Curbing Illicit Financial Flows from Resource-rich Developing Countries: Improving Natural Resource Governance to Finance the SDGs

Commodity Trade-related Illicit Financial Flows: Evidence of Abnormal Pricing in Commodity Exports from Ghana

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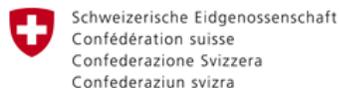**Ama A. Ahene-Codjoe**
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Commodity Trade-related Illicit Financial Flows: Evidence of Abnormal Pricing in Commodity Exports from Ghana

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Abstract

Cross-border illicit financial flows (IFFs) via misinvoicing of international trade has emerged as a prominent challenge for resource-rich developing countries aiming to increase domestic resource mobilisation to finance their Sustainable Development Goals. However, there is a lack of robust evidence and empirical methodologies to analyse the magnitude of trade misinvoicing from developing countries. In this paper, we identify IFF risks in the Ghanaian gold and cocoa sectors before using transaction-level data on commodity exports to provide novel evidence of abnormal pricing, defined as the magnitude of trade valued outside an estimated arm's length price range. We find that the undervalued exports for gold equalled 10% of its total export value between 2011-17. Similarly, we estimate that 1% of total cocoa beans and 7.2% of cocoa paste exported within the same period were undervalued. These findings corroborate our analysis of IFF risks in each industry as well as limited existing evidence of IFFs via commodity trading from Ghana.

JEL classification: F18 – Trade and Environment, O13 – Agriculture, Natural Resources; Energy; Environment; other Primary Products, Q17 – Agriculture in International Trade, Q01 – Sustainable Development

1. INTRODUCTION

Illicit Financial Flows (IFFs) are broadly defined as cross-border financial flows that are illegally earned, transferred or utilised. Alongside aggressive profit shifting by multinational firms and illegal smuggling, trade misinvoicing is a prominent channel for IFFs and defined as customs and/or tax fraud involving exporters and importers deliberately mis-reporting the value, quantity, or nature of goods or services in a commercial transaction. The economic motives for trade-related IFFs include tax-motivated profit shifting, off-shoring of financial assets and evasion of customs duties or trade restrictions on particular products or countries (Beer et al, 2018; Carbonnier and Mehrotra, 2018; Crivelli et al, 2015). Resource-rich developing countries are dependent on tax revenues from natural resource sector to finance their national budgets but tend to have low tax to GDP ratios, with IFFs suspected to be one of the leading factors (Guo, 2013; Mascagani et al., 2014; OECD 2017). Ghana has significant endowments of multiple natural resources and is the leading African producer of gold and the world's second largest producer of cocoa beans (Njini, 2019; Peprah, 2019). However, its tax revenue collections remain low as the ratio of tax revenue to gross domestic product (including natural resources and oil sector revenue) equaled only 14.1% (OECD, 2018).[1] IFFs via trade misinvoicing and abusive transfer pricing by multinational firms are argued to be major contributing factors in driving tax base erosion. Using limited methods based on mirror trade statistics, the Report of the High-Level Panel on Illicit Financial Flows from Africa estimated that African countries lose approximately USD 50 billion annually through trade misinvoicing (United Nations Economic Commission for Africa, 2015). However, these estimates and underlying methods have significant limitations and in the absence of robust evidence, the magnitude and appropriate regulatory responses to trade-based IFFs remain under-analysed.

Using Ghana's most economically significant export commodities, gold and cocoa, this paper estimates the magnitude of abnormal pricing in their exports using price filter methods. Abnormal pricing is a strong indicator for trade misinvoicing and is defined as magnitude of trade valued outside an assumed arm's length price range which represents fair market value between unrelated buyers and sellers (Hong & Pak, 2017; WCO, 2018). Price filter analysis makes use of declared customs export transactions to obtain the requisite detailed information for estimating abnormally priced transactions. Exports, for example, are described as undervalued when trade values fall below a lower-set boundary, and

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[1] This corresponds with the experience of other developing countries such as Cote D'Ivoire and Gabon where tax to GDP ratios remain at low levels, between 10% and 20%, compared to above 30% for OECD economies (Mascagni et al., 2014).

overvalued when values are above an upper-set boundary. Under-valued exports are interpreted as evidence of illicit outflow of financial capital from the exporting country. On the other hand, over-valued exports are interpreted as evidence of illicit financial inflows whereby financial capital enters the exporting country through the trade channel (Hong & Pak, 2017).

Our baseline analysis of gold and cocoa bean exports from Ghana is based on arm's length price filter analysis whereby transaction-level prices are compared to global benchmark prices from commodities exchanges or trading associations. The empirical methodology is motivated by the Comparable Uncontrolled Price (CUP) method for establishing the arm's length price range for commodities using commodities exchange prices, as per global transfer pricing guidelines (Platform for Collaboration on Tax, 2017; United Nations, 2017).[2] The CUP method allows the use of quoted market prices as a starting point for identifying arm's length prices, subject to reasonable comparability adjustments, after having accurately delineated each transaction based on a fact-intensive transactional and functional analysis on a case-by-case basis.[3] However, for our statistical analysis of the universe of all international export transactions, we adopt standardised assumptions regarding product heterogeneity, market conditions and transportation costs based on detailed interviews with commodity experts and regulators in Ghana.. For instance, in the case of unwrought gold doré exports, we supplement the Customs microdata with mine-level production information on the purity of their gold-silver doré output, estimated transportation costs and some limited variation in contract prices between different market participants. Similarly, we account for the fact that Ghanaian cocoa beans are predominantly traded abroad using futures contracts in the London commodity exchange, in addition to information on estimated transportation costs.

Next, in the case of cocoa paste exports from Ghana which are traded without any reference to a commonly accepted benchmark price, we use endogenously calculated interquartile range (IQR) price filter methods. This method is motivated by the United States' Internal Revenue Service (IRS) transfer

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[2] The use of prices from commodities exchanges for transfer pricing analysis is also referred to as the 'sixth method' in some countries, which is distinct from comparable uncontrolled prices (CUP) method which relies on data from comparable transactions between related and unrelated parties. See Section 2.4.2, United Nations (2017) for a detailed discussion of the 'sixth method.'

[3] The case by case transactional and functional analysis may include the specific contractual terms of the individual transaction; the functions performed by each of the parties to the transaction, their account assets used, and risks assumed; the individual characteristics of the transacted good; the specific market conditions in which the parties operate, including their relative competitive position; the business strategies pursued by the parties, etc. For the list of criteria used to delineate the economically relevant characteristics for transfer pricing analysis, see: Chapter 1-D1, OECD (2017).

pricing regulation (Internal Revenue Code 482) which specifies that an interquartile range is an acceptable arm's length transaction range (Hong et al., 2014). The OECD Transfer Pricing Guidelines also mention that the interquartile range or other percentiles can be used to help enhance the reliability of any transfer pricing analysis (paragraph 3.57, OECD, 2017). Since there is no product-specific economic rationale for the selection of the arm's length price range, this approximate method is the best approximation in the absence of more reliable information. For our analysis, we calculate the interquartile range of unit prices (USD per kilogram) by product using a rolling window of the preceding 365 days. This price range accordingly updates on the daily basis and takes into account the pricing dynamics over the previous year. All transactions valued in the top and bottom quartile of this distribution are designated to be abnormally valued.

Our main findings are as follows. First, our analysis of the trading value chains indicates that the centralized and regulated cocoa beans sector suffers from fewer IFF risks, relative to the more decentralized trade in cocoa paste and unwrought gold production. The main risks are driven by: 1) transfer pricing risks due to the nature of ownership of the firms operating in the sector; 2) the presence of artisanal, small-scale and informal firms in the sector; 3) regulatory infrastructure for verifying export valuation; 4) transit trade from neighbouring countries; and 5) lack of appropriate expertise and potential corruption.

Next, using the London Bullion Market Association (LBMA) daily price series for gold, we find that Ghanaian exports are undervalued by approximately 10% of the total value of gold exported (USD 35.6 billion). The undervalued amount thus constitutes USD 3.5 billion below the contemporaneous London market prices adjusted for purity of Ghanaian gold production. [4]

Similarly, using an arm's length range of 20% below the London International Financial Futures and Options Exchange (LIFFE) prices we estimate that cocoa beans exports are undervalued by USD 126.6 million[5] which represents 1% of the total export value of USD 12.6 billion. Finally, using the interquartile range price filter, we estimate that 7.2% of the total export of cocoa paste (USD 1.8

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[4] The percentages of gold in the gold – silver split of available companies in the GRA dataset are 95%, 91%, 82%, 77% and 64% (Metals Focus Ltd, 2019).

[5] Ghana's cocoa is mainly sold on the futures market. These sales are used as collateral for the syndicated loan the state takes to finance the purchases of cocoa beans from farmers through the Licensed Buying Companies (Personal communication, Cocoa Marketing Company).

billion) was undervalued, i.e. found below the 25th percentile of the per unit price distribution of the product. Despite the approximate nature of this methodology, the relatively high undervaluation of cocoa paste exports represents a significant risk for illicit outflows via transfer mispricing due to the presence of many multinational companies (MNCs) operating in this sector. As a result, we argue for more oversight and detailed audit by relevant regulators of exporters whose transactions appear to be abnormally valued.

This paper makes some significant contributions to our common knowledge of trade-based IFFs and research methodologies. Firstly, we contribute a novel, data-intensive and interdisciplinary approach for establishing the arm's length price range for traded commodities. Of the few previous studies which have used price filter analyses, an arbitrary definition is used to set arm's length price range. Notable studies in the research area include Hong et al., (2014) who used the market price filter approach to assess abnormal pricing for the US banana trade with Latin American and Caribbean countries. Another is a study by Pak (2014) that analyses cocoa beans and gold exports over the period 2010 – 2014 in Ghana. For gold, the total amount exported (FOB) was USD 3,832 million with an undervalued amount of USD 310 million and an overvalued amount of USD 21 million. These were arrived at by benchmarking reported transaction prices of gold exports from Ghana against the commodity market prices of gold in London (Bundesbank) with arm's length set at 10%. For cocoa beans, the paper focused on transactions documented in April 2011 to Amsterdam. Again, setting a 10% boundary above and below an IMF Primary Commodity Price in the same month and year, it was estimated that about 11.4 million USD of cocoa beans was undervalued (Pak, 2014).

Second, we contribute new evidence based on administrative microdata to analyse the possible tax and revenue losses due to abnormal pricing which could be indicative of the magnitude of IFFs in a country of interest. In recent years, the policy focus on IFFs and tax base erosion has increased across all developing countries, especially in Ghana. With the incumbent government's aim of steering Ghana out of an aid-dependency era to one that is dependent on its internal resources, there is thus the need to examine the fiscal systems in place to prescribe appropriate policies to reduce IFFs in Ghana.[6] Indeed, it has been globally acknowledged that emphasis has to be laid on the need to build strong domestic fiscal and financial systems as well as improve on domestic revenue mobilisation for

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[6] This government is led by President Nana Akufo-Addo, who launched the "Ghana Beyond Aid" agenda.

financing the development agenda of African countries in a sustainable manner (African Economic Outlook, 2010). Low to middle income countries do not only have to face the challenges of IFFs, but also deal with officials who are usually not equipped with the requisite skills to collect all the needed taxes as well as multinational companies that use sophisticated tax measures to evade taxes or negotiate deals that allow them to pay lower tax rates (Readhead et al., 2018).

The rest of the paper is organised as follows. Section 2 provides an overview of the natural resource sector in Ghana by presenting the value chains and the risks for IFFs in the specified commodities. This is followed by a description of the empirical methodology the paper used (Section 3). Section 4 is devoted to the data sources while section 5 presents the estimates of abnormal pricing. Section 6 presents the conclusion and recommendations.

2. NATURAL RESOURCE SECTOR IN GHANA

This section provides a brief overview of the gold and cocoa value chains in Ghana and an overview of their IFF risks based on our analysis of the trading value chains of these sectors.

Table 1 outlines the risks for IFFs in the cocoa beans, cocoa paste and gold sectors of Ghana focusing on the following categories: 1) transfer pricing risks due to the nature of ownership of the firms operating in the sector; 2) the presence of artisanal, small-scale and informal firms in the sector; 3) regulatory infrastructure for verifying export valuation; 4) transit trade from neighbouring countries; and 5) lack of appropriate expertise and potential corruption. Overall, our analysis indicates that in the centralised cocoa beans sector, the risks for IFFs are fewer than in the decentralised sectors of cocoa paste and gold.

Table 1: Risks for IFFs in Natural Resource Sector in Ghana

Risk	Gold	Cocoa Beans	Cocoa Paste
Transfer pricing risks due to multinational firms' international trade operations	✓	✗	✓
Artisanal, small-scale and informal firms	✓	✗	✓
Regulatory infrastructure for verifying export valuation	✓	✗	✓
Transit trade from neighbouring countries	✓	✗	✗
Lack of appropriate expertise and potential corruption	✓	✓	✓

2.1.   Gold Sector and Risks for IFFs

Gold is the most important export commodity for Ghana, accounting for 49% of the country's total exports. In 2017, gold accounted for 96.4% of total earnings from mineral exports from Ghana (OEC, 2019; Minerals Commission, 2018). In 2018, Ghana became the largest gold producer in Africa, overtaking South Africa; Ghana produced 4.8 million ounces of gold which surpassed the 4.2 million ounces produced by South Africa (Whitehouse, 2019). Overall, the minerals and mining sector is the largest contributor to Ghana's GDP (Minerals Commission, 2017). Fiscal contribution of gold mining to public finances is observed via general taxes on profit and labour borne by all companies as well as specific taxes such as mining royalties, license fees, property rates payments, and export duties.

We conducted intensive primary and secondary research, including personal communications with prominent private and public-sector institutions and stakeholder workshops, to identify the risks for IFFs as well as develop and validate our empirical methodologies.[7] Based on this research, the main risks for IFFs from the gold sector in Ghana are summarised below: [8]

1. Transfer pricing risks due to multinational firms' international trade operations: Some of the largest mining companies in the Ghana gold sector are local affiliates of international firms with their headquarters based outside Ghana and several other international affiliates across different tax and legal jurisdictions (Oppong, 2013). This leads to significant economic incentives for transfer mispricing and tax optimisation using the channels of intra-firm trade and financial transfers.

2. Artisanal, small-scale and informal firms: As of 2018, there were over 300 artisanal and small-scale mining (ASM) firms registered in Ghana.[9] Apart from the ASMs, there are also quite a sizeable number of illegal miners (referred to as *galamsey*) in the industry. According to the Minerals and Mining Act of Ghana (Act 703), small scale mining is a prerogative of Ghanaian nationals. However, many mining sites are operated by foreigners. This has largely been made possible due to loopholes in the acquisition of licenses to operate on small-scale mining concession sites. Foreign companies have taken

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[7] The institutions involved include Ghana Revenue Authority (Customs and Large Tax Payers Divisions), Precious Metals Marketing Corporation, Ghana Minerals' Commission, and Ghana Chamber of Mines.
[8] These were observed through desktop research, personal communications with some institutions along the value chain as well as stakeholder workshops organised for feedback and validation of the initial estimates of IFFs in Ghana. The institutions contacted include GRA (Customs Division), PMMC, Minerals' Commission and Ghana Chamber of Mines.
[9] https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Full-list-of-332-legal-small-scale-miners-709571

advantage of this leeway and stretched their involvement beyond the provision of technological support to the complete operation of mining concessions (Hausermann and Ferring, 2018).

3. Regulatory infrastructure for verifying export valuation: During our study period 2011 – 17, there existed significant loopholes for exporters to bypass regulatory oversight of the purity of their gold exports. In Ghana, the process of extracting gold from its ore is such that mined amalgam gold is smelted to obtain doré bars that can be between 70 to 95% pure gold, mixed with silver, copper and other impurities like arsenic and lead.[10] The large-scale mining companies often do their own assaying before shipment whilst ASMs are required to send their gold to a state-owned enterprise, Precious Minerals Marketing Company (PMMC), for assaying before shipment. However, the coverage of these assaying infrastructure remained limited. In 2016, a new assaying regime was established which requires both Small and Large-Scale Mining Companies to assay all their produce at PMMC starting from February 2018.[11] Accordingly, a modern national assay laboratory was built, and personnel capacity upgraded (Personal communications, K. Opare-Hammond).

4. Transit trade from neighbouring countries: The government of Ghana permits gold produced in neighbouring countries to be brought into Ghana for assaying, documentation, and onward shipment as transit gold. There is a risk for potential capital flight since with untrained customs officials, or corrupt officials, gold from Ghana could be exported as another country's gold, denying Ghana of the requisite returns. The government of Ghana lost GHS2 billion in revenue in 2018 through non-observance of rules governing transit trade and the probable complicity and collusion of Customs officials (Sarpong, 2019). The Customs Division of the Ghana Revenue Authority introduced new measures to curb the loss of revenue through the transit trade (Sabutey, 2019).

5. **Lack of appropriate expertise and potential corruption:** Due to lack of appropriate expertise and potential corrupt practices, there is a risk of misreporting the correct source and purity value of gold exports from Ghana in order to reduce taxable incomes and move financial capital abroad. The Head of the Tax Policy Unit at the Ministry of Finance reported that the Ghana Revenue Authority (GRA) has lost an accumulated revenue of GHS4.5 billion over the past five years as a result of infractions by traders, importers and governmental agencies (Ocloo, 2018).

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[10] Source: Metal Focus Dore Flow Service, Metal Focus
[11] Pursuant to Regulation (3) of the Minerals and Mining General Regulation 2012 (LI 2173).

2.2. Cocoa Value Chain and Risks for IFFs

Cocoa is a commercially significant agricultural commodity for Ghana and contributes approximately a quarter of the country's overall export earnings. Ghana is the world's second largest producer of cocoa beans (Peprah, 2019). On average, cocoa contributed about 2.3% of Ghana's real GDP over the period 2010 – 2017 and about 9.9% of mean agricultural GDP over the same period. Cocoa is also by far the most important agricultural export commodity, contributing about 80.7% of average agricultural export earnings between 2014 and 2017 (ISSER, 2018). Additionally, it is a key source of foreign exchange earnings, employs about three million farmers, provides business for service providers via haulage, warehousing, insurance, etc., and contributes to formal education through scholarships to mainly wards of farmers and the needy in cocoa farming communities. Cocoa is a primary source of livelihood to many rural communities in the southern part of the country where it is largely grown.

Contrary to the liberalised gold production sector, the Government of Ghana (GoG) plays a major role in the partly liberalised cocoa sector. The Ghana Cocoa Board (COCOBOD) regulates the sector with keen interest due to the socioeconomic importance of the commodity. About 80% of the cocoa produced (mainly the bigger beans from the main crop for the year) is exported. Although the centralised nature of operations in the cocoa bean sector are meant to ensure that the state derives the maximum benefit from the crop, inefficiencies in operations may still cause the state to lose revenue.

The rest of the beans (smaller beans) are mainly sold to local cocoa processing companies to make cocoa products such as cocoa paste, liquor, powder, cocoa husks, and other cocoa waste for export. Chocolate and other confectionary items are also made for sale both locally and in the international markets. The cocoa paste sector is decentralised. The state owned Cocoa Processing Company processes cocoa paste into chocolate for sale; other firms, mainly multinationals, also operate in the sector. In addition, the structure of the cocoa industry in Ghana has some characteristics that seem to create opportunities for IFFs. The following are some of the identified risks in the industry:

1. **Transfer pricing risks due to multinational firms' international trade operations:** Transfer pricing is not a significant risk in Ghana's cocoa beans sector. This is because the export and sale of cocoa beans is managed solely by the Cocoa Marketing Company (CMC) of COCOBOD. However, it is a risk in the cocoa paste sector because many of the companies operating in Ghana's cocoa

processing sector are branches of international firms and as such may have some economic incentives for engaging in abusive transfer pricing or misinvoicing. Although the companies are within the Free Zone enclave and are exempted from paying taxes for ten years, this is sometimes abused by resident companies through mis-reporting of business activities. Sometimes, companies are even re-formed with new names and management to extend the exemptions enjoyed after the compulsory 10-year base period. The abuse is mainly possible due to lack of co-operation between agencies engaged in the regulation of the area. Regulators such as the Ghana Free Zones Authority (GFZA) and the Ghana Revenue Authority (GRA) among others do not co-operate enough to synchronise their duties to effectively regulate these companies. This presents an opportunity for the companies to take advantage of the loophole and to engage in IFFs.

2. Artisanal, small-scale and informal firms:
The cocoa bean sector is wholly managed by the state and as such there are no artisanal, small-scale or informal firms operating within the sector. However, there are artisanal, small-scale and informal firms operating in the cocoa paste sector which may create some risks for IFFs.

3. Regulatory infrastructure for verifying export valuation
In the case of cocoa beans, there exists regulatory infrastructure for examining and verifying the quality of beans to be exported through the Quality Control Division (QCD) of COCOBOD. Conversely, the same does not exist in the case of cocoa paste due to the decentralised nature of the sector which may create some risks for IFFs.

4. Transit trade from neighbouring countries
Transit trade from neighbouring countries has presented a risk before in the case of the sale of cocoa beans. There have been some cases of smuggling of cocoa beans between Cote D'Ivoire and Ghana based on the price differentials between the two countries. However, from 2018 the two countries decided to announce their prices together to eliminate the phenomenon (Bruce, 2018).

5. Lack of appropriate expertise and potential corruption: Inaccurate data capture as a result of ineffective supervision of officers and/or ill-equipped personnel lead to inaccuracies in the national statistics. These provide corrupt officials and exporters the prospects to mis-report export values.

3. EMPIRICAL METHODOLOGIES

This study applies price filter methods for the estimation of abnormal pricing in international trade from Ghana. The method has two approaches including, the free market price filter and interquartile range analyses.

3.1. Free Market Price Filter

The free market price filter methodology is motivated by a simplified application of the Comparable Uncontrolled Price (CUP) method for establishing the arm's length price range for commodities using commodities exchange prices, as per global transfer pricing guidelines (OECD, 2017; Platform for Collaboration on Tax, 2017; United Nations, 2017). This method relies on transaction level trade micro-data on product type, quantity and unit value based on the Harmonized Commodity Description and Coding System (HS code) used internationally for classifying internationally traded products (Hong et al., 2014). This framework compares actual transaction level unit prices (price per kilogram) for a particular commodity (HS code) with an arm's length price range defined using the contemporaneous free market price, plus or minus a reasonable filter to account for normal price volatility, commodity heterogeneity or purity, transportation costs and other relevant product-country level factors. Transactions which deviate significantly from this arm's length price range are determined to be abnormally valued.

More specifically, we test the following hypothesis:

> **Hypothesis:** *All normally valued transaction prices for a particular product fall within the arm's length price range defined using the corresponding free-market prices.*

The abnormally overvalued amount is estimated as the deviation from the upper bound of the range (P_{High}) and the abnormally undervalued amount as the deviation from the lower bound of the range (P_{Low}). Specifically, the mispriced amount for each transaction is calculated as follows:

$$\text{Undervalued amount} = \text{Quantity} \times \text{MAX} (0, P_{Low} - P)$$
$$\text{Overvalued amount} = \text{Quantity} \times \text{MAX} (0, P - P_{High})$$

where:

P = Declared price (unit value implied in the quantity and value in each declared export record)

P_{Low} = Lower bound of the free market price range

P_{High} = Upper bound of the free market price range

3.2. Interquartile Range Price Filter Analysis

The inter-quartile range filter assumes that values between the 25th and 75th percentile of the observed distribution of unit prices for a specific commodity denotes the arm's-length price range. Any transaction that falls above or below this price range is categorised as abnormally valued. Thus, the overvalued transactions are identified by the values declared above the upper-quartile price range whilst the undervalued are those declared below the lower quartile price range.

Traditionally, this method relies on the inter-quartile range being calculated for each calendar year. However, in a methodological innovation from previous studies, we implement a dynamic version of the previous method by updating our calculation of the inter-quartile range on a daily basis using the price distribution observed over the previous 365 days, i.e. a 365-day rolling-window estimate of the interquartile range. The main advantage is to make our definition of the arm's length price range more responsive to pricing dynamics observed over the course of the year. For example: in the case of agricultural commodities, the observed trade prices may be affected by planting seasons, climactic variation and market conditions which do not directly correspond to calendar years.

Essentially, we test the following hypothesis:

> **Hypothesis:** *The transaction price for a correctly valued product lies within the arm's length price range defined by the interquartile range of the observed price distribution over the past year.*

Accordingly, any transaction value which exceeds the 75th percentile or fall below the 25th percentile of the observed price distribution is designated to be abnormally priced. The under or over-valued amounts for each transaction is then calculated as follows:

$$\text{Undervalued amount} = \text{Quantity x MAX } (0, \text{LoQ - P})$$
$$\text{Overvalued amount} = \text{Quantity x MAX } (0, \text{P - UpQ})$$

where:

P = Declared price (unit value implied in quantity and value in each trade record)

LoQ = Lower-quartile price calculated using price distribution over previous 365 days

UpQ = Upper-quartile price calculated using price distribution over previous 365 days

It is relatively straightforward to observe that since the interquartile price range is endogenously estimated using the observed price distribution, this hypothesis will be rejected by design for a certain

proportion of transactions. Therefore, these estimates of trade mispricing should be interpreted carefully and supplemented with further discussion regarding product, price, and individual market characteristics. For example, contemporaneous political, economic or environmental shocks may play a key role in determining whether the observed transaction price falls within the interquartile price range during a given period.

4. DATA SOURCES

4.1. Gold and Cocoa Exports: 2011 – 2017

Ghana Revenue Authority (GRA), Customs Division, provided the transaction-level gold and cocoa export data for this study. The recorded transactions cover trading activities from 2011 – 2017. The data also contains the weight of each exported commodity, detailed description of the commodity type, and the receiving country of the exported commodity. The weight is described as net mass (kilogram), which is the weight of the commodity exported without packaging in the system unit of the HS classification.

Using a 10 – digit HS code, Ghana Customs recorded seven types of gold exported within the stipulated years. This study however examines a combination of two of these – gold bullion (7108.13.1000) and unwrought, non-monetary gold (7108.12.0000). These were chosen primarily because of their relatively high trade volumes and values. We also realised, upon careful examination of the gold data and following discussions with Ghana Customs, Ghana Minerals' Commission, Precious Minerals' Marketing Company, and the Ghana Chamber of Mines, that gold bullion, as described in Ghana Customs data, is any gold smelted into bars and does not necessarily correspond with the technical description of refined gold bullion which is between 99.5% to 99.9% pure gold. Therefore, our study combines gold bullion and unwrought gold data for our analysis of Ghanaian unwrought gold exports.

Similarly, Ghana Customs used a 10 – digit HS code to classify the nine types of cocoa exported within the study period. Two of these types – cocoa beans, superior quality raw beans (1801.00.1100), and cocoa paste, wholly or partly defatted (1803.20.0000) are examined in this study. Consequently, three of the export commodities from Ghana are examined for abnormal pricing. The summary statistics of these commodities are presented in Table 2.

Table 2: Summary Statistics of Selected Commodities for Abnormal Pricing Estimates

HS: 7108.13.1000 &7108.12.0000	Gold				
	Transaction number	Mean	Standard Dev.	Max.	Min.
Quantity (kg)	20,933	49.1	265.8	30,646.0	0.03
Transaction value (USD)	20,933	1,699,228	3,373,144	46,200,000	135.0
Price per Kg (USD)	20,933	40,522.8	8,622.8	60,690.0	6.3
HS: 1801.00.1100	Cocoa Beans (superior quality raw beans)				
	Transaction number	Mean	Standard Dev.	Max.	Min.
Quantity (kg)	13,210	323,435.2	508,272.7	23,100,000	646
Transaction value (USD)	13,210	954,661	1,415,084	19,100,000	2,485
Price per Kg (USD)	13,210	3.03	1.5	31.8	0.002
HS: 1803.20.0000	Cocoa Paste (wholly or partly defatted)				
	Transaction number	Mean	Standard Dev.	Max.	Min.
Quantity (kg)	5,889	90,340	86,875	1,400,000	19.0
Transaction value (USD)	5,889	309,551	315,601	3,019,378	20.0
Price per Kg (USD)	5,889	3.5	0.9	7.2	0.07

4.2. Free Market Commodity Price Data: 2011 – 2017

Daily market price data is from Thomson Reuters Datastream, a database of global financial markets and economic indicators. The commodity exchanges' data used as benchmarks for the analyses are: the London Bullion Market Association (LBMA) for Gold Bullion LBM (US dollars per troy ounce), Metals Focus Gold Dore Flows Service Database on gold and silver from selected companies in Ghana, London International Financial Futures and Options Exchange (LIFFE) Prices for the assessment of the raw cocoa beans (US dollars per metric tonne), the African Cocoa Butter US Del Prices for the assessment of wholly and partially defatted cocoa paste (US dollars per metric tonne), and the International Cocoa Organisation (ICCO) – Cocoa-ICCO Daily Prices (US dollars per metric tonne) for comparisons with the aforementioned chosen international market prices of cocoa.

5. ESTIMATES OF ABNORMAL PRICING

Using the price filter methods, this section presents annual and total estimates of abnormal pricing for the selected gold and cocoa exports. The analyses presented in this paper are based on export trade between Ghana and various partners; hence, the abnormal price estimates are general rather than specific to a particular trading partner. Our estimates show economically significant undervaluation of some of the commodities. We provide some analysis and discussion on these results, which we will

test in future research. In the literature, some arguments advanced to explain undervaluation of exports include capital flight, evasion of income taxes, money laundering/terrorist financing, avoidance or reduction of export surcharges and concealing illegal commissions.

5.1. Gold (Semi-Manufactured)

Ghana exported roughly USD 35.6 billion worth of gold to partner countries during the study period. The firm level transactions data show that Ghana exported gold to 45 countries between 2011 and 2017.[12] The top four destination countries of Ghana's gold exports are South Africa, Switzerland, United Arab Emirates, and India, in that order. Gold mines in Ghana usually produce gold dore bars of between 70 – 95% purity, which are sent to refineries abroad for further purification or sold locally for jewellery making and as savings and investments. The gold dore is typically made up of gold and silver alloy that contains impurities such as copper, lead and bismuth of which permissible content constitute up to 5%. Mines are paid based on the percentages of gold and silver in a dore (Metal Focus Report, 2019). For international markets like LBMA, gold prices are set for 99.5% to 99.9% of gold in a dore, known as gold bullion. In this case, there is very little silver and impurities in the content. Thus, the percentage gold – silver split in dores exported are of utmost importance in our estimations since valuation, and hence the purchase price, is directly related to these percentages; including impurities. In addition to these, factors such as contract types as well as market and country characteristics are considered in setting arm's length price range.

Arm's Length Estimations

Declared FOB price vs free market price

In estimating the magnitude of abnormal pricing, this study first compares the declared export prices (FOB) with the free market prices for gold bullion by the LBMA. It should be noted that any dore of lower gold – silver split than the specified 99.5% to 99.9% of the former does not attract the stated market price of the day. Besides, varied contract terms, market volatilities and country transactions idiosyncrasies further cause export values to deviate from the free market reference prices. An arm's length price range is thus determined by setting boundaries around the free market reference prices. That is, instead of making the free market reference prices the sole arm's length prices, we also give

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[12] Upon cleaning the data to remove errors such as the listing of diamonds, gold dust, tar, soil samples, and silver as well as extremely large per unit prices outliers, 20,933 transaction level observations were left for the analysis; from an original 21,261 observations.

allowance for the gold percentage differentials and market conditions. Any declared export values falling out of the arm's length price range are considered abnormal. Details in setting the arm's length price ranges are as below with the following assumptions:

1. **Product Heterogeneity (-):** Since gold in the GRA data refers to semi-manufactured gold dore bars, we do not expect the export prices to be same as the published daily export prices by LBMA used as the free market reference prices. Typically, the precious metal content of the mined ore is between 70:30 to 95:5% for gold and silver respectively (Metal Focus Report and Database, 2019; Personal communications, C. Nyarko). Consequently, we established the various gold percentages in the content exported within the study period by merging with companies export data from Metal Focus database that gives specific gold – silver splits of exports.[13] However, with companies in the GRA dataset that are not in the Metal Focus database, we conservatively use the lowest gold content of 64% for such companies. We therefore assume varied price filters up to 36% downward deviations from the free market reference prices.

2. **Market conditions and contract terms (+/-):** Varied contract terms could exist between trading companies over a set period. To account for such as well as country idiosyncrasies, lending and exchange rate volatilities, 10% is added and subtracted around the benchmark prices to define the maximum and minimum price filters (Personal communications, C. Nyarko).

3. **Transport, storage and insurance costs (+):** Although these costs are present in all transactions undertaken between trading partners, their impacts on the gold trade are quite negligible; less than 2%. This is particularly so when the higher the volume of gold exported, the lower the transport and insurance costs relative to the value of gold.[14] As a result, we do not adjust our price filters to account for transportation costs of gold dore.

For the reasons above, various price filters, with the maximum being 46%, are set below the free market reference prices for gold bullion by LBMA and 10% above it. These serve as the arm's length price ranges, deviations from which would indicate whether Ghana's gold was undervalued or overvalued between 2011 – 2017. Figure 1 illustrates a typical trend of the per unit prices of gold vis-a-vis the free market reference prices and arm's length price range of 86:14% gold – silver split dore

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[13] Gold purity levels in the data include 100%, 96%, 86%, 81%, and 67%; all of which contain up to 5% trace metals. Taking the presence of impurities in the dore into consideration, the percentages of gold in the gold – silver split of available companies in the GRA dataset becomes 95%, 91%, 82%, 77% and 64% (Metal Focus Database, 2019).
[14] This information was gathered from two gold exporting agencies and a conversation with a contact at the Minerals' Commission.

exported. Based solely on the free market reference prices for gold bullion, most of the declared export prices fall below the free market prices. However, with a 28% lower boundary filter, fewer declared export values are observed. Table 3 gives the calculated annual and overall under- and over- valuations of our total observations.

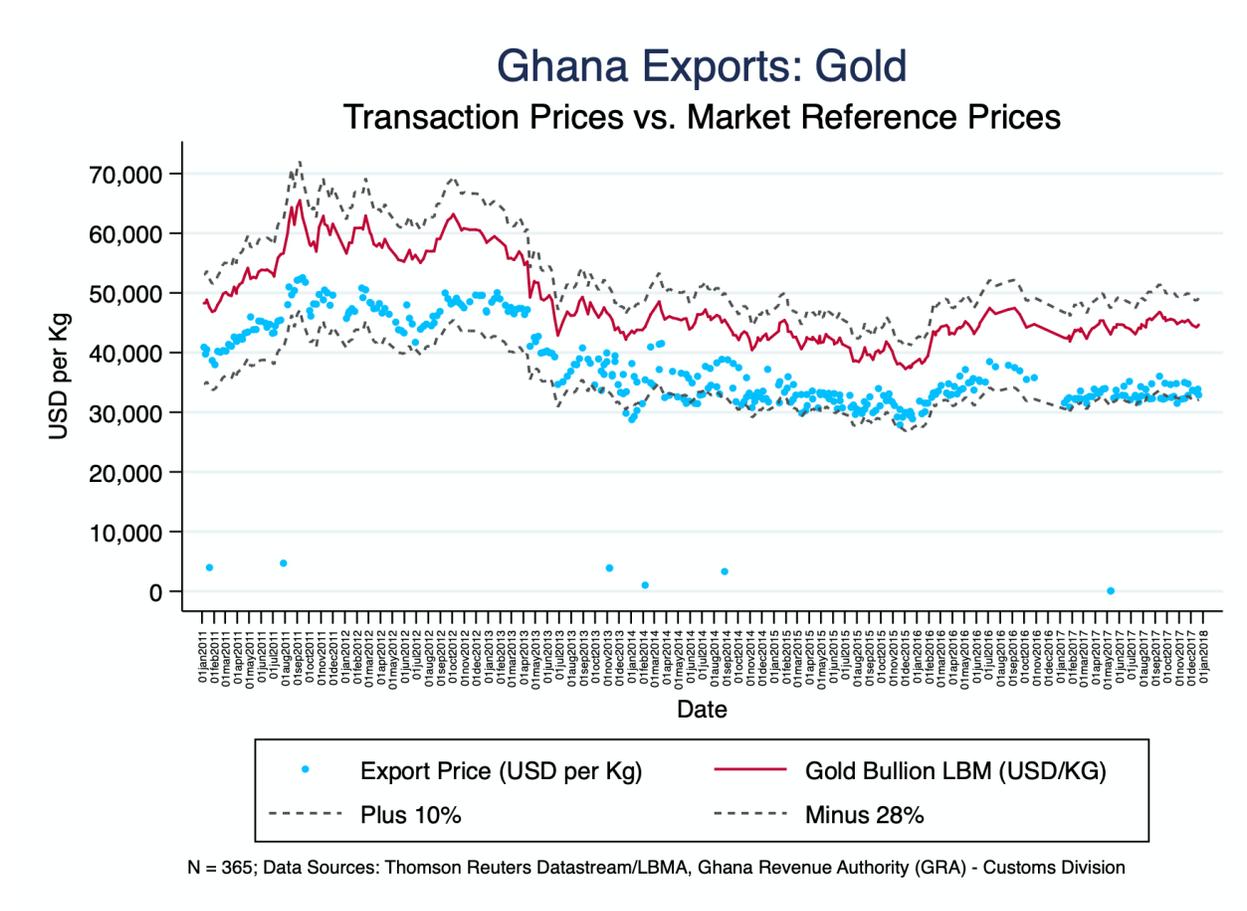**Table 3: Undervalued and Overvalued Exports – Gold**

Year	Free Market Price Filter: Minus various* % (USD, Million)	Free Market Price Filter: Plus 10% (USD, Million)
2011	205.0	-
2012	498.2	-
2013	471.6	0.3
2014	184.1	0.2
2015	69.2	0.3
2016	1,111.7	0.1
2017	987.2	0.7
Mean	503.8	0.2
Total	**3,526.9**	**1.6**
Observations	**1,743**	**66**

Data Source: Ghana Revenue Authority (GRA); and Metal Focus Limited
*The various undervalued filters or arm's length price ranges are 15%, 19%, 28%, 33%, and 46%.
Notes: Gold is semi-manufactured; a combination of two export types mis-classified in the GRA data as gold bullion (HS: 7108.13.1000) and unwrought gold, non-monetary including gold plated with platinum (HS: 7108.12.0000). Free market reference price is the daily Gold Bullion price from London Bullion Market Association (LBMA) ($/t oz).

Figure 1: Gold – An Illustration of Transaction-level Prices versus Free Market Prices

Ghana Exports: Gold
Transaction Prices vs. Market Reference Prices

Legend:
- • Export Price (USD per Kg)
- —— Gold Bullion LBM (USD/KG)
- ----- Plus 10%
- ----- Minus 28%

N = 365; Data Sources: Thomson Reuters Datastream/LBMA, Ghana Revenue Authority (GRA) - Customs Division

Estimates for undervalued amount

Ghana exported 1,027 tons of gold over the study period (2011 – 2017) for USD 35.6 billion. With the various filters set below the free market price as arm's length, an amount of USD 3.5 billion is estimated as undervalued. This constitutes about 10% of the total value of gold exported. The annual share of under-valuation of gold ranges from 0.2% in 2015 to 3.1% in 2016. Some of the destination countries of these undervalued gold exports are South Africa, Switzerland, India, United Arab Emirates, and the Netherlands. The corresponding undervalued amounts are USD 84.2 million, USD 20.2 million, USD 11.8 million, USD 17.2 million, and USD 7.0 million, respectively.

We attribute undervaluation to a number of reasons. The first is the misclassification of commodities in the data used for the analysis. Although Ghana exports two main types of semi manufactured gold, a lack of due diligence and possible ignorance on the part of exporters and customs officials led to the commodities being incorrectly classified. It is therefore possible that if the commodities were correctly classified and recorded accordingly, there would be less abnormal pricing recorded. Lack of data on

gold purity levels for all the companies in the dataset, hence a conservative use of the lowest available for such companies plausibly affects the total outcome.

The second reason is the nature of the commodity. In a policy paper on mining by Readhead (2018), it was stated that the risk of undervaluation is higher for commodities based on the state in which they are exported. There usually is less transparency for mineral valuations when they are in their raw form. This means that there is a higher possibility of undervaluation for gold dore bars exported from Ghana than gold bullion or other more processed gold items.

Thirdly, related party transactions due to mainly multinational companies operating in the sector is a plausible reason. In a study on Zimbabwe, Kwaramba et al. (2016) found that multinational companies tend to engage in export under-invoicing. Although further analysis would need to be done in order to make a definite conclusion in this case, companies operating in the sector may have an incentive to under declare/under report their exports in order to reduce their tax liability to the state. This is because the revenues the state obtain from the sector are mainly through corporate and income taxes as well as royalties and withholding tax (Annual Report, 2017, Minerals' Commission). The next stage of this study will explore this phenomenon in greater detail.

Finally, the undervaluation could be due to the nature of the companies engaged in the sector. Due to the disclosure requirements for companies which are publicly listed, there is a lower possibility for them to engage in undervaluation than for companies that are not. The disclosure requirements might discourage companies from deliberately undervaluing mineral exports. Many of the gold mining companies as well as ASMs that operate in Ghana are not listed on the Ghana Stock Exchange and as such do not have to publish their statements.

Estimates for overvalued amount

Similarly, based on the 10% boundary above the free market prices for gold, the calculated total over-valuations of gold between 2011 and 2017 are about USD 1.6 million (Table 2). Relative to the total value of gold exports, over-valuation seems negligible (less than 0.005%).

5.2. Cocoa Beans (HS Code: 1801.00.1100)

Here, cocoa beans refer to superior quality raw beans. It is also known as well-fermented cocoa beans. The specific descriptions in the Ghana Customs data include main crop raw cocoa beans (*abrabopa*; *kuapa kooko*; *certified*; *traceable*, and *UTZ certified*), and light crop raw cocoa beans. These descriptions signify the various types of raw cocoa beans exported. For example, some of the cocoa exported are certified as organic, bought from farmers who do not use child labour in cocoa production, and also from Farmers' associations etc. The Cocoa Marketing Company (CMC), sole exporter of raw cocoa beans from Ghana, trades most of the main crops, which they describe as relatively more stable in terms of yield as well as attract higher prices in futures sales. The top four destination countries of Ghana's cocoa are the Netherlands, Malaysia, United States of America and Belgium. Ghana exported USD 12.6 billion worth of cocoa to its partners between 2011 and 2017.
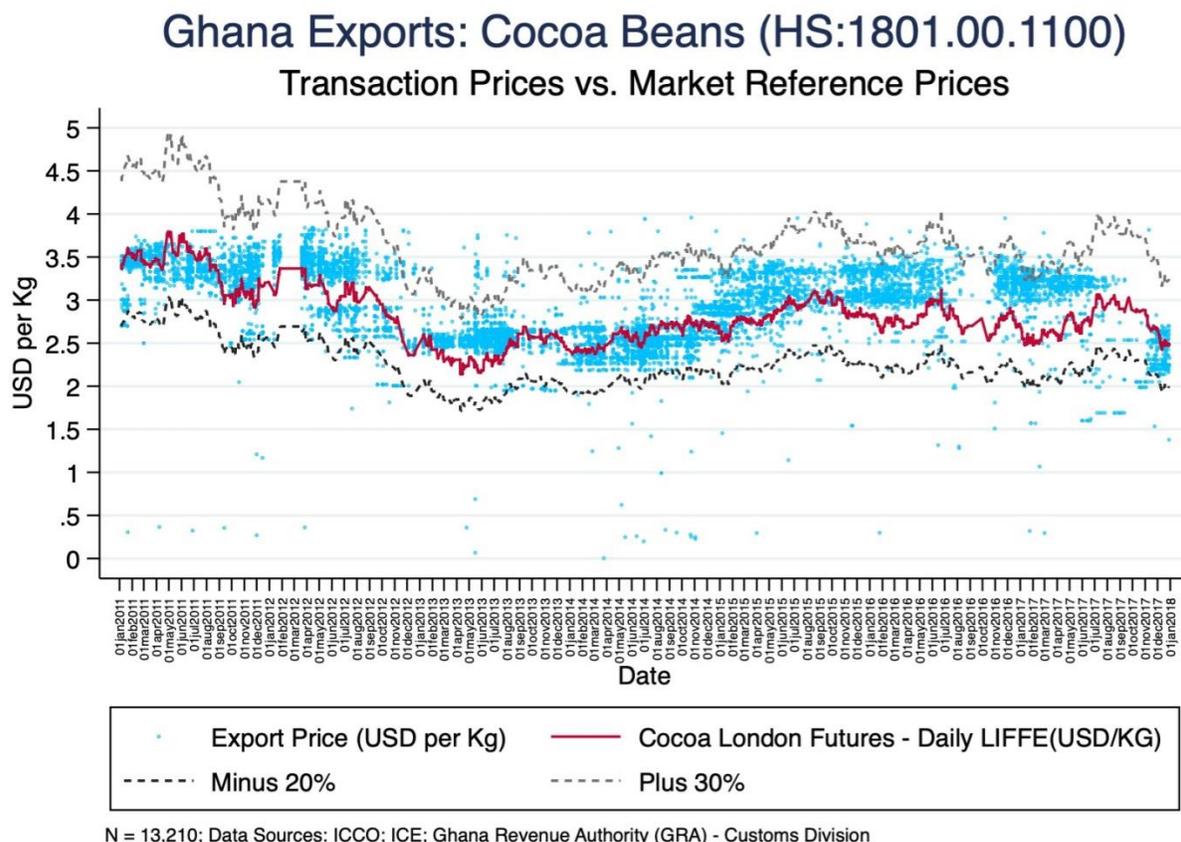
Arm's Length Estimations

Declared FOB price vs free market price

Again, in order to arrive at a reasonable estimate of abnormal pricing, the study juxtaposes the declared export prices of cocoa on the London Futures/Forward Prices from 2011 – 2017. We use the London Futures Prices as the free market reference prices because the CMC's trading of cocoa beans, especially to foreign buyers, is based on these prices. Sales are also usually conducted six to 12 months (or sometimes 15 to 18 months) prior to delivery. The main reason for the futures sales is that the sales serve as collateral for the syndicated loans acquired to pay LBCs for their cocoa beans, provide research and extension services to farmers as well as funds for the general administration of all the cocoa institutions in the country (Personal Communications, CMC Personnel).

Due to the trading strategies of CMC, the international market futures prices are set in the estimation data such that 2010 world market prices are used as reference prices for 2011 export values. This is with the belief that most of the cocoa beans (not less than 80%) exported in 2011, for instance, were sold using 2010 futures prices. Similarly, 2011 world market prices were set as reference prices for 2012 export values. This procedure was undertaken for all the years within the study period. Figure 2 presents the per unit export prices, the London Futures Prices, and the arm's length price ranges set to determine undervaluation and overvaluation of cocoa beans within the study period. The actual estimates are presented in table 4.

Figure 2: Cocoa Beans – Transaction-level Prices versus Free Market Prices

Ghana Exports: Cocoa Beans (HS:1801.00.1100)
Transaction Prices vs. Market Reference Prices

Export Price (USD per Kg)   Cocoa London Futures - Daily LIFFE(USD/KG)
Minus 20%   Plus 30%

N = 13,210; Data Sources: ICCO; ICE; Ghana Revenue Authority (GRA) - Customs Division

Filters set around selected market prices to determine the arms' length prices from which deviations suggest abnormal pricing are based on assumptions guided by our communications with experts in the industry and desktop research. The filters are set based on the following assumptions:

1. **Product Heterogeneity (+/-):** Since Ghana's cocoa beans are selected for export based on their top-grade quality and size, they are not as heterogeneous as gold (Personal Communications, COCOBOD Personnel). Variations are related to various certifications such as Organic, Fairtrade and traceability, which attract additional price premium of 150 USD per tonne (Dand, 2011) – about 5.4% of the average value of the London's Futures Prices per tonne for the period 2011 – 2017. Additionally, the premium on the cocoa beans could stretch as high as 16.5% of the average London's Futures Prices. The high premiums are due to a combination of an established guaranteed delivery of sold cocoa beans on time, quality of beans, and counterparty premium (Personal Communications, COCOBOD Personnel).   We thus allow for 17% dispersion around the selected market prices due to heterogeneity. Indeed, the heterogeneity of the beans is expected

to be geared mostly towards the positive than the negative, which we assume could be due to the inclusion of light crop beans in the exports

2. **Transport and insurance costs (+):** According to the CMC, exports are done on FOB terms. However, customers sometimes request shipments to be pre-financed by COCOBOD. On these occasions, the beans are exported under CIF, which is usually around USD 100 per tonne or 10% of cost of sales. In effect, COCOBOD bears no cost for transport and insurance except for possible exchange rate volatility affecting the pre-financed values. Ghana Customs, however, may not be aware of this arrangement and thus record CIF values as FOB. This is because cocoa CIF shipments from Ghana usually include bills of lading that are not stamped "freight paid" but have the cost of freight deducted from invoice later on (Dand, 2011). Using the World market price in 1999, Pedersen (2001) estimated transport cost of cocoa exported from Tema to Rotterdam to be around 13% of the market price. We thus approximate a 13% positive variation from the market values.

3. **Market conditions and contract terms (+/-):** A peculiar feature of Ghana's cocoa beans export is Government's control over the purchase and export of the beans. Syndicated loans are used to finance purchases and about 80% of the beans bought are exported on futures sales contracts. The remaining 20% of the cocoa beans are normally sold at spot prices when enough revenue has been secured to pay off the loans. The beans are subsequently delivered to destinations within three months of purchase. With the varied sales strategies undertaken by the traders based on instinct with experience, plausible portions of estimated abnormal pricing could be reflecting these contracts cum market conditions, which we assume to vary by 5% around the market values (Personal Communications, COCOBOD Personnel; Stakeholder Meeting at COCOBOD, 2019).

Given these features, we assume a 30% variation above the world market reference prices and a 20% below as arm's length price ranges suitable for the estimation of the magnitudes of abnormal prices for cocoa beans. The data shows that Ghana exported about 4.3 million tonnes of cocoa beans worth USD 12.6 billion over the study period (Table 4). The number of transactions observed during this period, after eliminating huge outliers suspected to be mis-reporting, is 13,210.

Table 4: Undervalued and Overvalued Exports – Cocoa Beans (HS: 1801.00.1100)

Year	Free Market Price Filter: Minus 20% (USD, Million)	Free Market Price Filter: Plus 30% (USD, Million)
2011	24.4	3.8
2012	8.5	7.9
2013	1.4	21.6
2014	57.4	12.0
2015	2.2	7.0
2016	9.0	47.0
2017	23.8	15.4
Mean	18.1	16.4
Total	**126.6**	**114.7**
Observations	**285**	**326**

Data Source: Ghana Revenue Authority (GRA)
Notes: Cocoa beans is superior quality raw beans (HS: 1801.00.1100). Free market price is the London Futures Prices (US$/MT).

Estimates of undervaluation

In spite of the unique marketing characteristics of Ghana cocoa beans exports, it is estimated that about USD 126.6 million worth of cocoa beans was undervalued between 2011 – 2017 based on the 20% boundary set below the free market price filter (Table 3).[15] This forms about 1% of the total value of cocoa beans exported, which is quite negligible in percentage terms. However, in terms of absolute value, the figure is relevant enough since tax revenues from such an amount could be used for some essential rural development projects like the provision of basic school and health facilities. Annual estimates show that undervaluation was highest in 2014. The estimates of the abnormal pricing for cocoa beans suggest their export from Ghana are hardly undervalued; considering an undervaluation of 1%.

Estimates of overvaluation

The estimates of abnormally overvalued cocoa beans exports are quite similar to the undervaluation estimates. For example, the estimated overvalued amount of cocoa beans is USD 114.7 million or 1% of total exports over the entire study period (Table 3). We speculate that use of a centralised authority

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[15] A further study using a 30-day moving average of the benchmark will be undertaken to check for sensitivity or validity of these results. The 30-day moving average is expected to account for an assumed time-lag between the transaction completion and importation dates.

such as COCOBOD could potentially have some benefits for other commodities exported from Ghana.

5.3. Cocoa Paste (HS Code: 1803.20.0000)

Ghana Customs describes cocoa paste as either wholly or partly defatted; it is generally made up of refined cocoa liquor, cocoa mass, unrefined cocoa nibs, non-deodorised filtered cocoa butter, fine alkalised cocoa liquor, coarse alkalised cocoa cake, natural coarse cocoa cake, defatted cocoa cake, and cocoa powder. The varied descriptions given in the data for these products suggest plausible variations in export prices. In the cocoa value chain, processing begins with the production of cocoa liquor, which results from the roasting of beans and grinding of the nibs after the shells are removed. The liquor can be pressed further into cocoa fat (also known as butter). Cocoa powder is processed from cocoa mass/cake upon grinding. Ghana provides incentives such as tax holidays, duty drawbacks and some import duty exemptions for companies that process cocoa. Trading here is usually undertaken by the private sector. The value of processed cocoa paste exports from Ghana over the study period totalled USD 1.8 billion. The top four countries that bought some of these cocoa paste products are the Netherlands, France, Belgium and Switzerland.

Arm's Length Estimations

Rolling Interquartile Range

Due to the presence of a high degree of price rigidity in the cocoa paste data, we choose to estimate the abnormal pricing based on the interquartile range filter instead of the free market filter. As explained under section 3.2, this study uses the price distribution observed over the previous 365 days, i.e. a 365-day rolling-window, to calculate the interquartile range within which exported values are considered normal. This method is endogenous, and caution should be taken in the interpretation of its results. However, the main advantage is that our definition of the arm's length price range is more responsive to the pricing dynamics observed over the course of the year. Undervalued exports are estimated from values below the 25th percentile of the rolling interquartile range whilst export values above the 75th percentile are estimated as overvalued exports. Table 5 presents estimates of both the undervalued and overvalued cocoa paste exports from Ghana.

Estimates of undervalued cocoa paste

Our estimations indicate that the amount of undervalued cocoa paste is USD 130.5 million or 7.2% of the total export value between 2011 and 2017. Although endogenously determined, the interquartile range filter provides better abnormal pricing estimates where market rigidities exist. For example, the declared export values of the cocoa paste in our data clearly show slight response to the free market reference making the latter a not so suitable benchmark for the analysis. This undervaluation could be attributed to the different cocoa paste/mass products combined to generate the estimates (COCOBOD Personnel Feedback, Stakeholder Meeting, 2019). A suggestion for a future study is to separate the various cocoa paste/mass products and estimate the abnormal pricing of each. Another reason is the high number of multinationals operating in the sector. The higher the number of multinational companies in the sector, the higher the export under invoicing that is expected in the sector. This is because when multinational companies trade with their parent companies they tend to have an incentive to under declare prices in order to reduce their tax liability to the state and increase profitability in general. However, further research needs to be undertaken to better understand the operations of the cocoa processing companies.

Estimates of overvalued cocoa paste

Overvaluation of cocoa paste is approximately USD 59.1 million, constituting roughly 3.2% of the total value of cocoa paste exported (Table 5).

Table 5: Undervalued and Overvalued Exports – Cocoa Paste (HS: 1803.20.0000)

Year	Rolling Interquartile Range Filter: Below 25th pctle (USD, Million)	Rolling Interquartile Range Filter: Above 75th pctle (USD)
2011	2.7	0.2
2012	7.7	4.1
2013	11.8	4.5
2014	33.7	19.1
2015	24.9	14.9
2016	18.4	7.7
2017	31.3	8.6
Mean	18.6	8.4
Total	**130.5**	**59.1**
Observations	**1,452**	**1,169**

6. SUMMARY AND CONCLUSIONS

As one of the natural resource-rich developing countries, Ghana is expected to benefit from the production and marketing of such resources for its socio-economic development. However, opportunities for IFFs reduce the potential of the natural resource sector to contribute to development as it leads to financial leakages in the economy. Using improved data and a more robust method of analysis – the price filter methods – this study provides estimates of abnormal pricing for Ghana between 2011 and 2017 using gold (gold bullion and unwrought gold) and cocoa (superior quality cocoa beans and cocoa paste) as case studies. These estimates are relatively more accurate as it relies on transaction level microdata rather than aggregate trade statistics used in the partner country trade method.

Our findings corroborate existing literature that IFFs via commodity trading occurs in Ghana. There is therefore an urgent need for government to put in more effort in providing institutional expertise to track, monitor and block the sources of these IFFs. The government has already put in some measures to streamline illicit operations such as the setting up of a transfer pricing unit and anti-money laundering unit at GRA. Other measures include designating a national assayer (PMMC) to assay all gold to be exported and agreeing with Cote D'Ivoire to announce the producer price of cocoa at the same time in a bid to curb smuggling of cocoa beans between the two countries.

We advise that the government further needs to improve data collection capacity of the various institutions engaged in the export of these commodities, create greater co-operation among the various institutions in these sectors to reconcile data collected and provide constant skills improvement of personnel of these units. The state should also set a price benchmark based on statistical tools such as percentiles or an interquartile range so that abnormally valued exports can easily be identified and be subjected to administrative review. This could potentially serve as a means for risk-based selection of cases for transfer pricing audit.

Additionally, customs statistics should be expanded to include relevant information relating to commodity quality and purity, which would be useful for verifying reported valuations. Another relevant information for trade assessments is whether the trading is between related or unrelated firms.

This information will be necessary for determining transfer pricing risks. Indeed, these information would improve customs risk management practices and serve as a first step for tracking potentially mis-invoiced trade transactions.

Besides the above, there should be more information sharing between customs officers and transfer pricing auditors. Ghana needs to be commended for setting up a transfer pricing unit within the GRA. However, we suggest that the unit should be better resourced to enable them follow up on IFFs incidents. New technologies such as blockchain, machine learning and artificial intelligence can be used to improve trade governance. These technologies could support with automating various customs activities such as customs declarations, exchange of information, electronic verification of regulatory requirements, revenue collection, compliance management and post clearance audits (WCO, 2018). Artificial intelligence can be used to identify suspicious transactions and develop sustainable policies (Fan and Chiffelle, 2018). Blockchain can also be used for tracking shipments and to facilitate faster automated payments that can easily be tracked (Lund and Bughin (2019). Automation of data collection by customs authorities would also aid in sharing data with other co-operating institutions and will reduce any errors created by manual data entry. These technologies make the global supply chain more transparent and secured with literally no fiddling of information at any point. Detailed raw customs data should then be compiled into repositories of transaction-level data in physical commodity markets to allow for more meaningful price analysis.

Finally, it is necessary for clear legal guidelines to be developed to aid trade and revenue authorities to distinguish between illicit and illegal financial flows especially in relation to abnormal pricing of commodity exports from Ghana. In this regard, we emphasise that the Transfer Pricing Unit of the Ghana Revenue Authority should be fully resourced to develop these guidelines.

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