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
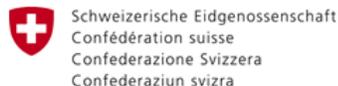
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EXECUTIVE SUMMARY

Illicit financial flows (IFFs) have emerged as important concerns in academic and policy debates regarding development finance, domestic resource mobilization and natural resource governance. This paper focuses on commodity trade-related IFFs which represent significant economic and governance challenges for mineral-rich, developing countries like Ghana by eroding the financial resources available to them for development finance. The two main, overlapping channels for IFFs identified in this context include trade mispricing and transfer mispricing; however, existing empirical evidence for Ghana remains severely limited.

This paper sets out to contribute to the limited literature on trade-based IFFs from Ghana by providing novel evidence of abnormal pricing in Ghana's commodity exports, defined as the magnitude of exports valued outside an assumed arm's length price range. Our baseline estimates are calculated using free-market price filter methods, whereby we compare each individual transaction-level unit price of commodity exports with an assumed arm's length price range based on free market prices from commodity exchanges. The assumptions made to define the arm's length price range are based on extensive commodity sector research and expert interviews. Next, we also compare these estimates with results based on the interquartile range price filter method, whereby the interquartile range of observed export prices is denoted as the arm's length price range. This method is useful to consider when there is no clearly acknowledged single market price for a particular commodity. We use transaction level trade micro data provided by the Ghana Revenue Authority (2011-17) for the analysis. Our analysis focuses on two of Ghana's most economically significant commodity exports, gold (gold bullion and unwrought gold) and cocoa (superior quality cocoa beans and cocoa paste), which represent approximately 70% of Ghana's annual primary exports.

Based on some clearly discussed assumptions informed by extensive commodity sector research, our findings indicate significant magnitude of abnormal undervaluation of commodity exports from Ghana. Using contemporaneous market reference prices, we find that abnormally undervalued export for gold (gold bullion and unwrought gold) equalled USD3.8 billion or 11% of the total export value (35.6 billion USD) between 2011 and 2017. The estimates for cocoa beans and cocoa paste are based on interquartile range price filter methods, due to lack of clear market reference prices. A possible explanation for the observed price rigidities of cocoa bean exports is their predominant trade in futures markets via forward contracts.

Based on our preferred interquartile range filters, we estimate that 2.7% of the 12.6 billion USD worth of cocoa beans exported was undervalued; that is found below the 25th percentile of the per unit price distribution of cocoa beans. Similarly, we estimate that 7.5% of the total export of cocoa paste (1.8 billion USD) was undervalued. The relatively high undervaluation of cocoa paste exports corresponds to IFF risks due to the presence of many multinational companies (MNCs) in the industry. The results for overvaluation are quite negligible, especially using the market price filters as benchmarks.

Our findings provide preliminary evidence and corroborate existing literature that IFFs via commodity trading are a concern for Ghana. There is therefore an urgent need for regulatory reforms and capacity development to monitor and block these IFFs. The Government of Ghana has already taken some measures, such as the setting up of a Transfer Pricing Unit within the Revenue Authority as well as an Anti-money Laundering Department, to counter these risks.

ABBREVIATIONS

AfDB	African Development Bank
ASM	Artisanal and Small-Scale Mining
CHED	Cocoa Health and Extension Division
CMC	Cocoa Marketing Company
CRIG	Cocoa Research Institute of Ghana
CIF	Cost Insurance Freight
FOB	Free On Board
GSA	Geological Survey Authority
GRA	Ghana Revenue Authority
GFI	Global Financial Integrity
GHEITI	Ghana Extractive Industries Transparency Initiative
HS Code	Harmonized Commodity Description and Coding System
IFFs	Illicit Financial Flows
ICCO	International Cocoa Association
LSM	Large Scale Mining
LBCs	Licensed Buying Companies
LBMA	London Bullion Market Association
MoFEP	Ministry of Finance and Economic Planning
NY	New York
OASL	Office of the Administrator of Stool Lands
ODA	Official Development Assistance
OSSC	One Stop Service Centre
OECD	Organization for Economic Co-operation and Development
PMMC	Precious Minerals Marketing Company
QCC	Quality Control Company
REER	Real Effective Exchange Rate
SPD	Seed Production Division
SDGs	Sustainable Development Goals
UNECA	United Nations Economic Commission for Africa

1. INTRODUCTION

Located in West Africa, Ghana is one of the most important natural resource-rich developing countries in sub-Saharan Africa. It is endowed with large reserves of both renewable natural resources, including agricultural land, wetlands, forest and forest land, fresh and salt water fisheries, and surface and underground water resources; as well as non-renewable resources including minerals (gold, diamonds, bauxites and manganese) and petroleum. Ghana remains the continent's second-largest producer of gold and world's second largest producer of cocoa beans which dominate the country's primary exports by value. According to the Ghana Extractive Industries Transparency Initiative (GHEITI), natural resource revenues have provided the main thrust for Ghana's economic growth and development (GHEITI, 2009). With a boost in oil production in recent years, Ghana emerged as one of the fastest growing economies in the world with over 8% annual growth in gross domestic product (GDP) in 2017 and similar levels expected for 2018. However, tax revenue collection remains low and significantly below capacity. As per the latest available data from Bank of Ghana, the ratio of tax revenue to gross domestic product (including oil sector revenue) equalled only 15% in 2016, with corporate taxes contributing only 14% of total tax revenues (Bank of Ghana, 2018; OECD, 2018). This corresponds with the experience of other developing countries where tax to GDP ratios remain at low levels, between 10% and 20%, compared with above 30 for OECD economies (Mascagni et al. 2014).

Illicit financial flows via trade and transfer mispricing are argued to be a major contributing factor in driving tax base erosion in many developing countries. IFFs are broadly defined as cross-border financial flows which are illegally earned, transferred or utilised. Trade misinvoicing refers to 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 (Forstater 2018). It is the intentional mis-stating of the value, quantity, or composition of goods on customs declaration forms and invoices, usually for the purpose of evading taxes or laundering money (Global Financial Integrity, 2014). Similarly, if such abusive mispricing occurs in trade between related firms then it is referred to as transfer mispricing. For example, multinational firms establish local branches in different countries that sell their production to their own affiliated marketing or purchasing companies. Furthermore, the local subsidiaries may also receive goods and services from the parent firm or related companies. These related parties' transactions prices and contract terms should be comparable to arm's length terms and prices, i.e. conditions under which the transaction would have taken place between

unrelated parties. However, transfer mispricing occurs when related parties distort the price of a transaction outside an arm's length range, usually with the objective of reducing the multinational firm's overall tax bill. In the natural resource sector, mispricing of transactions between related parties is therefore one of the main transfer pricing risks related to international commodity trade (Readhead, 2018).

However, this phenomenon remains relatively under-analysed in Ghana. Existing evidence is limited to the large asymmetries observed in trade statistics between Ghana and its trading partners. In Ghana, some estimates, by Global Financial Integrity (GFI, 2014) and Africa Centre for Energy Policy (ACEP, 2015), based on aggregate, macroeconomic data suggest that more than 1 billion US dollars (USD) is lost annually through trade misinvoicing. However, the validity of the underlying methodology has been heavily criticized due to significant data and methodological limitation, therefore there is an urgent need for better, more informed estimates. Reducing IFFs could make more resources available for financing the Sustainable Development Goals (SDGs). This is particularly important because most of the funding for SDGs is expected to come from domestic resources. Indeed, one of the SDGs (goal 16:4) is to significantly reduce illicit financial flows, strengthen the recovery and return of stolen assets and combat all forms of organised crimes by 2030 (SDGs, 2015).

In recent years, the policy focus on IFFs and related practices has increased significantly 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.[1] 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 financing the development agenda of African countries in a sustainable manner (AfDB, OECD Development Centre, and UNECA 2010). This has become even more critical as traditional sources of development finance, such as Official Development Assistance (ODA), are dwindling following the global financial crisis and other challenges facing developed countries. For instance, aid from OECD countries decreased by 2.7% in 2011 compared to 2010 because of the crisis. Bilateral aid to sub-Saharan Africa also fell by 0.9% (28 billion USD in real terms) whilst bilateral ODA to the group of Least Developed Countries fell by 8.9% in real terms to USD 27.7 billion during the same period (Balma et al. 2018).

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

Using Ghana's foremost trading commodities, gold and cocoa, this paper estimates the magnitude of abnormal pricing (henceforth, AP) in Ghana's exports.[2] In addition, the paper analyses the drivers underpinning the AP observed for gold and cocoa. Traditionally, there are two broad motivations for AP, namely, high customs duties (de Boyrie et al., 2007; Boyce and Ndikumana, 2001; Beja et al., 2005) and capital flight (Schulze, 1994). When firms pay high customs duty rates or Value-Added Tax (VAT) on international trade, or are subject to quantitative restrictions, they have a reason to understate the true value of imports and exports. Similarly, AP is viewed as a method for capital flight, which is because of fears of expropriation in interplay between unsound economic policy and political instability (Schulze, 1994). Indeed, it has been argued that AP is the main channel for IFFs, including capital flight (Kar, 2014; Kar and Cartwright, 2008; Kar and Freitas, 2012). Therefore, a reliable estimation of the possible tax and revenue losses due to AP could be indicative of the magnitude of IFFs in a country of interest. This is a major motivation for this paper's focus on AP in the context of gold and cocoa for Ghana. Besides, unlike the partner country trade statistics used by the GFI for estimating the magnitude of IFFs, this paper adopts the price filter methods; utilising both the market price arm's length and the interquartile price range filters.[3]

Developed by Simon Pak and his co-authors in the 1990s, the price filter analysis method which addresses some of the challenges posed by the partner country trade statistics method makes use of commodity prices to estimate arm's length price range within which trade prices are considered normal; but above or below which trading is evaluated as abnormally priced. AP occurs when the values of transactions declared at customs agencies are different from estimated arm's-length values of the transactions (Hong & Pak, 2017). Exports are described as under-valued when trade values fall below a lower-set boundary, and over-priced when values are above an upper-set boundary.

This study's main findings are as follows. The per unit export values for gold especially show a trend consistent with the daily market prices chosen as reference. Hence compared with the interquartile range filter, AP estimates using market reference prices with selected filters as benchmarks are this study's preference estimates for undervaluation and overvaluation. We observe that most of the per unit prices of gold are found below the market reference prices, albeit showing similar undulating

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[2] Aside petroleum oil.

[3] The Partner Country Trade method is based on the principle of double-counting in international trade statistics, whereby the exporting country's statistics are compared to the importing partner's corresponding statistics (Bhagwati, 1964; 1967; 1985). This method has been heavily criticised and the main reasons are provided in the methodology section of the paper.

pattern within the study period 2011 to 2017. Upon setting our 30% arm's length price range from the market reference prices, we find that gold exports are undervalued by roughly 11% of the total value of gold exported, which is 35.6 billion USD. The undervalued amount thus constitutes 3.8 billion USD. Five of the countries Ghana trades with and consequently lose some of the money to are South Africa (999.4 million USD), Switzerland (753.6 million USD), India (91.7 million USD), United Arab Emirates (25.5 million USD) and the Netherlands (14.1 million USD).

Unlike gold, the per unit prices of cocoa beans and cocoa paste do not show clear response to prevailing spot market prices for the study period. For superior quality cocoa beans exported, the per unit prices mainly fluctuated between 2 and 4 USD per kilogramme, whilst the per unit prices of cocoa paste show a near linear trend just below 4 USD per kilogramme (refer to relevant figures in Section 5). These price rigidities observed in the marketing of cocoa and its products makes the use of contemporaneous market prices as reference for AP estimates not so suitable. A possible explanation to the per unit prices of cocoa beans' lack of response to the market reference prices is the sale of cocoa beans in the futures markets via forward contracts by COCOBOD. Although endogenously determined due to the use of products' own declared export prices, the use of interquartile range in estimating AP is more appropriate. Based on our preferred interquartile range filters, we estimate that 2.7% of the 12.6 billion USD worth of cocoa beans exported was undervalued; that is found below the 25th percentile of the per unit price distribution of cocoa beans. Similarly, we estimate that 7.5% of the total export of cocoa paste (1.8 billion USD) was undervalued. The relatively high undervaluation of cocoa paste exports could be due to the presence of many multinational companies (MNCs) in the industry.

Overall, the study finds overvaluation in Ghana somewhat negligible based on the market reference price filters. For example, overvaluation of gold exports is less than 0.5% of its total export value of 35.6 billion USD. In relation to cocoa beans and cocoa paste, the overvalued estimates are 2% and 3.8%, respectively, of the total value of corresponding products exported; using the interquartile range filters. These imply that 2% of cocoa beans and 3.8% of cocoa paste are valued above the 75th percentile of their per unit price distributions.

Similar to related studies on the topic, the findings here suggest that estimates of AP differ significantly depending on the method used[4]. Method notwithstanding, this study suggests Ghana loses significant potential revenues to partner countries through undervaluation of its exported commodities. There is therefore an urgent need for government to put in more effort in providing expert knowledge and skills to track, monitor and block the sources of these IFFs. Although the government of Ghana has already put in measures, such as the setting up of a transfer pricing unit at GRA as well as an anti-money laundering department, constant skills development of personnel in these units needs to be ensured for successful outcomes.

2. NATURAL RESOURCE SECTOR IN GHANA

2.1. Cocoa Sector and Risks for IFFs

Cocoa is one of Ghana's main exports commodities. The industry provides employment for over three million farmers, employees of haulage companies, licensed buying companies and others along the cocoa value chain. 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 (Table 1). Agricultural exports contribute between 29% (including oil) and 33% (excluding oil) to Ghana's foreign exchange earnings. 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).

Table 1: The Role of Cocoa in Ghana's Economy (in Million Ghana Cedis)

	2010	2011	2012	2013	2014	2015	2016	2017
GDP (Constant 2006 prices)	24,101	27,486	30,040	32,237	33,522	34,808	36,104	39,175
Agriculture GDP (Constant 2006 prices)	6,453	6,507	6,657	7,035	7,362	7,567	7,790	8,441
Cocoa (Constant 2006 prices)	677	771	699	717	748	688	640	751
Share of cocoa in GDP (%)	2.8	2.8	2.3	2.2	2.2	2.0	1.8	1.9
Share of cocoa in Agriculture GDP (%)	10.5	11.8	10.5	10.2	10.2	9.1	8.2	8.9

Source: Provisional Annual Gross Domestic Product, April 2018 Edition, Ghana Statistical Service

Currently, Ghana is the second leading producer of cocoa in the world; second to Cote D'Ivoire. Because of the important role of cocoa in Ghana's economy, the state has been heavily involved in

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[4] Hong, K., H. Pak, C., & J. Pak, S. (2014). Measuring abnormal pricing–an alternative approach: The case of US banana trade with Latin American and Caribbean Countries. Journal of Money Laundering Control, 17(2), 203-218; and Carbonnier, G. and Mehrotra, R (forthcoming) Abnormal pricing in international commodity trade: empirical evidence from Switzerland.

the entire domestic value chain, from production to export. However, cocoa production is primarily the preserve of smallholder farmers. Annual production is close to one million metric tonnes. The Seed Production Division (SPD), the Cocoa Research Institute of Ghana (CRIG) and other input suppliers assist farmers with seeds and other inputs for cocoa production.

After production, cocoa beans are sold to licensed buying companies following inspection by the Quality Control Unit of the Ghana COCOBOD. The beans are then transported to the coast where most of the cocoa beans are exported by the Cocoa Marketing Company. Some of the beans are also sold to cocoa processing companies that make other products such as cocoa paste out of them for export. Chocolate and other confectionary items are also made for sale on the local market. The sector is regulated by COCOBOD, the Ministry of Finance, the Ministry of Agriculture and the Ministry of Lands and Natural Resources.

Risks for IFFs in Ghana's cocoa sector are expected in the area of abusive transfer pricing by the cocoa processing companies who have subsidiaries in Ghana. In addition, there is a lack of monitoring and data-collection capacity by regulatory agencies to monitor IFF risks in the sector.

2.2.   Gold Sector and Risks for IFFs

Gold is one of the many minerals mined in Ghana. Ghana is the second largest producer of gold in Africa, second to South Africa, and the tenth largest producer in the world. In 2016, gold production in Ghana reached 4.2million ounces (2016 Annual Report, Mineral's Commission). Gold is mined in mainly four regions of Ghana through Large-Scale Mining (LSM) and Artisanal and Small-Scale Mining (ASM).

The sector is regulated by a number of bodies which increases the scope for IFFs through corruption. The regulators include the Ministry for Lands and Natural Resources, the Ministry for Environment, Science and Technology, and the Ministry of Finance. Other agencies which also have an oversight role include the Minerals Commission, the Lands Commission, the Office of the Administrator of Stool Lands (OASL), the Environmental Protection Agency, the Bank of Ghana, the Ghana Revenue Authority, the One Stop Service Centre (OSSC), the Geological Survey Authority (GSA) and the Precious Minerals Marketing Company. Others include the traditional authorities in charge of land, the town and country planning unit, the district mining committees and

the security services. Many of the LSM companies are members of the Ghana Chamber of Mines. There is an association for the small-scale miners known as the Small-Scale Miners Association.

Mined amalgam gold is smelted to obtain dore bars that can be up to 23 carats; just below the 24 carats for which prices are usually quoted for global trading. However, 23 carats gold from Ghana is relatively small and so far, been mined only in one of the villages in the Eastern region. Ghana does not operate a commercial refinery that would produce and certify gold bars of very high purity such as bullion bars as technically defined. After mining, gold is transported to Accra for assaying by PMMC. Most of the gold is exported while the rest are mostly made into jewellery and sold on the local market.

The main risks for IFFs in Ghana's gold sector arise mainly in the area of export under-invoicing where multinational companies mining gold in Ghana may have an incentive to undervalue their exports with the aim of under declaring the value of exports and thereby have lower tax liability for the government of Ghana. During data collection, we realised that the data capture processes of the customs division of the Ghana Revenue Authority where officials pays closer attention to the values of import commodities than exports because most export commodities are duty free. This situation is worrying because resource rich countries such as Ghana provide many incentives to multinational companies for the sake of increasing FDI, which most developing country governments consider critical for growth and development.

3. EMPIRICAL METHODOLOGIES

There are two main methods for estimating trade mispricing – the Partner Country Trade Gap Method and the Price Filter Method. Each method has its pros and cons, some of which are discussed to guide the utilisation of this study for policy and other decision-making purposes. With such in mind, this study makes use of the Price Filter Method in the estimation of abnormal pricing through trade in Ghana. The method has two techniques namely, the interquartile price filter; and the arm's length price filter. The methods are briefly discussed here as follows.

3.1. Partner-Country Trade Gap Method

The Partner Country Trade Gap (PCTG) method is the most widely used approach for estimating trade misinvoicing. It was first developed by Bhagwati in 1964 and is based on the principle of

double-counting in international trade statistics. It uses mirror statistics whereby one country's exports are another country's imports and as such should balance out if there is no misinvoicing. However, there have been several criticisms of the PCTG approach, which include the following:

1. Incorrect to assume that trade statistics in advanced economies exhibit no misinvoicing: One main assumption of Partner Country mirror trade statistics is that it assumes advanced economies' trade statistics as arms-length values with which to compare developing countries' trade statistics. However, a 2017 study by Hong and Pak using both aggregate trade statistics from the IMF DOTS database and transaction-level trade data from Customs agencies show that a significant degree of trade misinvoicing occurs in advanced economies as well.

2. Unobserved trade costs: Typically, import transactions are valued on Cost, Insurance and Freight (CIF) basis. This has to be converted to Free-On-Board (FOB) values used for exports before any trade gaps can be calculated. Unfortunately, because data on the transaction cost of trade is generally not recorded, a 10% rule-of-thumb adjustment is used for these conversions. The rule of thumb stems from aggregate differences between global export and import values. This means that a standard 10% estimate of trade costs is limited in reliably converting bilateral trade values across all commodities which have varying shipping and insurance costs.

3. Use of aggregate trade statistics: The bulk of the related literature in the area has focused on calculating aggregate trade gaps, using total annual exports and imports figures. However, in many of the cases, bilateral data between trading partners may not be available for all goods and commodities being traded, leading to the generation of highly misleading estimates of trade gaps. In addition, the use of aggregate trade gaps can mask under or over-invoicing in particular commodities which cancel out when aggregated.

4. Data unavailability for certain countries, years, or commodities: Consistent time-series of bilateral trade statistics for all commodities is not generally available for all countries engaged in international trade. This can lead to misleading estimates of trade gaps. For instance, there is missing data on cocoa exports from Ghana for several years in the International UN Comtrade database.

5. Export and import transactions can be recorded in different years: Subject to the mode of transportation and the distance between trading points, international trade can take significant time to complete. This could lead to trade partners recording the same transaction in different years, yet trade gaps are computed using statistics for one year.

6. Entrepôt trade: For many commodities, the source and destination countries recorded actually reflects reports from intermediate ports where shipments are kept before they are finally shipped to their ultimate destinations. Also, the chance to benefit from arbitrage opportunities that arise when market prices fluctuate can lead international commodity trading firms to decide to divert shipments in transit to storage warehouses. There is double-counting when exports and imports passing through entrepôt ports are reported by both transit countries and the exporting-importing partners. For example, some exporters from neighbouring countries such as Burkina Faso bring their gold to Ghana for assaying before export and this could lead to the entrepôt trade problem.

7. Exchange rates used for currency conversion: International trade transactions are conducted either in vehicle currencies such as the US dollar or in local currencies. As a result, if different exchange rates are used by trading partners to convert trade values, there could be gaps in their mirror trade statistics. In addition, some developing countries maintain multiple exchange rate regimes, which increases the probability of such errors.

8. Country idiosyncrasies: Estimations of trade gaps may be affected by some countries deciding not to report bilateral trade flows of particular goods for particular years. For example, although Switzerland is a major importer of gold, it did not report its international trade in unwrought gold until 2012

3.2. Price Filter Analysis Method

As a result of the above shortcomings, alternative approaches such as the price filter analysis have been developed for estimating AP in international trade (eg. Pak & Zdanowicz, 1994; and Hong et al., 2014). Price filter analysis 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).[5] There are two main approaches to price filter analysis: Inter-quartile range filter and Arm's length price filter.

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[5] This is used internationally for classifying commodities. The classifications are usually up to the 6-digit level where the first two digits show the chapter of the HS code the specific commodity falls under. The third and fourth digits relate to the headings under the specified chapter and provide further details about the class of commodity. The fifth and sixth digits denote the sub-divisions of the heading, and then the individual countries and regional bodies are allowed to go up to the 10-digit level to cater for their domestic tariff arrangements as well as provide further clarity for their classifications. The HS codes are revised regularly, and sometimes, some are dropped altogether. For example, the described gold bullion in the data given by Ghana Customs has two different HS codes, namely, 7108.13.1000 and 7108.13.0010. The first is the current one being used now, and the second code is an older version that is not in use anymore.

3.2.1. Interquartile Price Filter Method

The inter-quartile price filter assumes that unit prices within 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 priced.

3.2.2. Arm's Length Price Filter Method

This framework compares actual transaction level unit prices for a particular commodity with their contemporaneous free-market price, plus or minus a reasonable filter to account for price volatility, contract variations between firms, commodity types, and various sector-specific issues. Transactions which deviate significantly from arm's length prices beyond what can be explained by reasonable price volatility are then determined to be abnormally priced. One advantage of the free market price filter approach is that researchers do not need to estimate arm's length price at all, as the free market price is readily available. In addition, the free market price filters have some other advantages over the interquartile price filters; such as the following:

o   Unlike the interquartile price filter, the free market price filter accounts for variation in monthly commodity prices.

o   The free market price filter is observed independently from the declared import values, while the interquartile prices are estimated based on the declared import values. Therefore, the free market price filter is not affected by related party transaction records in the import and export database.

To apply this approach, however, requires free market prices, which may not be readily available, especially when there is no established commodity market (Hong et al, 2014).

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, which is the weight of the commodity exported without packaging in the system unit of the HS classification. The assigned unit for weight in the data is kilogramme (kg).

Using a 10 – digit HS code, Ghana Customs recorded 7 types of gold exported within the stipulated years. This study however examines a combination of 2 of these – gold bullion (7108.13.1000) and unwrought gold, non-monetary including gold plated with platinum (7108.12.0000). These were chosen primarily because of their relatively high trade volumes and values. We also realised, upon careful examinations of the gold data and discussions with Ghana Customs, Ghana Minerals' Commission, Precious Minerals' Marketing Company, and the Ghana Chamber of Mines, that gold bullion, as described in Ghana, is any gold smelted into bars and does not necessarily correspond with the technical description of gold bullion. Therefore, the term gold bullion as used in this study is flimsy due to this mis-classifications. Indeed, the goods description under both gold bullion and unwrought gold are the same and interviews with the above-named institutions confirmed the similarities. These institutions reiterated that all the gold mined in Ghana are only semi-manufactured or processed for exports or local use in the form of jewellery, dental and cultural ornaments.

Thus, due to the mis-classifications of gold bullion and unwrought gold as well as their similarities in inter alia goods descriptions, this study combines the two in its analyses as semi-manufactured or processed gold. Henceforth in the study, this would simply be referred to as gold.

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 AP. The summary statistics of these commodities are presented in Appendix Table A1.

4.2. Free Market Commodity Price Data: 2011–2017

Daily market price data is from Thomson Reuters Datastream. This database includes global financial and macroeconomic information. The commodity exchanges' data used as benchmarks for the analyses are: the London Bullion Market Association (LBMA) for Gold Bullion LBM (USD/troy ounce), Ghanaian Cocoa Ex Dock NY Prices for the assessment of the superior quality raw cocoa beans (USD/metric ton), the African Cocoa Butter US Del Prices for the assessment of wholly and

partially defatted cocoa paste (USD/metric ton), and the International Cocoa Organisation (ICCO) – Cocoa-ICCO Daily Prices (USD/metric ton) for comparisons of both types of cocoa.

5. ESTIMATES OF ABNORMAL PRICING

Using price filter methods, this section presents annual and total estimates of AP for the selected gold and cocoa commodity exports. The estimations based on the free market price filter and the inter quartile price filter methods utilise transaction-level exports data acquired from Ghana Customs. For the free market price filter, declared export prices are compared with existing free market prices. Unit prices (in US dollars per kilogramme) are calculated by dividing the export values given in the data of the selected commodities by the weight exported.[6] The unit prices are then compared with the daily market prices declared for each commodity. Magnitudes of AP are subsequently calculated using values that fall outside the estimated arm's length price range. Those that fall below are labelled under-valued amounts, and those that fall above are labelled over-valued amounts of the exported commodities.

With regard to the calculation of the interquartile price range filter, the range between the 25th and 75th percentile of the unit prices distribution of reported export values is observed as the arm's length price range. Thus, the over-priced amounts are the values declared above the upper-quartile price range whilst the under-priced are those declared below the lower quartile price range. Although this method is better than the partner country analysis, the disadvantages are that the arm's length price range is endogenously determined, and it lacks the ability to consider product heterogeneity amongst others. Hence, although this study calculates both the market price filter and the interquartile range APs, the former is preferred especially in the case of gold estimates where trade prices fluctuates more with its market reference prices. Unlike gold, the trade prices of cocoa beans and cocoa paste do not fluctuate much with their market reference prices due to their contract and market peculiarities including, inter alia, futures trading, hedging as well as government policies. Also, because the analyses presented in this paper are based on export trade between Ghana and various partners, the AP estimates are general rather than specific to a particular trading partner.

[6] This is recorded as Net Mass in the data and the unit is kilogrammes.

5.1. Gold (Semi-Manufactured)

Gold mines in Ghana usually produce gold dore bars of about 80% purity, which are sent to refineries abroad for further purification or sold locally for jewellery making and as savings and investments. Our interviews with industry experts show that although some gold exports from Ghana are described as bullion gold, what the country actually exports are dore gold of between 80 – 90% purity. The remaining elements are silver, copper and other trace metals.

Firm level transactions data show that Ghana exported gold to 45 countries between 2011 and 2017. 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.

Ghana exported about 35.6 billion USD worth of gold to partner countries during the study period. Figure 1 shows the average monthly distribution of exports from 2011 – 2017. The highest value of gold exported is in January 2013, from where export values fell till the first quarter of 2017. The top four destination countries of Ghana's gold exports are South Africa, Switzerland, United Arab Emirates, and India, in that order.

Figure 1: Ghana Exports – Gold (Monthly, 2011 – 2017)
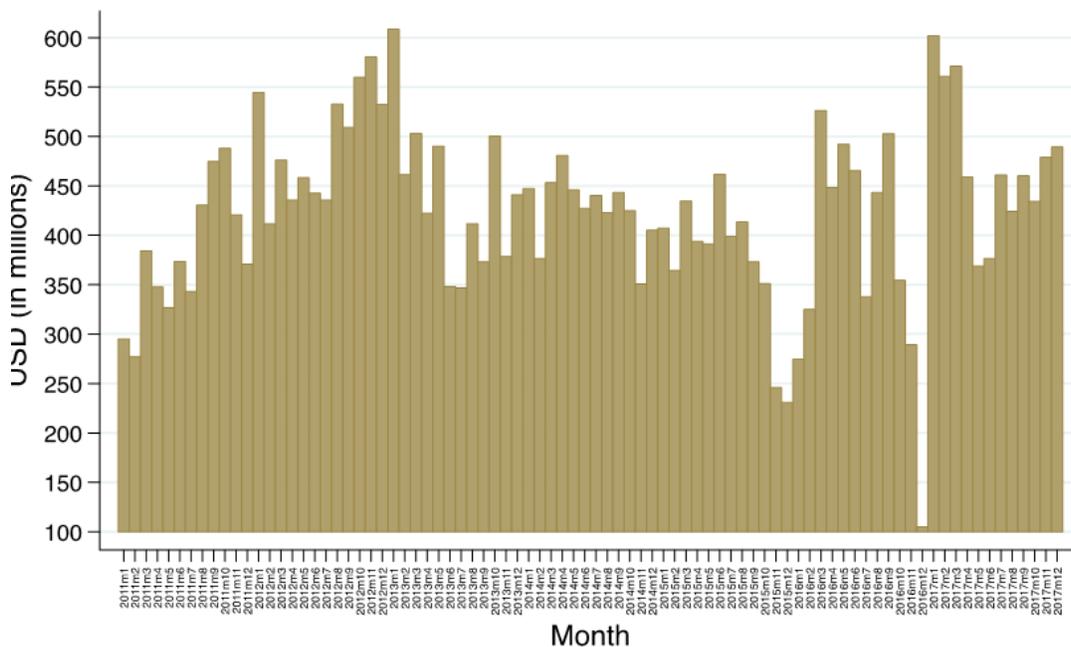
N = 20,933; Data Source: Ghana Revenue Authority (GRA) - Customs Division

Arm's Length Estimations

Declared FOB price vs free market price

In estimating the magnitude of AP, this study first compares the declared export prices (FOB) with the free market prices for gold bullion by the LBMA. Furthermore, an arm's length price range is determined by setting boundaries around the free market prices. That is, instead of making the free market prices the sole arm's length prices, we also give allowance for varied contract terms, market and country transactions idiosyncrasies. Any declared export values falling within the arm's length range are considered normal, and those out of the range are considered abnormal. In setting the boundaries (also known as filters), the following assumptions are made:

1. Product Heterogeneity (-): Since the gold bullion and unwrought gold in the GRA data refers to semi-manufactured gold dore bars of 80 – 90% purity, we do not expect the export prices to be same as the published daily export prices by LBMA used as benchmarks. We therefore assume 20% downward deviations from the benchmark 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, interest and exchange rate volatilities, 10% is added to the filters.
3. Transport and insurance costs (+): Although these are present in all transactions undertaken between trading partners, their impacts on the gold trade are quite negligible. This is particularly so because the higher the volume of gold exported, the lower the transport and insurance costs relative to the value of gold.[7]

For the reasons above, a 30% price filter is set around the benchmark (free market prices for gold bullion by LBMA). This serves as the arm's length price, deviations from which would indicate whether Ghana's gold was under – priced or over – priced between 2011 – 2017. The filters are varied by 10 percent points below and above the 30% (i.e., 20% and 40%) for the purpose of sensitivity analysis. The AP estimates based on the 20% and 40% filters are presented in Appendix B.

Figure 2 shows trends of the per unit prices of gold vis-a-vis the benchmark prices. Based solely on the free market prices for gold bullion, most of the declared export prices fall below the free market prices. Even so, this does not necessarily suggest that all these transactions are under-valued, hence

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[7] This information was gathered from two gold exporting agencies and a conversation with a contact at the Minerals' Commission.

the filters. As figure 2 shows, fewer declared export values fall below our preferred 30% filters. Tables 2 and 3 show the calculated annual and overall total under- and over- valuations, respectively.

Figure 2: Gold – Transaction-level Prices versus Free Market Prices
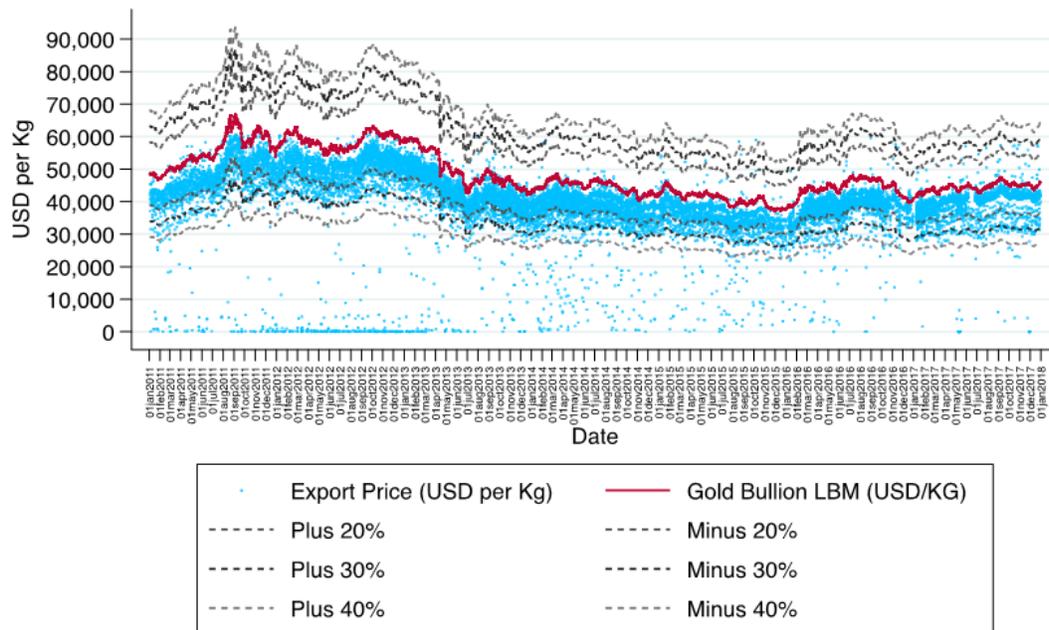
N = 20,933; Data Sources: Thomson Reuters Datastream/LBMA, Ghana Revenue Authority (GRA) - Customs Division

Arm's Length and Interquartile Range Calculations

Estimates for undervalued amount

Ghana exported 1,027 tons of gold over the study period (2011 – 2017) for 35.6 billion USD. When a 30% boundary is set below the free market price as arm's length, the amount of undervalued gold is 3.8 billion USD; constituting about 11% of the total value of gold exported. Some of the countries that received these undervalued gold exports are South Africa, Switzerland, India, United Arab Emirates, and the Netherlands. Their corresponding undervalued amounts are 999.4 million USD, 753.6 million USD, 91.7 million USD, 25.5 million USD, and 14.1 million USD, respectively.

Using the interquartile range filter, the total amount of undervalued gold exports is 5.8 billion USD or approximately 16% of the value of declared gold exports. The annual share of under-valuation of gold, based on the free market price filter, ranges from 0.04% in 2015 to 3.9% in 2016.

Table 2: Undervalued Exports – Gold

Year	Export Value (USD, Million)	Annual Exports Weight (1,000 kg)	Free Market Price Filter: Minus 30% (USD, Million)	Interquartile Range Filter: Below 25th pctle (USD, Million)
2011	4,532.3	106.7	235.1	390.5
2012	5,918.6	136.0	456.8	705.9
2013	5,284.5	145.6	513.5	759.5
2014	5,118.7	144.5	104.7	345.8
2015	4,466.6	133.2	15.9	205.7
2016	4,563.5	167.5	1,378.2	1,712.7
2017	5,685.9	193.6	1,100.2	1,654.9
Mean	**5,111.5**	**148.9**	**543.5**	**825.0**
Total	**35,569.9**	**1,027.0**	**3,804.3**	**5,775.0**
Observations	**20,933**	**20,933**	**1,141**	**5,231**

Data Source: Ghana Revenue Authority (GRA)
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 price is the daily Gold Bullion price from London Bullion Market Association (LBMA) ($/t oz). Interquartile range is calculated for unit prices (USD per kg) using transaction-level data from the GRA.

Estimates for overvalued amount

Similarly, based on the 30% boundary above the free market prices for gold, the calculated total over-valuations of gold between 2011 and 2017 are about 78.7 thousand USD (Table 3). Using the interquartile range filter, calculated over-valuation increases to 170 million USD. Relative to the total value of gold exports therefore, over-valuation seems negligible (less than 0.5%). In the case of gold exports, we prefer the estimates generated using free-market price filter method due to the presence of a clear market reference price from LME. Since the interquartile range is endogenously defined using the observed distribution of prices, this method always designates a certain proportion of transactions to be abnormally priced. It is however useful to consider in cases when there is no clear market reference price.

Table 3: Overvalued Exports – Gold

Year	Export Value (USD, Million)	Annual Exports Weight (1,000 kg)	Free Market Price Filter: Plus 30% (USD, Million)	Interquartile Range Filter: Above 75th pctle (USD, Million)
2011	4,532.3	106.7	-	33.1
2012	5,918.6	136.0	-	16.8
2013	5,284.5	145.6	-	50.9
2014	5,118.7	144.5	0.01	20.6
2015	4,466.6	133.2	0.07	14.7
2016	4,563.5	167.5	0.0002	19.3
2017	5,685.9	193.6	-	14.8
Mean	**5,111.5**	**148.9**	**0.026**	**24.3**
Total	**35,569.9**	**1,027.0**	**0.078**	**170.1**
Observations	**20,933**	**20,933**	**5**	**5,231**

5.2. Cocoa Beans (HS Code: 1801.00.1100)

Here, cocoa beans refer to superior quality raw beans. The specific descriptions in the Ghana Customs data include main crop raw cocoa beans, main crop raw cocoa beans (bulk loading), main crop raw cocoa beans (abrabopa; kuapa kooko; certified; traceable), UTZ certified main crop, 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' association etc. The Cocoa Marketing Company (CMC) Ghana Limited, a subsidiary of COCOBOD, is the sole exporting body of raw cocoa beans from Ghana. The top four destination countries of Ghana's cocoa are the Netherlands, Malaysia, United States of America and Belgium. Ghana exported 12.6 billion USD worth of cocoa to its partners between 2011 and 2017. Figure 3 shows monthly observations of cocoa beans exports.

Figure 3: Ghana Exports – Cocoa Beans (Monthly, 2011 – 17)
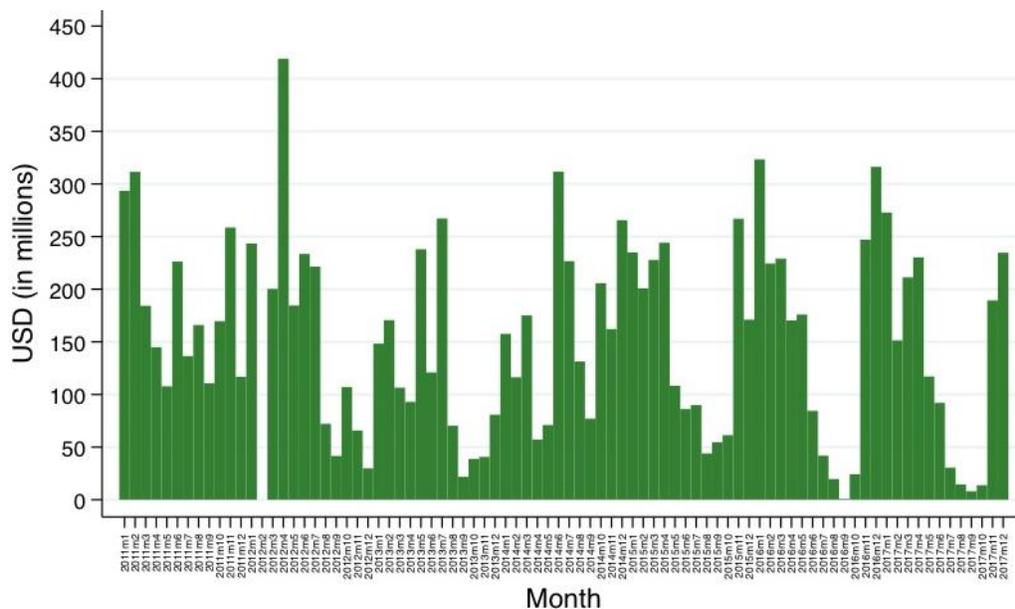
N = 13,210; Data Source: Ghana Revenue Authority (GRA) - Customs Division

Arm's Length Estimations

Declared FOB price vs free market price

As before, in order to arrive at a reasonable estimate of AP, the study juxtaposes the declared export prices of cocoa on the Ghana Cocoa Ex Dock NY prices as published by International Cocoa Exchange (ICE) from 2011 – 2017. These are accessed via Thompson Reuters Datastream database. For example, compared with the general ICCO daily prices, Ghana Cocoa Ex Dock NY prices are, on average, about 14% higher (Figure 4).[8]

With the set boundaries based on the Ghana Cocoa Ex Dock NY Prices (red line in Figure 4), superimposing the per unit export prices display different price trends, with slight variation in the export values. A possible explanation is the sale of cocoa via forward contracts. Figure 4 also shows that many of the trade transaction values are above the plus 30% arm's length range than below it, especially in clusters around mid-2012 and mid-2017. Although this suggests over-invoicing, it could be due to forward trading.

Figure 4: Cocoa Beans – Transaction-level Prices versus Free Market Prices

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

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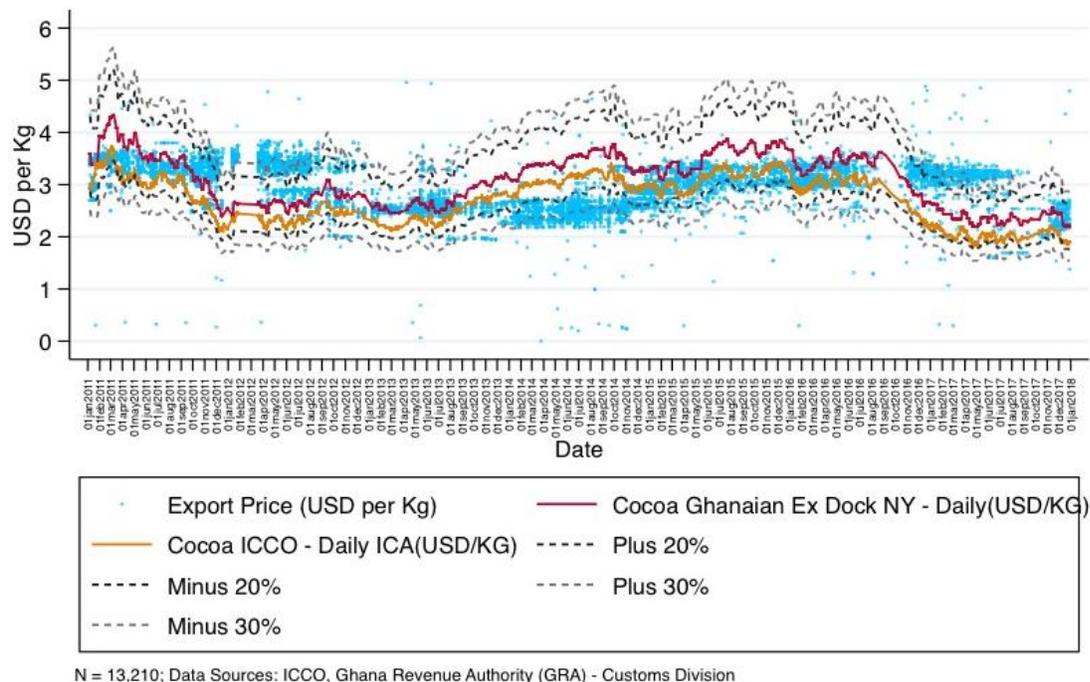
[8] This is with a standard deviation of 4 percent (see also Carbonnier and Mehrotra, forthcoming).

Filters set around selected market prices to determine the arms' length prices from which deviations suggest AP are based on assumptions guided by our qualitative research as well as related literature. The first filter is set at 20%. We also report estimates at 10% and 30% for the purpose of sensitivity analyses (see Appendix B). We make the following assumptions in determining the filter thresholds:

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[9]. 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% of the average value of the Ghana Cocoa Ex Dock NY prices per tonne for the period 2011 – 2017. We thus allow for 5% dispersion around the selected market prices due to heterogeneity.

2. Transport and insurance costs (+): According to the Cocoa Marketing Company (CMC), a subsidiary of COCOBOD, 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 100 USD per tonne or 10% of cost. 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 laden 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) also estimated transport cost of cocoa exported from Tema to Rotterdam to be around 13 percent of the market price. We thus approximate a 10% positive variation around 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 beans. Syndicated loans are used to finance purchases and about 80% of the beans bought are exported on futures sales contracts. Plausible portions of estimated AP could be reflecting these contracts cum market conditions, which we assume to vary by 5% around the market values

Given these features, assuming 20% above and below the free market prices as the arm's length range seems reasonable for estimating the magnitudes of AP for cocoa. The data shows that Ghana exported about 4.3 million tonnes of superior quality cocoa beans worth 12.6 billion USD over the

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[9] Informed via interviews with experts in the industry including personnel at COCOBOD.

study period (Table 4). The number of transactions observed during this period, after eliminating huge outliers suspected to be mis-reporting, is 13,210.

Estimates of undervaluation

In spite of the unique marketing characteristics of Ghana cocoa beans exports, it is estimated that about 337 million USD worth of cocoa beans was undervalued between 2011 – 2017 based on the 20% free market price filter (Table 4).[10] This forms about 2.7% of the total value of cocoa beans exported, which is about the same as the interquartile range filter estimates. Annual estimates show that undervaluation was highest in 2014 (roughly 13% of the total value of exported cocoa in that year).

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

Year	Export Value (USD, Million)	Annual Exports Weight (1,000 tonnes)	Free Market Price Filter: Minus 20% (USD, Million)	Interquartile Range Filter: Below 25th pctle (USD, Million)
2011	2,226.1	675.1	27.9	66.0
2012	1,818.5	566.5	5.9	42.4
2013	1,396.6	538.0	6.9	11.7
2014	1,957.0	783.7	252.2	85.6
2015	1,790.0	578.4	11.1	23.4
2016	1,857.3	576.5	18.3	34.2
2017	1,565.6	554.5	15.1	83.1
Mean	**1,831.3**	**628.3**	**48.2**	**49.5**
Total	**12,611.1**	**4,272.6**	**337.4**	**346.5**
Observations	**13,210**	**13,210**	**2,747**	**3,258**

Data Source: Ghana Revenue Authority (GRA)
Notes: Cocoa beans is superior quality raw beans (HS: 1801.00.1100). Free market price is the Ghanaian Cocoa Ex Dock NY Prices (US$/MT). Interquartile range is calculated for unit prices (USD per kg) using transaction-level data from the GRA.

Estimates of overvaluation

The estimates of abnormally overvalued cocoa beans exports are similar to the undervaluation estimates. For example, based on the free market price filter analysis, the estimated overvalued amount of superior quality cocoa beans is 360 million USD or 2.9% of total exports over the entire study period (Table 5). The over-valued total estimate using the interquartile range filter is less than the estimate of the free market price filter by about 104 million USD.

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[10] 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.

Table 5: Overvalued Exports – Cocoa Beans (HS: 1801.00.1100)

Year	Export Value (USD, Million)	Annual Exports Weight (1,000 tonnes)	Free Market Price Filter: Plus 20% (USD, Million)	Interquartile Range Filter: Above 75th pctle (USD, Million)
2011	2,226.1	675.1	18.5	25.4
2012	1,818.5	566.5	145.9	35.6
2013	1,396.6	538.0	19.8	37.4
2014	1,957.0	783.7	10.0	56.9
2015	1,790.0	578.4	6.5	18.4
2016	1,857.3	576.5	55.2	61.1
2017	1,565.6	554.5	104.5	21.5
Mean	1,831.3	628.3	51.5	36.6
Total	**12,611.1**	**4,272.6**	**360.3**	**256.3**
Observations	**13,210**	**13,210**	**2,384**	**3,290**

Data Source: Ghana Revenue Authority (GRA)
Notes: Cocoa beans is superior quality raw beans (HS: 1801.00.1100). **Free market price** is the Ghanaian Cocoa Ex Dock NY Prices (US$/MT). **Interquartile range** is calculated for unit prices (USD per kg) using transaction-level data from the GRA.

5.3. Cocoa Paste (HS Code: 1803.20.0000)

Ghana Customs describe 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 1.8 billion USD. The top four countries that bought some of these cocoa pastes are the Netherlands, France, Belgium and Switzerland. Figure 5 shows the monthly distribution of cocoa product exports using the Customs data.

Figure 5: Ghana Exports – Cocoa Paste (Monthly, 2011 – 2017)
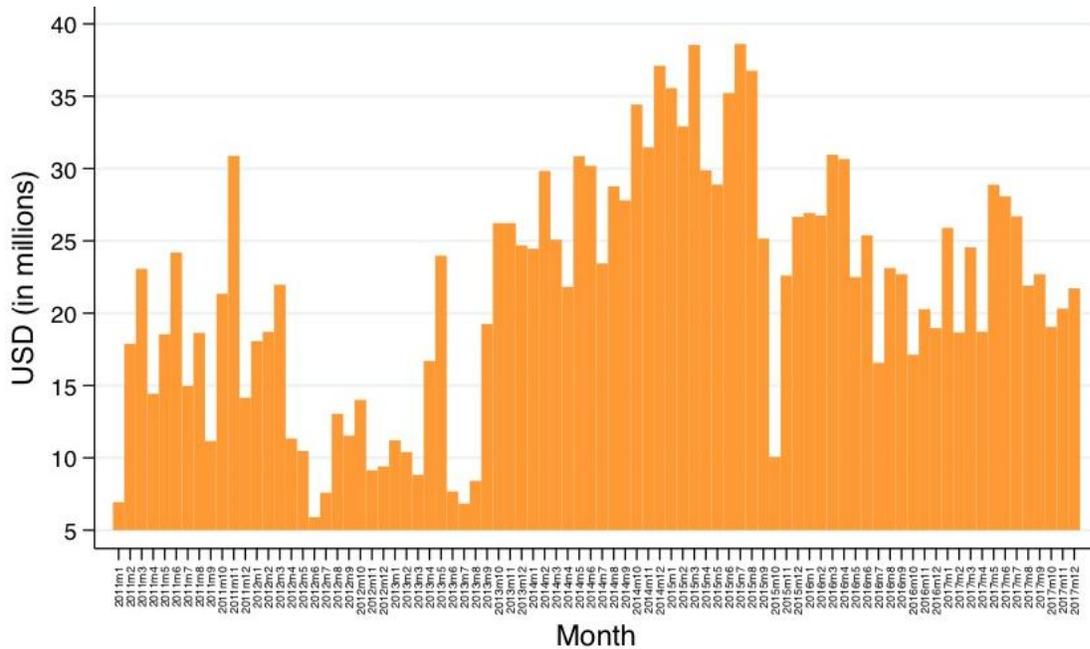
N = 5,889; Data Source: Ghana Revenue Authority (GRA) - Customs Division

Arm's Length Estimations

Declared FOB price vs free market price

Abnormal pricing of cocoa butter is achieved by comparing the per unit prices of the processed products (acquired from the declared export values as recorded in the customs data) with the market values of African cocoa butter. The African cocoa butter daily prices are used as benchmarks because they are the market prices for the region and could cater for the butter from Ghana although prices may be relatively high for cocoa liquor, nibs and cakes. In the cocoa processing industry, the butter is the most expensive of all the processed products (Dand, 2011).

As Figure 6 shows, the published African cocoa butter prices could be up to twice the general ICCO prices for cocoa beans, although the price differences were negligible in the late 2011 to 2012. Figure 6 also shows a high degree of price rigidity. Indeed, the per unit prices of the products show a near linear trend just around four USD per kilogramme. These prices are also mostly below the benchmark prices except for some part of 2011 and 2012. With the products under the HS code being relatively more heterogeneous than those of the cocoa beans, the arm's length range set is bigger; even after considering the use of the African cocoa butter market prices. The boundaries are fixed under the following assumptions:

1. Product Heterogeneity (+/-): With the different products captured here, covering the various outcomes of processed cocoa, a variation of 10% around the benchmark is considered prudent for the assessment. Since the prices for cakes/mass or even liquor, for instance, are lower than the butter in general, the filter would cater for them as the benchmark caters for the butter. In addition, some factories spend extra resources to get the product in the form required since cocoa producing countries are unable to meet such quality demands (Dand, 2011). This could lead to lower offer prices than the benchmark market prices. We add extra 5% for various certification requirements such as Organic, Fairtrade, traceability, and Forest Alliance, yielding an estimated 15% arm's length range due to product heterogeneity.

2. Market conditions and contract terms (+/-): Processing the cocoa does not only have to meet particular factory specifications (e.g., aromas, colours, fat content, degree of alkalisation) but also be delivered at precise times and conditions for further processing to suit their customers' standards (Dand, 2011). Traders would therefore have various contract terms with exporters depending on their ability to deliver the needed quantity and specifications as well as on time, which could eventually affect export prices. We therefore estimate around 15% plus or minus the benchmark market prices for such variations in the market conditions and contracts.

3. Transport and insurance costs (+): The shipment of processed cocoa products is generally less costly than the beans because they are less bulky. They are also treated as food, so extra care is given during shipment and handling. It has been estimated that 1.25 kilogrammes of cocoa beans make 1.0 kilogrammes of cocoa liquor (Dand, 2011). We therefore assume that with varied weights of the various cocoa products, transport and insurance would cost between 5 - 8%.

In sum, we rationalise that setting the filters at 40% would better capture the heterogeneous aspect of the products under this HS code. A 30% filter has also been included for sensitivity test (Figure 6).

Figure 6: Cocoa Paste – Transaction-level Prices versus Free Market Prices
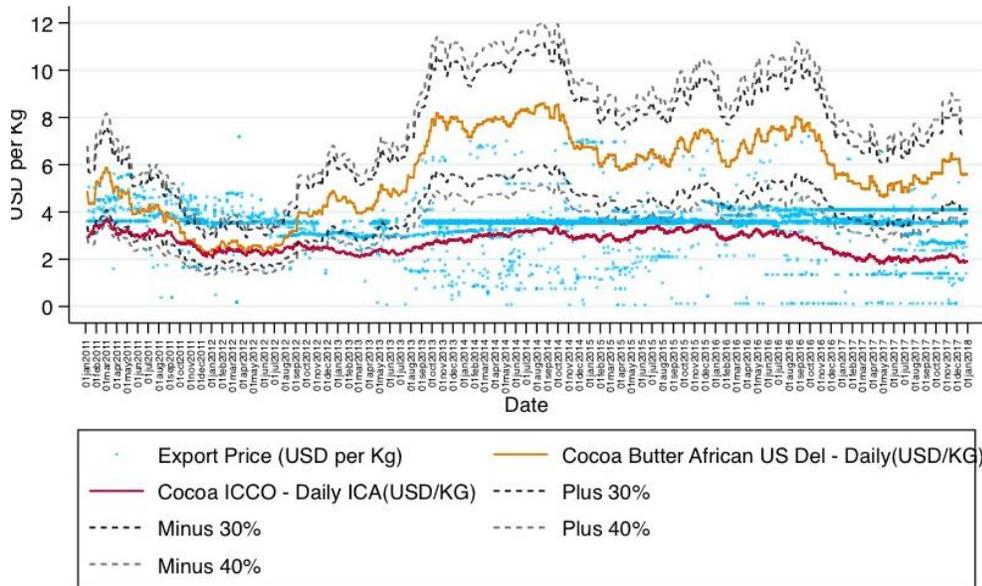
N = 5,889; Data Sources: ICCO, Ghana Revenue Authority (GRA) - Customs Division

Arm's Length and Interquartile Range Calculations

Estimates of undervalued cocoa paste

Table 6 gives estimates of both annual and total abnormally undervalued cocoa paste exports. With a 40% arm's length range set below the free market prices, the amount of undervalued cocoa paste is 332 million USD or 18.2% of total export value between 2011 and 2017. The corresponding estimates using the interquartile range filter is 136.9 million USD or 7.5% of the total export value.

Due to the presence of a high degree of price rigidity in the cocoa paste data, we prefer the AP estimates based on the interquartile range filter to the free market filter. This is because the export values clearly show slight response to the free market reference making it a not so suitable benchmark for the analysis. Although endogenously determined, the interquartile range filter provides better AP estimates where market rigidities exist. As such, our results suggest that 7.5% of Ghana's cocoa paste exported within the study period were undervalued; since these values are found below 25% of the total price distribution of the product.

Table 6: Undervalued Exports – Cocoa Paste (HS: 1803.20.0000)

Year	Export Value (USD, Million)	Annual Exports Weight (1,000 tonnes)	Free Market Price Filter: Minus 40% (USD, Million)	Interquartile Range Filter: Below 25th pctle (USD, Million)
2011	216.2	56.4	2.0	8.1
2012	151.1	43.5	0.4	3.5
2013	190.4	60.0	46.2	11.8
2014	345.2	102.7	144.3	39.8
2015	360.9	103.7	50.2	24.9
2016	281.9	79.9	53.2	18.4
2017	277.2	85.8	36.3	30.3
Mean	**282.3**	**82.8**	**47.5**	**19.6**
Total	**1,822.9**	**532.0**	**332.5**	**136.9**
Observations	**5,889**	**5,889**	**3,427**	**1,359**

Data Source: Ghana Revenue Authority (GRA)
Notes: Cocoa paste includes wholly and partly defatted (HS: 1803.20.0000). **Free market price** is the African Cocoa Butter US Del Prices (US$/MT). **Interquartile range** is calculated for unit prices (USD per kg) using transaction-level data from the GRA.

Estimates of overvalued cocoa paste

Overvaluation of cocoa paste, using the free market price filter, is somewhat insignificant (Table 7). With 275 observations, the estimated overvalued amount using the free market price filter is 11.2 million USD (less than 1% of the total export value). However, our preferred estimates, the interquartile range filter, suggests an overvaluation of 69.8 million USD, constituting roughly 3.8% of the total value of cocoa paste exported.

Table 7: Overvalued Exports – Cocoa Paste (HS: 1803.20.0000)

Year	Export Value (USD, Million)	Annual Exports Weight (1,000 tonnes)	Free Market Price Filter: Plus 40% (USD, Million)	Interquartile Range Filter: Above 75th pctle (USD)
2011	216.2	56.4	3.1	8.4
2012	151.1	43.5	8.1	7.2
2013	190.4	60.0	-	3.9
2014	345.2	102.7	-	19.1
2015	360.9	103.7	-	15.3
2016	281.9	79.9	-	6.3
2017	277.2	85.8	-	9.5
Mean	**282.3**	**82.8**	**5.6**	**10.0**
Total	**1,822.9**	**532.0**	**11.2**	**69.8**
Observations	**5,889**	**5,889**	**275**	**1,227**

Data Source: Ghana Revenue Authority (GRA)
Notes: Cocoa paste includes wholly and partly defatted (HS: 1803.20.0000). **Free market price** is the African Cocoa Butter US Del Prices (US$/MT). **Interquartile range** is calculated for unit prices (USD per kg) using transaction-level data from the GRA.

6. RISKS FOR IFFs IN GHANA'S NATURAL RESOURCE SECTOR

One major driver of illicit financial flows in Ghana's commodity sector is capital flight through export under invoicing.

Given the structure of Ghana's gold sector where the bulk of companies operating in the sector are multi nationals, the revenue the state obtains from the sector is mainly through corporate and income taxes as well as royalties and withholding tax (Annual Report, 2017, Minerals' Commission). However, these companies tend to under report/under invoice their exports to allow free movement of money out of the country. This is because whatever taxes they need to pay to the government is based on the value of exports declared. As such, if the undervaluation occurs, then it reduces their tax liability to the state while the money that has been illicitly moved out of the state can be used by the company for other purposes. It is also in line with abusive transfer pricing in the sense that many of the companies that export gold from Ghana are subsidiaries of multinationals who may be importing their own gold. The same can be said for the cocoa sector where the bulk of processing companies are multinationals.

The weaknesses in the regulatory environment also contribute to IFFs in the commodity sector in Ghana. One instance is where customs officials of GRA do not pay as much attention to volumes and values of exports recorded as they do to imports. This is because most exports do not attract any tax and as such, customs officials may not feel the same level of responsibility as they do for imports to ensure that accurate values are recorded. For example, an official may be punished for causing revenue loss to the state if he/she does not charge the right amount of tax on an imported item or if it is discovered that there has been under invoicing. However, the same may not be true for exports since no taxes are charged and as such, officers do not feel directly responsible to ensure that accurate values are recorded.

In addition, the different regulatory agencies in the gold sector and the fact that they do not use an integrated system can create opportunities for IFFs. For example, data reported by GRA, Ghana Statistical Service, Bank of Ghana and the Minerals Commission on gold in Ghana show discrepancies for the period of the study. Each of these institutions has their own focus for the data they collect and as such create opportunities for companies in the sector to engage in IFFs.

7. 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 socioeconomic 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 AP for Ghana between 2001 and 2017 using gold (gold bullion and unwrought gold) and cocoa (superior quality cocoa beans and cocoa paste) as case studies. The current estimates are relatively more accurate as it relies on transaction level microdata rather than the aggregate trade statistics used in the partner country trade method.

Based on the market reference price filters for gold, this study finds that gold exports are undervalued by roughly 11% of the total value of gold exported (35.6 billion USD). The undervalued amount constituting 3.8 billion USD below the contemporaneous London market prices are lost to countries Ghana trades with including South Africa (999.4 million USD), Switzerland (753.6 million USD), India (91.7 million USD), United Arab Emirates (25.5 million USD) and the Netherlands (14.1 million USD). Due to price rigidities observed in the marketing of cocoa and cocoa paste, the interquartile range filters were preferred to the use of contemporaneous market prices as reference for AP estimate. Thus, based on the interquartile range filters, we estimate that 2.7% of the 12.6 billion USD worth of cocoa beans exported and 7.5% of the total export of cocoa paste (1.8 billion USD) were undervalued during the period of the study. We do not find the estimates of cocoa paste so surprising as the industry is dominated by Multinational Companies (MNCs) with sophisticated operational systems. With global subsidiaries, MNCs can easily shift prices as well as bargain to get as much from a contract as possible to the plausible detriment of an exporting country with a weaker industry. The overvaluation estimates of the selected products are somewhat negligible; less than 0.5% of the total value of exported gold. This suggests that overvaluation is hardly an issue in Ghana's gold exports.

Our findings thus corroborate existing literature that IFFs via commodity trading is a risk in Ghana. There is therefore an urgent need for government to put in more effort in providing expert knowledge and skills to track, monitor and block the sources of these IFFs. Although the government of Ghana has already put in measures, such as the setting up of a transfer pricing unit at

GRA as well as an anti-money laundering department, to streamline illicit operations, constant skills improvement of personnel of these units need to be ensured for successful outcomes.

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APPENDICES

A1   Summary Statistics

Table A1: Summary statistics of selected commodities

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

B1   Sensitivity Analysis with Different Free Market Price Filters

Table B1: Undervalued Exports – Gold (HS: 7108.13.1000 &7108.13.1000)

Year	Export Value (USD, Million)	Annual Exports Weight (1,000 kg)	Free Market Price Filter: Minus 10% (USD, Million)	Free Market Price Filter: Minus 20% (USD, Million)	Free Market Price Filter: Minus 40% (USD, Million)
2011	4,532.3	106.7	817.1	367.0	183.2
2012	5,918.6	136.0	1,295.0	669.9	386.6
2013	5,284.5	145.6	1,231.4	690.0	432.5
2014	5,118.7	144.5	714.4	273.7	78.2
2015	4,466.6	133.2	477.3	123.6	6.8
2016	4,563.5	167.5	2,239.4	1,671.3	1,168.7
2017	5,685.9	193.6	2,106.7	1,489.1	925.4
Mean	**5,111.5**	**148.9**	**1,268.8**	**754.9**	**454.5**
Total	35,569.9	1,027.0	8,881.4	5,284.6	3,181.3
Observations	20,933	20,933	13,675	3,623	637

Table B2: Overvalued Exports – Gold (HS: 7108.13.1000 &7108.13.1000)

Year	Export Value (USD, Million)	Annual Exports Weight (1,000 kg)	Free Market Price Filter: Plus 10% (USD, Million)	Free Market Price Filter: Plus 20% (USD, Million)	Free Market Price Filter: Plus 40% (USD, Million)
2011	4,532.3	106.7	-	-	-
2012	5,918.6	136.0	-	-	-
2013	5,284.5	145.6	0.3	0.1	-
2014	5,118.7	144.5	0.2	0.08	-
2015	4,466.6	133.2	0.3	0.1	0.025
2016	4,563.5	167.5	0.1	0.02	-
2017	5,685.9	193.6	0.7	0.13	-
Mean	**5,111.5**	**148.9**	**0.32**	**0.1**	**0.025**
Total	35,569.9	1,027.0	1.6	0.5	0.025
Observations	20,933	20,933	66	30	2

Table B3: Undervalued Exports – Cocoa Beans (HS: 1801.00.1100)

Year	Export Value (USD, Million)	Free Market Price Filter: Minus 10% (USD, Million)	Free Market Price Filter: Minus 30% (USD, Million)	Free Market Price Filter: Minus 40% (USD, Million)
2011	2,226.1	67.0	20.9	17.1
2012	1,818.5	10.7	3.8	3.0
2013	1,396.6	21.4	1.8	0.5
2014	1,957.0	480.9	92.2	59.0
2015	1,790.0	81.4	3.4	1.8
2016	1,857.3	43.8	11.1	6.9
2017	1,565.6	23.7	10.3	7.4
Mean	1,831.3	104.1	20.5	13.7
Total	**12,611.1**	**728.8**	**143.4**	**95.7**
Observations	**13,210**	**5,192**	**1,105**	**70**

Table B4: Overvalued Exports – Cocoa Beans, Superior Quality (HS: 1801.00.1100)

Year	Export Value (USD, Million)	Free Market Price Filter: Plus 10% (USD, Million)	Free Market Price Filter: Plus 30% (USD, Million)	Free Market Price Filter: Plus 40% (USD, Million)
2011	2,226.1	36.8	10.6	6.5
2012	1,818.5	242.9	67.3	24.8
2013	1,396.6	23.0	18.0	17.3
2014	1,957.0	10.6	9.5	9.1
2015	1,790.0	6.8	6.2	5.9
2016	1,857.3	83.6	45.4	41.8
2017	1,565.6	187.4	46.0	18.7
Mean	**1,831.3**	**84.4**	**29.0**	**17.7**
Total	**12,611.1**	**591.1**	**203.1**	**124.0**
Observations	**13,210**	**3,127**	**1,386**	**471**

Table B5: Undervalued Exports – Cocoa Paste, Wholly or Partly defatted (HS: 1803.20.0000)

Year	Export Value (USD, Million)	Free Market Price Filter: Minus 10% (USD, Million)	Free Market Price Filter: Minus 20% (USD, Million)	Free Market Price Filter: Minus 30% (USD, Million)
2011	216.2	15.0	8.1	3.8
2012	151.1	8.6	4.0	1.3
2013	190.4	142.3	105.9	72.8
2014	345.2	373.9	296.6	219.8
2015	360.9	240.4	176.0	111.7
2016	281.9	212.1	157.5	103.5
2017	277.2	138.4	94.0	57.2
Mean	**282.3**	**161.5**	**120.3**	**81.4**
Total	**1,822.9**	**1,130.8**	**841.9**	**570.1**
Observations	**5,889**	**5,173**	**4,937**	**4,284**

Table B6: Overvalued Exports – Cocoa Paste, Wholly or Partly defatted (HS: 1803.20.0000)

Year	Export Value (USD, Million)	Free Market Price Filter: Plus 10% (USD, Million)	Free Market Price Filter: Plus 20% (USD, Million)	Free Market Price Filter: Plus 30% (USD, Million)
2011	216.2	16.6	10.6	6.1
2012	151.1	24.5	18.6	12.9
2013	190.4	-	-	-
2014	345.2	-	-	-
2015	360.9	0.2	-	-
2016	281.9	0.01	-	-
2017	277.2	0.3	0.1	0.02
Mean	**282.3**	**8.3**	**9.7**	**6.4**
Total	**1,822.9**	**41.6**	**29.2**	**19.1**
Observations	**5,889**	**503**	**427**	**376**