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Abnormal Pricing in International Commodity Trade: Evidence from Lao P.D.R.

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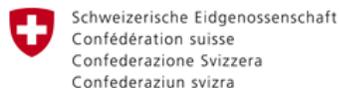
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Commodity Trade Mispricing: Evidence from Lao P.D.R.

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Abstract: Mispricing of international trade in natural resources is a significant channel for tax base erosion from resource-rich developing countries. Existing evidence indicates that trade mispricing from developing countries could exceed USD 1 trillion annually. However, the empirical approach based on asymmetries in aggregate trade data suffers from various limitations resulting in unreliable estimates. In this paper, we apply a novel, interdisciplinary approach motivated by legal rules for trade valuation and statistical price-filter methods informed by commodity experts to estimate the magnitude of trade mispricing commodity exports from Laos, i.e. exports valued outside an estimated arm's length price range that represents fair market values. Using transaction-level export microdata from Lao Customs, our results indicate that the undervalued export for copper cathodes, copper concentrate and coffee beans equalled USD 9.47 million (0.32 percent of total copper cathode export value), USD 124.9 million (6.8 percent of total copper concentrate export value), and USD 260 million (77.1 percent of total coffee export value) respectively during 2012-2017. We identify transfer pricing, i.e. trade between affiliated firms, and limited commodity export valuation capacity of Lao authorities as important drivers of this phenomenon.

Key words: commodity trade; illicit financial flows (IFFs); Lao PDR; price filter analysis; resource sector; and trade mispricing.

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

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1. Introduction

Trade mispricing represents a significant economic and regulatory challenge for developing countries. It is defined as customs and tax fraud involving exporters and/or importers deliberately misreporting the value, quantity, or nature of goods or services in a commercial transaction. This phenomenon is driven by tax-motivated profit shifting, off-shoring of financial assets and evasion of customs duties or trade restrictions on particular products or countries and represents a significant economic and regulatory challenge, especially for developing countries (Beer, Mooij, and Liu, 2018; Carbonnier and Mehrotra, 2018; Crivelli, Mooij, and Keen, 2015). The resulting flight of financial capital erodes the tax base of developing countries, where tax revenue as a proportion of economic activity remains significantly below potential.¹ Commodity-dependent developing countries that rely on revenue from their natural resource sector are particularly susceptible to commodity-trade mispricing driven by limited regulatory capacity and economic incentives of multinational actors with the capacity to shift income to low-tax jurisdictions (Guo, 2013; Mascagni, Moore, and McCluskey, 2014; OECD, 2017). Existing global estimates indicate that trade mispricing from developing countries could potentially equal USD 1 trillion annually (Global Financial Integrity, 2017). While the underlying aggregate trade statistics and empirical methods have been shown to be unreliable for estimating the true magnitude of this phenomenon, it has nonetheless triggered a significant push by policymakers to respond to trade-related tax base erosion (Beer *et al.*, 2018; Nitsch, 2016; OECD, 2014, 2017; United Nations, 2017).

This paper proposes a novel and interdisciplinary approach for estimating the magnitude of trade mispricing in commodity exports motivated by legal rules of customs valuation and transfer pricing analysis. Trade mispricing is defined as the magnitude of trade valued outside an assumed arm's length price range which represents fair market value between unrelated buyers and sellers (Hong and Pak, 2017; World Customs Organization, 2018). Our empirical approach, therefore, compares the valuation of transaction-level trade microdata with an appropriate market benchmark calculated using free-market prices adjusted for relevant product and market-specific factors identified by traders and regulators. This methodology is motivated by the World Trade Organization's Transaction Value methods for customs valuation and the Comparable Uncontrolled Price (CUP) method for transfer pricing analysis of trade between related firms (IMF *et al.*, 2017; United Nations, 2017).² Note that transfer pricing or abusive transfer pricing refers to '*the manipulation of intra-firm transactions with a multi-national corporation, in order to reduce the overall tax exposure of the corporate group*' (Norasingh, Musselli, and Bonanomi, 2020). These methods recommend the use of quoted, free-market prices as a starting point for identifying arm's length prices, subject to reasonable comparability adjustments.³ We define the arm's length

¹ According to Modica *et al.* (2018), tax revenue-to-gross domestic product ratios remain significant lower in Africa (between 10.8 to 30.3 percent) and Latin America (between 12.4 to 38.6 percent), compared to OECD countries (range from 16.2 to 45.9 percent).

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 Our empirical approach is distinct from comprehensive case-by-case audits which are based on accurately delineating each transaction based on a fact-intensive transactional and functional analysis on a case-by-case basis. Case-specific 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

price range for our selected commodities based on their benchmark prices quoted by commodities exchanges, product characteristics (metal purity or bean types), transportation costs, and normal contractual variations. Moreover, additional data sources on commodity characteristics and fact-intensive interviews with commodity traders and regulators are used to determine this information.

Our analysis focuses on copper cathode, copper concentrate, and coffee exports from Laos since they represent the country's most significant extractive and agricultural export commodities. We use transaction-level export microdata at 8 digits level based on the international classification of Harmonized System (HS) from Lao Customs for the period 2012-2017. This study also uses the data on free-market, reference prices for Lao copper and coffee exports from Thomson Reuter Datastream and the International Coffee Organization (ICO).

We find a significant magnitude of trade mispricing in Lao commodity exports of copper concentrate and coffee beans during 2012-2017. This indicates that the invoiced export prices agreed between the exporters and importers and recorded at Lao customs are outside the defined arm's length price range that represents fair market values. In particular, we find significant undervaluation in coffee exports. We define the arm's length price range using + 40 percent above and - 20 percent below the free-market price of coffee beans from the International Coffee Organization (ICO) to investigate the trade mispricing. This range considers the type of coffee beans produced (*arabica* and *robusta* varieties), transportation costs and market factors informed by commodities experts. By comparing the customs transaction values with the defined arm's length price range, we find under-valued transactions equal USD 260 million or 77.1 percent of total coffee exports. This undervaluation results in an estimated tax revenue loss of USD 3.1 million during the study period assuming a fixed profit tax of 5 percent and the standard corporate income tax rate of 24 percent (Coffee companies and Lao Coffee Association (LCA), 2018). The under-valued transactions are largely seen in exports to Vietnam.

For copper concentrate, the daily spot price at the London Metal Exchange (LME) is used as the free-market price, which is adjusted for the degree of pure copper content in the concentrate. Transportation and logistical costs are taken into account to define the arm's length price range between the daily spot price (adjusted for copper content) and + 5 percent above. We find overvaluation of USD 259.3 million and undervaluation of USD 124.9 million occurring from transactions outside the arm's length price range. These figures represent 14.1 percent and 6.8 percent of total invoiced copper concentrate exports, respectively. Exports to China is the main source of trade mispricing. However, the interpretation of these mispricing estimates is different from coffee because Lao mining companies export at pre-determined fixed prices and later adjust the actual gain and loss in their annual financial statements (Anonymous mining company A, 2018). Transaction-level information on each mining company's adjustments between export invoice prices and final sales prices is not publicly available. Therefore, this limits the interpretation of any mispricing and tax revenue loss estimates for copper concentrate export from Laos.

For refined copper, as the daily spot price at the London Metal Exchange (LME) is used as the free-market price, the value of trade mispricing outside the defined price filter (+ 10 and - 5) is significantly small compared with coffee and copper concentrate. It is because most of the declared invoiced prices by exporters are in line with the defined arm's length price range. As a result, the

of criteria used to delineate the economically relevant characteristics for transfer pricing analysis, see: Chapter 1-D1, OECD, (2017).

values take USD 2.83 million for over-valuated transactions and USD 9.47 million for under-valuated transactions. These numbers are less than 0.4 percent of total copper cathodes export value, which represents weak evidence of trade mispricing for this commodity export.

Our qualitative analysis of the commodity value chains in Laos indicates that trade among affiliated firms (parent and subsidiary companies, or companies under common control) and the limited capacity of authorities in the valuation of export are the most significant risks for trade mispricing in coffee and copper exports from Laos. Furthermore, the fixed export invoice prices adds to lack of transparency in copper sector (Anonymous mining company A, 2018). The role of local agents to acquire coffee beans from farmers on behalf of importers is also identified as a contributing factor for trade mispricing risks in the Lao coffee sector.

This paper makes significant contributions to the literature. First, we use transaction-level analysis of commodity trade and combine statistical methods with qualitative research to estimate a more reliable arm's length price range. Unlike previous studies which have used price filter analyses, we advance beyond arbitrary estimates to set arm's length price range. Notable studies in the research area include K. Hong et al. (2014) who used the free market price filter approach to assess trade mispricing for the US banana trade with Latin American and Caribbean countries.

Next, we provide novel evidence of trade mispricing from the Lao People's Democratic Republic, a resource-rich developing country in Southeast Asia. Past evidence is generally limited to macroeconomic studies of partner-country trade gaps or asymmetries in aggregate and product-level export and import statistics of trading partners. Global Financial Integrity (2017) applied the partner-country trade gaps indicates that the value of mis-invoicing in export could reach 12 percent of total export value while the value of mis-invoicing in import could be 53 percent of total import value during 2005-2014. Likewise, Bannister et al. (2017) demonstrate that Laos is potentially underreported by 8-50 percent for the export and 30-70 percent for the imports. However, underlying this aggregate trade data has some important limitations due to which their estimates of trade mispricing are generally considered weak evidence of trade mispricing and cross-border financial flows (Global Financial Integrity, 2017; Ndikumana, 2016). Certain studies have also used transaction-level trade data instead of aggregate data to analyze trends of trade mispricing at the commodity level. However, this evidence currently remains limited to certain advanced economies due to administrative restrictions on public access to transaction-level customs data (Hong *et al.*, 2014; Hong and Pak, 2017; Zdanowicz, Pak, and Sullivan, 1999). Therefore, our case study of Laos will be one of the first pieces of literature that analyzes the trade mispricing at the commodity level in developing countries.

From an economic development perspective, the Lao economy is heavily dependent on capital-intensive natural resource sector exports, which include mineral and agricultural commodities (copper, gold, coffee, wood products, cassava), as well as significant hydroelectricity generation. However, domestic revenue mobilization remains low in Laos compared with other developing countries. According to the Ministry of Finance (2020) and World Bank (2020), total domestic revenue equaled only 14.3 percent of GDP in Laos in 2018 compared to 19.9 percent in neighboring Cambodia and 19.5 percent in Thailand. For this reason, expanding the tax base, improving tax administration and increasing revenue contributions from the natural resource sector are important priorities for Lao government. Since there is a lack of available evidence on significant risks for tax base erosion due to commodity trade mispricing in Laos, the finding of this study can be used to inform policymakers and motivate well-targeted regulatory responses.

Furthermore, this study also contributes directly to the Sustainable Development Goals (SDGs) for target 16.4.1: curbing illicit financial flows (IFFs) and target 17.1: strengthening domestic resource mobilization by explicitly identifying the magnitude of trade mispricing as one of three major components of IFFs at the commodity trade and discuss the ways to stop the leak of tax loss due to the trade mispricing. Other components of IFFs are illegal natural resource extraction, harvesting or capture; and corruption-related flows (Norasingh *et al.*, 2020).

The rest of this paper proceeds as follows. The next section reviews the background of copper and coffee industries and discusses the potential risks of trade mispricing in these sectors. The empirical methodology and data are described in section 3 while section 4 discusses the results. Section 5 concludes with some reflections on policy implications for Laos and other developing countries.

2. Natural resource sector in Laos and risks for trade mispricing

This sector provides relevant background on copper and coffee industry in Laos before discussing trade mispricing risks based on the discussion and expert interviews with private and public organizations such as tax authorities, Lao coffee association, and firms.

2.1. Copper sector

Copper has contributed significantly to the Lao economy as one of the main export commodities and an important source of government revenue. During 2012-2017, the extractive sector, especially copper, contributed an average of 4.2 percent of total domestic government revenues (Department of Tax, 2018). Laos mainly produces and exports copper concentrates and copper cathodes. The production of copper cathodes has remained constant at around 64 kilotons annually during 2010-2017 while the production of copper concentrates slightly increases from 298.7 kilotons to 398.8 kilotons during the same period (Lao Statistics Bureau, 2011, 2018). In total, the value of copper export increased from USD 886 million in 2012 to USD 1,183 million in 2018, approximately equal to 90 percent of total mineral exports from Laos during this period. The main export markets of copper are Thailand, China, Vietnam, the Republic of Korea, and Malaysia (Department of Export and Import, 2018). Lao copper industry is dominated by few large scale mining firms where the main investors are from China and Australia. Lao mining industry mostly engages in the mining stage of the value chain to produce, export copper concentrate and cathodes (Anonymous mining company A, 2018; Anonymous mining company B, 2018). There are also other several medium and small scale operations mostly at the prospecting and exploration stage.

2.2. Coffee sector

Coffee is Laos' major agricultural export and contributes significantly to the value-added of the agriculture sector. The harvested area increased from 50.6 thousand ha in 2010 to 93.3 thousand ha in 2017 and coffee production also increased from 46.3 kilotons to 150.8 kilotons (Lao Statistics Bureau, 2011, 2018). In 2016 the coffee plantation area shares 6.4 percent of total agricultural land and covers less than 1 percent of the global harvested area and 1.46 percent of the world output (FAO, 2018). Laos produces and exports both Robusta and Arabica coffee varieties. The share of Arabica in coffee export was in an upward trend over the last decade from 19 percent in 2006 to

67 percent in 2017 (The Lao Coffee Association, 2014). However, the majority of Lao coffee export is still in the form of green coffee beans (more than 90 percent in 2017) where coffee roasting is taken placed overseas.

Lao coffee industry mainly focuses on the plantation, primary processing, and export stage of the coffee supply chain while most of the roasting is done offshore. Lao coffee producer comprises of many players of different scales and several producer groups. The biggest planters are foreign companies and one domestic company.⁴ Also, there are many small-scale producers especially at the household level and many of them engage in some kinds of contract farming. Wholesale buyers and collectors usually engage in the processing and the exporters are responsible for the milling stage such as cleaning, sorting, and grading.

2.3. Risks for trade mispricing

The following table shows some major risks for trade mispricing in the Lao copper and coffee industry. The common risks in both industries are the transaction between affiliated firms and weak capacity of local authorities in the evaluation of exports, the assessment of the financial transactions, and misinvoicing of quantity and quality. There are also other factors contributing to the risks for trade mispricing such as price hedging practices in the copper industry and the role of local agents in the coffee industry. The discussions for each risk are as follows:

Table 1: Risks for trade mispricing in copper and coffee sectors

No.	Copper sector	Coffee sector
1	Transactions between affiliated firms	Transactions between affiliated firms
2	Limited capacity of local authorities	Limited capacity of local authorities
3	Fixed invoice price phenomena	Role of local agents

2.3.1. Transactions between affiliated firms

According to Readhead (2018), the tendency for trade mispricing is higher for trade among affiliated firms as a means to reduce the overall tax liability for multinational firms. This represents a significant risk for Lao commodities exports because most exporters engage in cross-border trade with their affiliates. In the case of copper concentrates, Lao mining companies export copper concentrates mainly to their affiliated smelters in China (Anonymous mining company A, 2018). Similarly, the mining companies mainly export refined copper cathodes to their affiliated companies in China, as well as some electrical and electronic manufacturers, automobile manufacturers, and trading companies in Thailand (Anonymous mining company B, 2018). For coffee, domestic and foreign firms in Laos trade predominantly with their affiliates located in Thailand and Vietnam (Coffee companies and Lao Coffee Association (LCA), 2018). In the

⁴ Outsapan - Olam from Singapore is one of the biggest foreign companies who owns more than 1,100 ha of farmland and other three big Vietnamese companies also possess between 500 and 1,000 ha. Dao Heuang is the biggest domestic company.

absence of legal rules regulating transfer pricing practices in Laos, there exists a significant risk for cooperation between trading partners for misreporting the price, quality or quantity of exports.

2.3.2. Limited capacity of local authorities

Customs and revenue authorities in Laos have limited infrastructure for trade valuation and monitoring of offshore financial transactions. Exporting firms are legally required to transfer their foreign income to their Lao bank account within 120 days of receiving the payment (Bank of the Lao PDR, 2019). However, off-shore payments for Lao copper exports between buyers and the mining companies' foreign headquarters is allowed through concession agreements negotiated by these firms in the Lao mining sector (Anonymous mining company B, 2018). This practice limits the ability of relevant local tax authorities to monitor and assess the financial report of the company (Norasingh *et al.*, 2020: 21).

On the other hand, Lao coffee exports largely consist of unroasted, green coffee beans in the early stage of their value chain leading to large variations in product quality and prices. Currently, there is no quality control body from the government to verify the coffee quality and consequently the declared prices (National Institute for Economic Research, 2019). Transactions for coffee exports rely largely on the information provided by exporters. Therefore, there are concerns that there could be under-reporting of the export quality and quantity hence affecting the export value and the tax revenues that could be collected from this sector (National Institute for Economic Research, 2019).

2.3.3. Fixed invoice price phenomena

Our Customs data shows fixed price phenomena in the export of copper concentrate from Laos. The buyer and seller agree on a pre-determined fixed proforma invoice price while exporting concentrate from Laos and later the realized price is compared with the provisional price to settle the balance (Anonymous mining company A, 2018). Note that the realized price refers to the average market price at London Metal Exchange (LME) from the date of the agreement between traders until the delivery of the physical product known as Quotational Period (QP) takes usually 3-4 months (PanAust, 2014: 80). Accordingly, the exporter would lose when the realized price is above the agreed price whereas the exporter will gain otherwise. Such gain or loss from price hedging is considered as additional income or expenses of the exporting company (World Bank, 2019). New tax laws adopted in 2019 allows revenue authorities to review the financial report of the company to calculate tax and non-tax obligations and request further information for tax adjustment if needed (Anonymous tax official, personal communication, May 25, 2020; Norasingh *et al.*, 2020, p.13-14). However, the revenue authorities still lack specific guidelines and tools to detect any abnormality in the declared invoice prices (Norasingh *et al.*, 2020: 12).

2.3.4. Role of local agents

Most international and regional importers of Lao coffee have established their local agents to help negotiate prices with Lao coffee exporters. Galindo J *et al.* (2007, p. 54) indicates that these local agents engage in quality control and prepare other exporting procedures. Therefore, in the absence of requisite transparency and oversight, there is a risk that these local agents misreport

their export transactions to be of low quality and under-valued to reduce their tax obligations in Laos. The value chain risk maps developed by Brugger & Engebretsen (2019) illustrate that local agents of the importers in Laos are considered as high risk for Illicit Financial Flows (IFFs) at the customs in the value chain of coffee sector. The risk involves misreporting quality, quantity arbitrary, collection of fees and taxes, falsification of a certificate of origin, and the collusion between authorities and exporters. For this reason, the function of local agents is attributed as a significant risk for trade mispricing from the Lao coffee sector.

3. Empirical methodologies and data

As discussed in Section 1, the mispricing of commodity trade transactions is a prominent challenge for resource-rich developing countries. It refers to the practice of exporting firms understating their trade values on Customs invoices, or importers overstating their import expenditures, with the motivation of transferring financial capital abroad either for private gain or for reducing corporate tax liabilities. In order to quantify the magnitude of this phenomenon, researchers have analysed asymmetries in partner-country trade statistics or examined pricing anomalies in transaction-level data. In this section, we discuss the price-filter analysis methods introduced by K. Hong et al. (2014) and Zdanowicz et al. (1999), alongside a brief discussion of their limitations and qualitative research methodology to verify the range of arm's length prices.

3.1. Free-market price filter analysis

This framework compares actual transaction-level unit prices for a particular commodity at Customs with their contemporaneous free-market price, plus and minus an assumed range of deviation to account for expected price volatility due to product characteristics, transportation costs, contract terms, and business conditions. This range is assumed to represent the arm's length price range for the particular traded product. All transaction prices within this price range are assumed to be normally priced or trade pricing, while any prices outside the range are designated to be abnormally priced. More specifically, we test the following hypothesis by applying this method:

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 mispriced overvalued amount is estimated as the deviation from the upper bound of the range (P_{High}) and the mispriced 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:

$$\text{Overvalued amount} = \text{Quantity} \times \text{MAX}(0, P - P_{High}) \quad (1)$$

$$\text{Undervalued amount} = \text{Quantity} \times \text{MAX}(0, P_{Low} - P) \quad (2)$$

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

The main advantage of using the free-market price filter method is that we do not need to endogenously estimate arm's length price using the observed transaction prices. Therefore, this

method is not affected by related party transaction records in the import and export database. However, this method requires easily identifiable and commonly acknowledged benchmark prices which may not be readily available for products where there is no established commodity market.

3.2. Methodological limitations of price-filter analysis

According to Reuter (2011) and Carbonnier & Cadena (2015), price filter analysis based on trade micro-data is an intuitive methodology, however, it has some important limitations in accurately estimating trade mispricing. Firstly, product heterogeneity needs to be clearly understood in the application of this methodology. For product categories that are very heterogeneous in terms of quality and prices, this method can incorrectly identify high-end products as overpriced and low-end products as under-priced. This problem is further exacerbated by limitations in the international commodity classification system which contains several broad and open-ended categories for very diverse product types. Secondly, transaction-level trade data can also suffer from poor reliability due to frequent misclassification of products by Customs authorities as well as mis-recording of quantities, rather than prices.

3.3. Qualitative research methodology

We introduce some methodological innovations beyond previous empirical literature to address limitations of price filter method. Specifically, we use qualitative research and expert interviews on commodity characteristics such as types, quality and supply chains to inform our assumptions regarding the selection of price filters or arm's length price range around the free-market prices. The interviews with experts were conducted at different organizations including mining companies, coffee exporters, Lao coffee association, Lao authorities, and non-government organizations (NGOs). The interview methodology used here is called the semi-structured approach where it relies on a pre-conceived interview guide or standard questions and then further questions are asked for greater details or in-depth analysis of a particular issue (Young *et al.*, 2018: 12).⁵ The main issues we collect qualitative data on include product heterogeneity, market conditions and contract terms, and shipping costs. Furthermore, we also conducted stakeholder workshops with academics, policymakers and private sector experts to validate our research methods and findings.

3.4. Data

This paper uses transaction-level data on daily basis from Lao Customs Department from 2012 to 2017. The final data set includes a total of 2,600 transactions for copper cathode export, 2,349 transactions for copper concentrate export, and 1,950 transactions for coffee export.⁶ The summary statistics for the three commodities are reported in Table 2.

⁵ Our semi-structured interview approach takes the middle-ground between structured and unstructured approach. The structured approach relies on a fixed interview script or pre-determined questions whereas the unstructured one is based on the conversation or questions and responses spontaneously between interviewers and interviewees.

⁶ Since the means of unit price for three commodities are much higher than the means of the free-market price. In particular, there were some transactions for copper concentrate with the unit price as extremely high as USD 16,462 per kg compared with the international market price (USD 6.14 per kg) which might indicate some outliers in the statistics presumed due to the hand error typing or poor record. Therefore, we exclude the extremely outliers who

We use the Harmonized System (HS) classification code. HS is an international six-digit coding system for the classification of products that are widely used in international trade statistics. There are 2, 4, and 6 digits for HS coding system. HS-2 or 2 digits refer to the chapter the goods that are classified in, e.g. 09 = Coffee, tea, mate and spices. HS-4 identifies groupings within that chapter, e.g. 0901 = Coffee, whether or not roasted or decaffeinated; husks and skins; coffee substitutes containing coffee in any proportion. HS-6 or 6 digits provide more specific information, e.g. 090111 = Coffee; not roasted or decaffeinated. However, countries are allowed to add more digits for further classification such as 8 digits. For our case studies, the HS coding system for refined copper, copper ores, and green bean coffee is 74301100, 26030000, and 09011110 respectively.

The free-market price used as the benchmark for copper is the daily spot LME-Copper Grade A price at the London Metals Exchange where we access the database from the Intercontinental Exchange (ICE) Administration accessed via Thomson Reuters Datastream. For coffee export, the free-market price is the daily spot prices of Arabica and Robusta green bean at the New York market. The data source is from the International Coffee Organization (ICO) who provides the statistics of daily prices of green coffee beans for all major origins and types at the international markets such as New York, German and French markets.

4. Estimates of trade mispricing and discussion

This section estimates the magnitude of trade mispricing. The daily free-market prices at London Metal Exchange and New York Market for three commodities are taken as a reference to define an arm's length price range to capture the normal variation in prices or trade pricing, depending on product quality, associated transportation and insurance costs, as well as contract terms and transaction situation (Hong *et al.*, 2014: 211). These underlying assumptions are based on commodity sector research and are clearly discussed. The estimation of undervaluation and overvaluation due to trade mispricing is based on the method of price filter analysis at the free-market, which has been explained in section 3. The following sections provide the statistical results for each trading commodities.

Table 2: Summary statistics of selected commodities

HS Code: 74031100	Refined copper: cathodes and sections of cathodes				
	N	Mean	Std. Dev.	Minimum	Maximum

are above 99th percentile of the sample's distribution. There are equaled to less than 0.5 percent of the total quantities for each trading commodity. Thereafter, 26, 23 and 19 transactions for three trading commodities (refined copper, copper concentrate and coffee bean) are excluded.

Quantity (kg)	2,600	170,164	81,571	333	601,834
Value (USD)	2,600	1,133,621	593,001	11	4,621,135
Unit price (USD/kg)	2,600	6.66	1.11	0.033	8.54
HS Code: 26030000	Copper ores and concentrates				
	N	Mean	Std. Dev.	Minimum	Maximum
Quantity (kg)	2,349	462,859	578,469	103	9,622,700
Value (USD)	2,349	784,106	589,288	20	2,334,578
Unit price (USD/kg)	2,349	2.01	1.35	0.05	16.01
HS Code: 09011110	Coffee, not roasted, not decaffeinated: Arabica or Robusta				
	N	Mean	Std. Dev.	Minimum	Maximum
Quantity (kg)	1,950	112,264	1,373,098	100	60,000,000
Value (USD)	1,950	173,279	187,292	62	1,734,640
Unit price (USD/kg)	1,950	2.38	0.93	0.0021	5.67

Source: Lao Custom Department, Ministry of Finance.

4.1. Trade mispricing estimates for copper cathode exports

Lao mining companies use daily LME prices as a benchmark to set the price (Anonymous mining company B, 2018). To define the arm's length price range for Lao copper cathode exports, the following assumptions are used.

- Product heterogeneity (+/-):** Copper cathodes refer to refined products extracted from the ore or concentrate then shaped into bars or plates of bullion through the process of a whole-of-ore leach, solvent extraction, and electrowinning before being transported to manufacturers of cable, wire, and tube in foreign markets. There are different grades of refining copper traded in the international market. The difference between grades depends on the purity of copper or chemical composition. For instance, Grade A copper contains the purity of copper with 99.9 percent while Grade B contains 95 percent of copper purity. Off-grade refine copper is copper scrap. The copper cathode export from Laos is of grade A quality containing 99.9 percent of copper (Anonymous mining company B, 2018). Therefore, the variation in the purity is expected to be small and in our baseline we assume there is no variation in prices due to product heterogeneity.
- Transportation and other logistic costs (+):** A price premium is added to the LME commodity exchange price which could be up to 5 percent of the copper price at the maximum level (Anonymous mining company B, 2018). This price premium incorporates transport costs and other logistic costs from the mine site in Laos to the seaport in Thailand before shipping to the final destination. Hence, we use 5 percent for price premium as a conservative estimate above the free-market price at LME for Grade A copper.

- **Normal market condition (+/-):** Some normal variation in prices is also expected due to contractual terms between trading partners. For instance, mining companies take the average spot prices from LME in the previous month as the reference for settling their transactions in the early stages of the next month (Anonymous mining company B, 2018). These practices are expected to lead to a minor variations between the custom prices reported by exporters and the benchmark prices used for our analysis. Therefore, in our baseline, we conservatively assume price variation up to 5 percent around our benchmark, free-market price of copper.

To account for all the above-mentioned factors, we assume the range of arm’s length price filter to be + 10 percent above and – 5 percent below from the free-market at London Metal Exchange (LME). The estimates of undervalued and overvalued exports due to trade mispricing are reported in Table 3.

Table 3: Trade mispricing for copper cathode export

Year	Export value (USD, million)	Overvalued export: + 10% (USD, million)	Undervalued export: – 5% (USD, million)	Trade mispricing (USD, million)
2012	608	0.06	2.22	2.28
2013	641	0.34	0.07	0.41
2014	612	0.5	0.16	0.66
2015	507	1.94	1.03	2.97
2016	241	0	2.5	2.5
2017	338	0	3.49	3.49
Mean	491	0.47	1.58	2.05
Total	2,947	2.83	9.47	12.3

Data Source: Lao Customs Department, Ministry of Finance.

Notes: Free market price is the daily LME-Copper, Grade A price from London Metals Exchange (USD per metric ton, converted to USD per kilogram).

The result shows that the prices of copper cathode exports were mostly declared within the defined range of arm’s length price (+ 10 percent and – 5 percent) throughout 2012-2017. We find 101 transactions out of 2,600 transactions were declared above the arm’s length price range and 162 transactions were declared below the price range. Hence, we estimate USD 12.3 million of trade mispricing for copper cathode export during 2012-2017. In which, overvaluation is USD 2.83 million and the undervaluation is USD 9.47 million. These overvaluation and undervaluation

share less than 0.4 percent of total copper cathode export. We also find that such overvaluation and undervaluation are dominantly in the export to Thailand.

4.2. Trade mispricing estimates for copper concentrate exports

The valuation of trade mispricing for copper concentrate is different from the case of cathodes since its reference price depends on the percentage of contained copper, the free-market price for Grade A refined copper from the London Metals Exchange, value of contained gold and silver, refining and treatment costs, penalties and delivery terms (Devlin, 2015). Therefore, the export price for copper concentrate per unit is defined using the simple formula:

$$\begin{aligned} \text{Price} = & (\% \text{ copper} * \text{reference price}) + (\text{value of gold \& silver}) - (\text{treatment and refining costs}) \\ & - (\text{penalties}) + \text{delivery terms} \end{aligned} \quad (3)$$

where the reference price refers to the daily market price of refined copper Grade A at London Metals Exchange (USD per metric ton, converted to USD per kilogram)

The above formula is consistent with the information from our key informant interview that the price of Lao copper concentrate is determined mainly based on the level of contained copper in the exported copper concentrate (Anonymous mining company A, 2018). According to PanAust (2017), Lao copper concentrate contains between 23-25 percent of copper, up to 9 grams per ton of gold, and up to 60 grams of silver per ton of copper ore. The value of contained minerals in the copper concentrate such as gold and silver is equivalently calculated to be less than 1 percent of the copper price per ton. Therefore, we assume that the free market price of copper concentrate to be 25 percent of the LME-Copper Grade A price as the defined reference price.

Next, to identify the arm's length price range around the defined reference price for copper concentrate export, the following assumptions are used:

- **Product heterogeneity (+/-):** The copper concentrate exported from Laos has high quality and there are not many exporters of copper concentrate, hence; product heterogeneity is expected to be small. Therefore, like copper cathodes, we assume that product heterogeneity has no variation around the reference price.
- **Transportation and other logistic costs (+):** Lao exporters add additional premium from importers for marketing, transportation and logistical costs. According to the financial statement of Phu Bia Mining Limited (PBM) in 2013, there were marketing, realization, and freight costs sharing around 2-5 percent of sales during 2012-2013. These include transportation costs from the mine site to the seaport in Thailand (Anonymous mining company A, 2018). For this reason, we conservatively assume 5 percent at the maximum variation above the reference price of copper concentrate.

To account for all the above-mentioned factors, in our baseline we assume the range of arm's length price filter to be + 5 percent above and – 0 percent below of the free-market price of copper concentrate.

Using the customs data, the result for copper concentrate reveals that the invoice prices declared by the exporters were mainly outside the range of defined arm's length price (+5 percent and – 0 percent) for 2012-2017. We find 1,849 transactions out of 2,349 (or 78.7 percent of the transaction number) are above the arm's length price range while only 358 transactions had the prices below the range. Tables 4 presents the estimates of undervaluation and overvaluation of copper concentrate exports outside the defined arm's length price range. We find a magnitude of trade mispricing equaled to USD 384.2 million, which is larger than copper cathodes during the study period. The overvaluation outside the filter prices is estimated to be USD 259.3 million or 14.1 percent of the total copper concentrate export value. Most of the overvaluations are seen in the export to China (98 percent of total overvaluation). In addition, undervaluation is estimated to be USD 124.9 million or 6.8 percent of total invoiced copper concentrate export. Similarly, the undervaluation is mainly found in the export to China.

Table 4: Trade mispricing for copper concentrate export

Year	Export value (USD, million)	Overvalued export: + 5% (USD, million)	Undervalued export: – 0% (USD, million)	Trade mispricing (USD, million)
2012	126	0.01	1.38	1.39
2013	37.8	0.0	0.81	0.81
2014	353	22.70	103.00	125.7
2015	256	38.60	9.45	48.05
2016	513	145.00	0.0	145
2017	555	53.00	10.30	63.3
Mean	307	43.22	20.82	64.04
Total	1,841	259.31	124.94	384.25

Data Source: Lao Customs Department, Ministry of Finance.

Notes: Free market price is 25 percent of the daily LME-Copper, Grade A price from London Metals Exchange (USD per metric ton, converted to USD per kilogram).

However, our custom data shows that the invoiced prices of copper concentrate export are almost fixed during the study period. This is due to the pre-determined fixed price agreed by the exporter and importer or price hedging strategy. As already mentioned in section 2.3.3 on risks for trade mispricing, any gain or loss from the pre-determined fixed price is regarded as additional income or expense and later adjusted in the financial statement of firms. Therefore, if a firm discloses detailed information of price hedging related adjustment in the financial statement to the relevant authorities, the trade mispricing found in our analysis will not affect the tax revenue and vice versa. The companies can use the result of hedging strategies to protect the cash flow margin

or to protect the reported earning against price volatility in the financial statement (Deloitte, 2020). However in the absence of this financial information, the mispricing estimates from our price filter analysis can not be directly interpreted (unlike refined copper cathodes and coffee bean exports).

4.3. Trade mispricing estimates for coffee exports

Green bean coffee is selected as a case study because it represents the most traded agricultural commodity from Laos. Lao coffee industry uses the coffee prices in the New York market as benchmarks (Coffee companies and Lao Coffee Association (LCA), 2018). Prices are also influenced by the quality and other additional costs especially transportation. Based on this information, we use the following assumptions to define the arm's length price range at the free-market price for Lao coffee export:

- **Product heterogeneity (+/-):** Arabica and Robusta are the two main types of coffee variety traded internationally. The database of ICO daily price series provides daily spot prices at the New York market for those two coffee beans. However, our custom data cannot differentiate individual transactions by coffee variety. Therefore, we are unable to match the invoiced price at custom data with the market prices of coffee by varieties. To overcome this, this paper uses data from Lao Coffee Association to understand the structure of coffee beans export by types. Therefore, we use the share of Lao coffee export by the coffee variety on monthly basis during 2012-2017 as weight and use the daily prices of coffee-ICO Arabica and Robusta Mild at the New York market to construct the composite ICO daily price as a free-market price or reference price.⁷ Besides, many exporters in Laos are both foreign and domestic firms of different scales. Therefore, exported coffee could be of different qualities. In our baseline, we assume that product heterogeneity could result in a variation of 10 percent around the reference prices.
- **Transport and other logistic costs (+):** Exporters of coffee in Laos are usually responsible for transport costs from their factories to the Lao-Thai border and then to the seaport in Thailand (Coffee companies and Lao Coffee Association (LCA), 2018). According to Galindo J et al. (2007), transportation, insurance, and the additional cost are accounted for 13 percent of the contract price FOB to export Robusta coffee to Bangkok (Table 5). This additional cost includes weight losses due to drying and grading, manual sorting, export quality bags and bagging, weighting, stocking, and loading. Such cost for the Arabica coffee is 21.4 percent of the contract price FOB. Accordingly, we assume that the variation in price due to transport and other logistic cost is 20 percent added to the free-market price.
- **Normal market conditions (+/-):** Some normal variations in prices of coffee due to normal business conditions such as contractual conditions and bargaining power are expected because of many actors involved in coffee export (National Institute for Economic Research, 2019). We, therefore, in our baseline, assume a 10 percent variation of market price due to normal business conditions.

⁷ The composite ICO daily price (reference price) = Weight*Arabica ICO daily price + Weight*Robusta ICO daily price

Given these assumptions, the arm’s length price range is identified as + 40 percent above and – 20 percent below from the free-market price assumed for our analysis on the export of coffee from Laos.

Table 5: Export Freight on Board (FOB) price structure for natural Robusta and washed Arabica beans

Price/cost	Robusta (USD/MT)	Share of contract price FOB (%)	Arabica (USD/MT)	Share of contract price FOB (%)
1. Average contract price FOB at the port in Bangkok	1,750	-	2,600	-
2. Shipping costs to the port in Bangkok	136	7.70%	136	5.20%
3. Conditioning costs	90	5.10%	420	16.20%
4. Shipping and conditioning costs (2 + 3)	228	12.80%	556	21.40%

Source: Author summarized from Galindo J et al. (2007, pp. 84–85, annex 7&8).

Similarly to the case of copper concentrate, there is evidence of significant trade mispricing in the transactions of coffee exports from Laos. The result clearly illustrates that there are trade mispricing outside the defined arm’s length price range resulting in both undervaluation and overvaluation. However, the size of undervaluation outweighs the overvaluation during the studied period. For instance, there were 1,297 transactions (66.5 percent of the total transaction) below the range of arm’s length price as under-valued transactions. Whereas, 87 transactions (4.5 percent of total transactions) are above the range as over-valued transactions. Therefore, undervaluation is estimated to be USD 260 million (77.1 percent of total coffee exports) and could result in the tax revenue loss of USD 3.1 million. This estimation of tax loss is calculated using Lao tax rates which impose a fixed profit tax of 5 percent on every firm, in addition to a standard corporate income tax rate of 24 percents⁸ (Coffee companies and Lao Coffee Association (LCA), 2018). Under-valued exports are mainly observed for Vietnam (81.4 percent of total undervaluation). Other trading partners where undervaluation is observed include Thailand (4.2 percent), Belgium (4.0 percent), Japan (3.5 percent), and Denmark (2.9 percent). On the other hand, the overvaluation is estimated to be USD 2.2 million or less than 1 percent of total coffee export value.

⁸ It should be noted that the profit tax obligation is also subjected to the negotiation between private firms and government because some firms appeared to receive 18 percent and 20 percent of profit tax which are lower than the standard profit tax rate of 24 percent.

Table 6: Trade mispricing for coffee export

Year	Export value (USD, million)	Overvalued export: + 40% (USD, million)	Undervalued export: – 20% (USD, million)	Trade mispricing (USD, million)
2012	50	0.81	6.76	7.57
2013	68	0.57	9.13	9.7
2014	61	0.14	27.30	27.44
2015	52	0.11	196.0	196.11
2016	32	0.09	11.0	11.09
2017	75	0.49	10.40	10.89
Mean	56	0.37	43.43	43.8
Total	338	2.20	260.0	262.20

Data Source: Lao Customs Department, Ministry of Finance

Notes: Free market price is the International Coffee Organization ICO Daily Price (USD per metric ton, converted to USD per kilogram).

5. Conclusions and policy implications for Laos

The natural resources sector contributes significantly to government revenues in resource-rich developing countries. However, several research studies have shown that revenue collections from the natural resource sector remain well below its potential and part of the reason is attributed to the problem of trade mispricing. Therefore, the main objective of this paper is to estimate the magnitude of trade mispricing for exports of copper and coffee from Laos during 2012-2017. The paper uses the price-filter analysis by comparing daily transaction-level export prices from customs data against the daily free-market benchmark prices. We find an economically significant magnitude of trade mispricing, especially in the exports of coffee from Laos.

This study has several policy implications for Laos and the implementation of SDGs target 16.4.1 (curbing illicit financial flows), and SDGs target 17.1 (strengthening domestic revenue mobilization). Given current fiscal difficulties of the government, the issue of trade mispricing should not be neglected and be better understood by policymakers and tax authorities. This study identifies four risks for trade mispricing in Laos. They are (1) transaction between affiliated firms, (2) limited capacity of local authorities, (3) practice of price hedging, and (4) the role of local agent. To address these risks, we propose policy recommendations as follows:

Firstly, a regulatory framework and legal guidelines are required to address transfer mispricing risks among affiliated firms. Our analysis finds that the transaction between affiliated firms is one of the major sources of trade mispricing risks. For instance, the coffee sector has sizable intra-firms or related parties' transactions across borders resulting in a large undervaluation of trade mispricing. Currently, Laos does not have a specific legal and regulatory framework or guideline for trade mispricing or transfer pricing between related parties or affiliated firms (Deloitte, 2020; Norasingh *et al.*, 2020). Tax laws in Laos should include specific transfer pricing rules to address this important phenomenon and exploring the United Nations or OECD Transfer Pricing

Guidelines could be a starting point. This guideline would help customs and tax authorities to inspect the transactions with abnormal prices or mispricing for further audit by using the reference prices based on the market price or price range from a reliable trading hub. According to Transfer Pricing team of Crowe Malaysia PLT (2019), all ASEAN countries except Laos and Myanmar have added transfer pricing rules into their regulatory framework in last few years. This includes Cambodia in 2017, Indonesia in 2016, Malaysia in 2018, Thailand in 2018, and Vietnam in 2018.

Secondly, capacity building efforts for relevant tax and custom authorities need to be strengthened to understand commodity trading practices. In the case of mining sector, financial transactions including the payments and price negotiations between affiliated firms are mostly conducted offshore. This makes it challenging for Lao tax and customs authorities to monitor and govern these transactions. Besides, we show that exporters often report fixed prices agreed in advance concession agreements when exporting minerals like copper and are supposed to adjust the gain or loss based on the final realized prices in their financial statement. It is of utmost importance for Lao tax and customs administration to have access to the required information to monitor these financial practices and ensure all tax liabilities are settled. In the coffee sector, there is a need to develop clear guidelines on quality measurement and export valuation under a specific public authority.

Finally, trade statistics infrastructure in Laos needs to be further improved in terms of product definitions and data accuracy, specifically to record information on product quality and types, economic relationships between importers and exporter (trade among affiliated firms), de facto origin, and destination of exports. Laos and similar developing countries can utilize the methodologies used in this paper to examine the magnitude of trade mispricing in their countries. Price filter analysis can help researchers and policymakers to build better estimates of potential trade mispricing and analyze their implications for resource mobilization in the country.

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