magnitude of gold export misinvoicing raises the question of whether it reflects systematic underreporting of gold exports by destination or pure smuggling.¹⁰ This peculiarity of the reporting of country-by-country gold exports calls for further investigation.

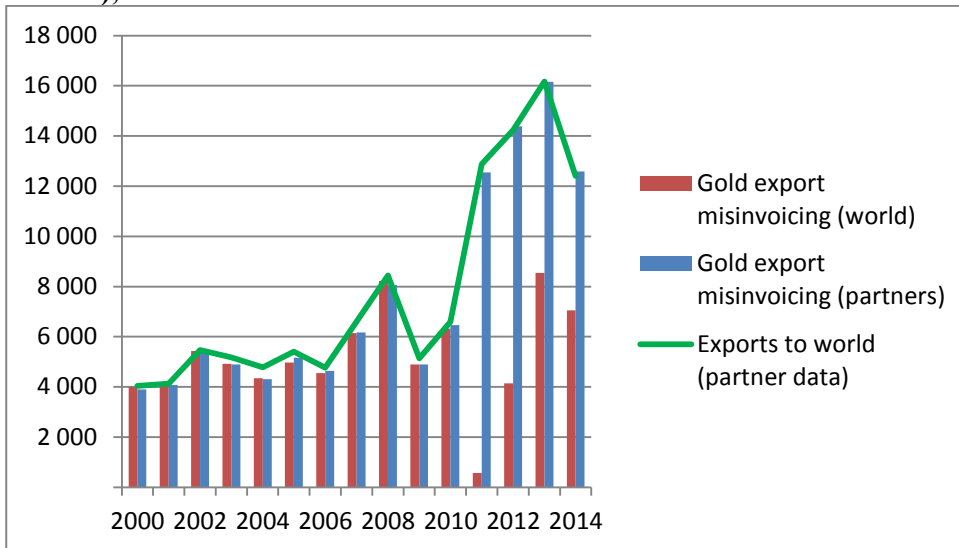
Another peculiar phenomenon is the sharp drop in the share of the 14 partners in total gold exports, according to South African data since 2011: from 99.8 per cent in 2010 to 2.5 per cent in 2011. This was due to a sharp drop in the share of Hong Kong (China) in South Africa's gold exports, as reported by South Africa, from 90 per cent in 2010 to 2 per cent in 2011. In contrast, the share of

¹⁰ As discussed in Section 4, pure smuggling refers to cases where imported or exported goods are not recorded at all at entry into or exit out of the country

Hong Kong (China) in the total partners' gold imports from South Africa rose from 4.6 per cent in 2010 to 22.3 per cent in 2011 (figure 10).

In summary, gold export underinvoicing is pervasive both over time and across trading partners. Unlike other commodities, there is no export overinvoicing vis-à-vis any of South Africa's trading partners (table 11). The gold sector deserves close scrutiny to identify the factors that may explain systematic export underinvoicing.

Figure 9: South Africa: Gold exports and export misinvoicing (Millions of constant 2014 dollars), 2000–2014



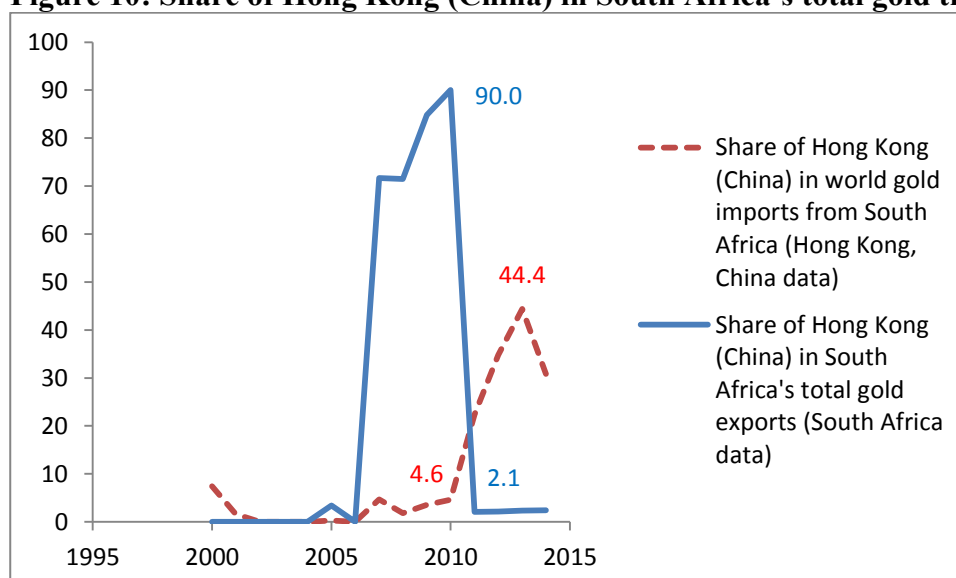
Source: Author's computation using UN Comtrade data.

Table 11: South Africa: Gold exports and export misinvoicing (Millions of constant 2014 dollars) and partners' share in South Africa's total exports (Per cent), 2000-2014

Gold exports (by volume) and export misinvoicing (Millions of constant 2014 dollars)				Shares of partner's (per cent)		
Country	Exports (SA data)	Exports (Partner data)	Export misinvoicing	Exports (SA data)	Exports (Partner data)	Mis-invoicing
Australia	0.0	102.9	102.8	0.0	0.1	0.1
Belgium	36.3	109.9	70.0	0.1	0.1	0.1
Germany	606.8	1 244.3	576.9	1.8	1.1	0.7
Hong Kong (China)	1 579.0	20 150.0	18 413.2	4.6	17.3	23.5
India	202.3	40 248.9	40 026.4	0.6	34.6	51.2
Italy	17.5	15 541.8	15 522.5	0.1	13.4	19.8
Saudi Arabia	0.0	1 466.9	1 466.9	0.0	1.3	1.9
Switzerland	386.0	2 949.5	2 524.9	1.1	2.5	3.2
Thailand	0.0	4 748.5	4 748.5	0.0	4.1	6.1
Turkey	42.9	10 033.7	9 986.5	0.1	8.6	12.8
United States	8.4	584.3	575.1	0.0	0.5	0.7
United Arab Emirates	37.5	2 930.2	2 889.0	0.1	2.5	3.7
United Kingdom	251.3	14 019.5	13 743.1	0.7	12.1	17.6
Zimbabwe	0.0	2 991.4	2 991.3	0.0	2.6	3.8
Partners	3 167.9	117 121.7	113 637.0	9.2	100.8	145.2
World	34 507.5	116 197.7	78 239.5	100	100	100

Source: Author's computation using UN Comtrade data.

Figure 10: Share of Hong Kong (China) in South Africa's total gold trade (Per cent)



Source: Author's computation using UN Comtrade data.

6. Conclusion and policy recommendations

The objective of this study was to investigate and quantify the extent of trade misinvoicing in primary commodities in a sample of resource-rich developing countries. The novelty of the study arises from the representativeness of the commodities investigated and the heterogeneity of the countries covered in the sample, which exhibit important similarities as well as substantial differences.

The analysis of the data confirms the widely known dominance of primary commodities in these countries' exports. But it also highlights another important dimension of concentration, namely that a few trading partners account for a large share of total primary commodity exports of each of the sample countries studied. The results show substantial export misinvoicing – both underinvoicing and overinvoicing – in all the five countries, with a clear preponderance of export underinvoicing, except for copper exports from Chile. It is therefore clear that export misinvoicing could be an important channel of capital flight from these countries. In the case of Nigeria, the results show misinvoicing of both oil exports and imports. With oil exports both overinvoicing and underinvoicing occur, but export underinvoicing dominates, suggesting net capital flight. In the case of oil imports, there appears to be systematic smuggling of oil into the country.

A number of key results emerge at the product level. The first is the puzzling case of gold exports from South Africa, where the country's official statistics report very little gold exports while substantial amounts appear in its leading trading partners' records. This does not appear to be a simple matter of undervaluation of the quantities of gold exported, but rather a case of pure smuggling of gold out of the country. Second, similar products show different misinvoicing patterns across exporting countries, even with the same partners. In Chile, there is systematic and massive export overinvoicing of copper, while the results for Zambia show both underinvoicing and overinvoicing of copper exports. It would be worth investigating the sources of these differences, in particular, whether these disparities arise from differences in trade regulation regimes, tax regimes or capital control regimes between the two countries.

Puzzling results also emerge at the trading partner level. Trade with the Netherlands presents a peculiar case, with systematic and substantial export overinvoicing. It appears that primary commodities exported to the Netherlands never dock in the Netherlands. This is also the case for copper exports from Chile and Zambia to Switzerland. The question is whether this is the outcome of smuggling or incorrect reporting of the residence of the buyers. Answering this question may require an investigation at the company level.

The results show that, typically, the leading partners in terms of share in the sample country's total exports also account for the bulk of trade misinvoicing in all the countries and products examined. There is a close correlation between concentration of trade and concentration of trade misinvoicing suggesting that trade misinvoicing is a systemic problem in these countries.

The results of this study provide strong reasons for investigating the motives of trade misinvoicing in primary commodities. Tax evasion is a possible motive for the large degree of export overinvoicing observed in most countries in the sample (except Chile). It is also possible that in some cases of export overinvoicing (as in trade with the Netherlands and Switzerland), products may end up in other destinations than the ones listed in official records as a result of transit trade. Export overinvoicing could also be motivated by the attempt of exporters to take advantage of tax incentives aimed at promoting export-oriented activities. Tax evasion could be a motive for the observed substantial import smuggling, as in the case of oil in Nigeria, where oil seems to be

entering the country illicitly. These conjectures need to be further investigated at country and product levels.

Foreign exchange and capital account controls could also be a motive for trade misinvoicing. However, the increasing volume of trade misinvoicing in recent years is puzzling, given the steady move towards capital account openness and liberalization of currency markets in all the countries in the sample, as in most developing countries. The question remains whether these reforms have been effectively implemented and enforced to reduce the incentives for smuggling of foreign currency.

The persistence of trade misinvoicing implies that there are important structural and institutional factors that drive this practice. It cannot simply be that illegal trade persists under the cover of legal trade; in some cases, trade misinvoicing constitutes too large a share of total trade to be disguised by legal trade. This may be the case of gold exports from South Africa. The question is whether or not illegal gold trade is taking place disguised behind legal trade of other products. Answering this question would require investigating whether gold exporters are also involved in exports of other major products so that gold smuggling takes place under the cover of legal trade in other products.

The results from this study have important implications for research and policy. First, the fact that exports of primary commodities are concentrated by product and market could be a blessing in disguise. Export concentration implies that policy efforts could be focused on a limited number of products and partners to increase the effectiveness of reforms. In each country, the government and its development partners should be able to identify which products and export destinations need to be scrutinized when investigating trade misinvoicing.

Second, the analysis in this study demonstrates a substantial need for improving trade statistics. In particular, improvements are urgently needed in data gathering at the product and partner levels, and there should be coordination between national statistics and international statistical databases such as UN Comtrade and the IMF's DOTS. This will require scaling up both financial and technical assistance to developing countries to help improve human capacity as well as the infrastructure for the compilation and management of trade statistics.

Third, the results from this study highlight the need for an investigation into the role of TNCs involved in the exploitation, export and import of commodities, as well as the role of secrecy jurisdictions in facilitating trade misinvoicing. Such an investigation may shed light on the mechanisms of export overinvoicing and import underinvoicing. Enhanced transparency in global trade is indispensable, especially through coordinated enforcement of the rules on country-by-country reporting by TNCs at the global level.

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Table A1: Cumulative export misinvoicing by exporter and trading partner (millions of constant 2014 dollars)

Country	Chile:(copper [682])	Cote d'Ivoire: cocoa	Nigeria: oil	South Africa: iron ore	South Africa: silver and platinum	South Africa: gold	Zambia: copper [682]	Comments: systematic pattern (if any)
Belgium	-3 151.3	290.3				70.0		
Canada	-1 000.5	1 249.0	-4 719.9					
China	-791.0	56.0		3 031.9	13 855.8		5 644.5	Underinvoicing except with copper from Chile
France	147.7	1 451.4	-12 714.6					
Germany	9 403.8	4 563.2	23 909.7	287.0	1 856.0	576.9		Underinvoicing
Hong Kong (China)					-1 779.6	18 413.2		
Italy	-2 272.2	237.2	-25 122.4	54.2	3 052.5	15 522.5		
Japan	-5 935.7			1 018.6	3 318.9		168.7	Underinvoicing except with copper from Chile
Rep. of Korea	-2 098.6		-2 643.6	959.7	3 109.9		3 923.5	
Netherlands	-16 085.4	-4 971.9	-20 533.0	-1 372.5				Overinvoicing
Switzerland	-874.7	234.8	6 907.1		-6 322.5	2 524.9	-31 765.4	
United Kingdom	-5 502.3	198.1	3 382.7	301.8	-4 860.9	13 743.1	-4 360.4	
United States	-6 992.1	492.3	69 755.0		6 838.4	575.1		Underinvoicing except with copper from Chile
Comments: systematic pattern (if any)	Overinvoicing except with France and Germany	Underinvoicing, except with the Netherlands		Underinvoicing		Underinvoicing		

Source: Author's computation (drawn from Tables 3-11)