



Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

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

Working Paper No.: R4D-IFF-WP01-2024

Drivers of Abnormal Pricing in Switzerland's Commodity-Trade

29.02.2024

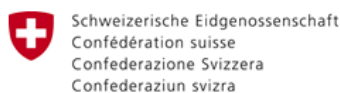
Gilles Carbonnier

Graduate Institute of International and Development Studies, Geneva

Siddhant Marur

Graduate Institute of International and Development Studies, Geneva

© The Authors. All rights reserved. For more details, visit the project website: <https://curbing-iffs.org/>
This project is funded through the Swiss Programme for Research on Global Issues for Development (www.r4d.ch) by the Swiss Agency for Development and Cooperation (SDC) and the Swiss National Science Foundation (SNSF)



Swiss Agency for Development
and Cooperation SDC



SWISS NATIONAL SCIENCE FOUNDATION

Table of Contents

1	Introduction	5
2	Literature Review	6
	2.1 Theory	6
	2.2 Research Motivation and Switzerland	8
3	Data	11
	3.1 Swiss Imports Data: 2011-17	11
	3.2 Commodity price data: 2011-17	11
	3.3 Measuring import misinvoicing: Price Filter Analysis	12
4	Empirical strategy	15
5	Results	17
	5.1 Baseline results	17
	5.2 Income and Product Differentiation	18
	5.3 Producer and Firm Ownership	19
	5.4 Corruption and Political Stability	20
	5.5 Transfer Pricing Strength, Capital Account Openness, and Trade Facilitation Indicators	21
6	Robustness Checks	24
	6.1 Alternate Dependent Variable: Interquartile Range	24
	6.2 Alternate Arm’s Length Price Range	24
	6.3 Alternate Dependent Variable: 30-Day Moving Average of Free-Market Prices	25
7	Conclusion	25
8	References	28

Appendices		32
-------------------	--	-----------

I	Tables	33
I.1	Summary Statistics: Commodities	33
I.2	Summary Statistics: Variables	34
I.3	Baseline Results	35
I.4	Income and Product Differentiation	35
I.5	Producer Status and Firm Ownership	36
I.6	Corruption and Political Stability	37
I.7	Transfer Pricing and Trade Facilitation	38
I.8	Robustness Checks	38

List of Tables

1	Summary statistics of selected commodities	33
2	Summary Statistics of Variables	34
3	Baseline regressions	35
4	Heterogeneity Based on Income Classification and Product Differentiation	35
5	Producer Status and Firm Ownership	36
6	Corruption and Political Stability	37
7	Transfer Pricing, Capital Accounts, and Trade Facilitation	38
8	Robustness: Interquartile Range Estimates	38
9	Robustness: Alternate Arm's Length Price Range	39
10	Robustness: 30-Day Moving Average of Free-Market Prices	39

Abstract

This study provides an in-depth investigation into trade misinvoicing by examining abnormal pricing patterns in Switzerland's imports of key commodities such as coffee, cocoa, gold, and copper. Positioned within the broader context of Illicit Financial Flows (IFFs) and the 'resource curse', this research leverages transaction-level data from the Swiss Federal Customs Administration to offer a nuanced understanding of the role of tax rate differentials between Switzerland and its trading partners in driving abnormal pricing. Our findings indicate that a one-percentage-point increase in this tax rate differential leads to a 0.27% to 0.32% increase in abnormal pricing. The study employs an interdisciplinary framework, incorporating factors like governance and commodity-specific attributes, and reveals significant policy implications for both Switzerland and its trading partners. The study contributes to the ongoing discourse on trade misinvoicing and tax evasion, offering actionable insights for policymakers and serving as a foundation for subsequent academic inquiry.

I Introduction

Countries heavily reliant on natural resources often face a paradox: while abundant in valuable commodities, they grapple with underutilized resource wealth due to governance deficiencies, flawed resource management, and institutional inefficacy (Venables, 2016; Mehlum et al., 2006; Sachs and Warner, 2001). This phenomenon, often termed the 'resource curse', is manifested through suboptimal economic performance and heightened vulnerability to the Dutch disease (Auty and Warhurst, 1993; Sachs and Warner, 1995). Further, these nations are frequently beleaguered by governance challenges, including rent-seeking, armed conflicts, and the dynamics of a rentier state, all of which stifle economic diversification (Carbonnier et al., 2011; Le Billon, 2011; Collier and Hoeffler, 2004).

Against this backdrop emerges the complex issue of Illicit Financial Flows (IFFs). Defined by the World Bank (2016) as the 'cross-border movement of capital linked with illegality', IFFs envelop a gamut of malpractices—from corruption and organized crime to tax evasion. Notably, these illicit flows often manifest through trade misinvoicing and manipulative transfer pricing mechanisms, thus becoming entangled with the resource sector (Nitsch, 2017; Reuter, 2012).

This study delves into the intricacies of trade misinvoicing by analyzing abnormal pricing patterns in Switzerland's imports of key commodities—namely, coffee, cocoa, gold, and copper. We offer a novel contribution by zooming in on Switzerland, a pivotal yet enigmatic player in global commodity trade, which has recently come under heightened regulatory scrutiny due to its low corporate tax regime (Sharman, 2010; Shaxson, 2011). Guided by the persistent reliance of developing countries on natural resources, our inquiry spans both agricultural and mineral commodities, allowing for a nuanced understanding of the varying drivers of misinvoicing based on commodity type. Uniquely, we depart from traditional macroeconomic metrics and employ a more granular approach using transaction-level estimates (Mehrotra and Carbonnier, 2020). Derived from the Swiss Federal Customs Administration (FCA), these estimates facilitate a more precise measurement of trade misinvoicing by comparing transaction-specific unit prices against arm's-length benchmarks.

The distinctiveness of this research lies in its interdisciplinary approach, bridging the literature on natural resource governance (Sachs and Warner, 1997; Mehlum et al., 2006; Harding and Venables, 2016) and trade misinvoicing (Fisman and Wei, 2004; Berger and Nitsch, 2008; Kellenberg and Levinson, 2018). Going beyond traditional economic determinants such as GDP and FDI, we incorporate a broader array of factors—total tax rates, transfer pricing laws, and political stability, among others—to offer a comprehensive analysis of abnormal pricing behavior (Javorcik and Narciso, 2008; Johannesen and Pirttilä, 2016).

Our primary variable of interest—the differential in total tax rates between Switzerland and its trading partners—stems from a rich academic discourse that elucidates the catalytic role of tax evasion in illicit financial outflows (Lessard & Williamson, 1987; Dooley, 1988; Ndiaye & Siri, 2016). The extant literature provides a conceptual foundation, identifying tax evasion as an initial step in a cascade of actions that erode the tax base (Collier, Hoeffler, & Pattillo, 2001).

Such erosion generates a disproportionate fiscal burden on tax-compliant firms, a scenario exacerbated by intensified regulatory scrutiny as tax authorities strive to meet revenue benchmarks (Keen & Slemrod, 2017; Slemrod, 2007; Devereux, 2019). In this context, trade misinvoicing emerges as a rational, adaptive strategy for firms. It serves not merely as a conduit for capital flight, but also as a mechanism to restore some

semblance of fiscal equilibrium in an asymmetrical taxation landscape (Johannesen & Zucman, 2014; Torgler & Schneider, 2009).

Empirically, our analysis substantiates this theoretical framework. Utilizing granular customs data from Switzerland and employing robust statistical methodologies, we find that a one-percentage-point increase in the tax rate difference corresponds to an increase in abnormal pricing activity ranging from 0.27% to 0.32%. This empirical finding lends credence to our hypothesis: greater tax rate discrepancies incentivize firms to engage in abnormal pricing as a means to strategically circumvent higher tax burdens and reallocate profits to jurisdictions with more favorable tax regimes (Reuter, 2012; Johannesen & Zucman, 2014).

Our study provides a comprehensive examination of the determinants of abnormal pricing in Swiss commodity trade, focusing on the critical variable of tax rate divergence. We extend our inquiry across multiple dimensions: income classification, product differentiation, producer status, firm ownership, as well as governance and policy effectiveness.

We find that high-income countries tend to exhibit less abnormal pricing, though the results are not statistically significant. This aligns with existing literature suggesting that robust financial systems in such countries may act as deterrents to illicit financial activities (Johannesen & Zucman, 2014). Additionally, the study reveals that differentiated products like cocoa and coffee are more susceptible to abnormal pricing, confirming that such goods offer more opportunities for price manipulation (Javorcik and Narciso, 2008; Nitsch, 2012). Our data reveals an intriguing finding in the mining sector: foreign ownership appears to mitigate the impact of tax rate divergence on abnormal pricing. This suggests that foreign-owned firms may employ sophisticated, legal tax avoidance strategies that reduce the need for trade misinvoicing (Desai and Dharmapala, 2006; Fuest and Riedel, 2009). Although results related to the producer status of countries in commodities like cocoa and coffee are inconclusive, they open up avenues for future research, particularly in understanding the 'resource curse' phenomenon (Auty and Warhurst, 1993; Ross, 2001; Vezina, 2015). We integrate key governance indicators like the Corruption Perceptions Index (CPI) and World Governance Indicators to understand their influence on abnormal pricing. Our results show that higher CPI scores, indicating less corruption, significantly reduce abnormal pricing, underscoring the role of governance in curbing illicit financial flows (Reuter, 2012; Slemrod, 2007). However, political stability does not show a statistically significant impact, indicating the need for more nuanced analyses in future research (Haberly & Wójcik, 2015). Our findings also shed light on the inefficacy of existing policy measures in curbing abnormal pricing. While stringent Transfer Pricing Regulations (TPRs) have been assumed to reduce profit shifting, we do not find evidence of this via the trade mispricing route (Klassen and Laplante, 2012). Moreover, capital account openness appears to neither exacerbate nor mitigate abnormal pricing, challenging existing theories on financial liberalization (Aizenman and Noy, 2009). Importantly, effective trade facilitation measures significantly reduce abnormal pricing, emphasizing their potential as a policy tool.

2 Literature Review

2.1 Theory

Trade misinvoicing remains a pivotal mechanism for illicit financial outflows, garnering increased scholarly attention. While early research laid the foundation for understanding its implications (Cuddington, 1986;

Kar and Freitas, 2012; Bhagwati, 1974), contemporary studies have shifted focus towards its prevalence in developing economies. This is particularly true for African nations and, to some extent, developing countries in Asia (Ndikumana et al., 2015; Beja, 2006; Jha and Truong, 2014; Kar et al., 2010).

The theoretical discourse on trade misinvoicing diverges into two main lines of inquiry, with the first scrutinizing the welfare implications of such practices. This line challenges the traditional notion that illegal trade enhances economic welfare by bypassing tariff barriers. Bhagwati and Hansen's seminal paper disrupts this narrative, arguing that both legal and illegal trade operate at the same global market price (Bhagwati and Hansen, 1973). While illegal traders may evade tariffs, they incur tangible costs through smuggling, leading to an unfavorable rate of transformation. They further argue that if the cost of evading tariffs equals the cost of trade misinvoicing, then both legal and illegal trade can coexist. Otherwise, firms will exclusively engage in one form or the other. This form of trade, they assert, erodes tax revenue without offering efficiency gains, concluding that illegal trade fails to improve overall welfare. Subsequent work by Pitt (1981) posits that both forms of trade empirically coexist, as firms often use legal trade to mask their illegal activities. According to his model, when firms engage in both, legal traders are edged out of the market. Thursby et al. (1991) extend this analysis to a setting where some, but not all, firms engage in illegal trade. They suggest that such coexistence can improve welfare if it enhances market competition, meaning higher welfare correlates with a greater number of firms in the market.

The second focal point of the theoretical discourse delves into identifying the determinants that fuel trade misinvoicing. A burgeoning empirical literature has emerged to substantiate these theoretical constructs, predominantly employing trade discrepancy data derived from the balance of payments as the metric for gauging the scale of trade misinvoicing. Notably, this empirical approach has been validated through extensive studies conducted by various scholars such as Javorcik and Narciso (2008), Mishra et al. (2008), and Ferrantino et al. (2004)¹. Additionally, specialized examinations have been undertaken focusing on particular aspects: Buehn and Eichler (2011) zero in on trade involving the USA, Vézina (2015) scrutinizes misreported trade in natural resources, and Rotunno and Vézina (2015) investigate misinvoicing in U.S. apparel imports from China.

The principal driving forces behind trade misinvoicing can be classified into three predominant categories: financial incentives, customs considerations, and enforcement-related factors (Buehn and Eichler, 2011; Patnaik et al., 2012). Financial incentives primarily involve tax evasion mechanisms such as dodging import tariffs or exploiting export subsidies. In Turkey, for instance, commodities subjected to higher tariffs have been observed to be more susceptible to import under-invoicing, as delineated in seminal work by Bhagwati (1964). On the other hand, in Madagascar, products exempt from tariffs—like fertilizers, books, and cereals—are more prone to import over-invoicing (Chalendard et al., 2016). From an export perspective, Celâsun and Rodrik (1989) and Fisman and Wei (2007) have documented that commodities benefiting from export subsidies are more likely to experience export over-invoicing, whereas those subjected to export restrictions predominantly exhibit export under-invoicing.

In addition to the aforementioned motives, foreign exchange controls also serve as catalysts for traders to navigate around currency restrictions and exploit exchange rate disparities for additional gains in foreign currency. Specifically, traders engage in practices like export under-invoicing and import over-invoicing to

¹For a comprehensive overview, see Javorcik and Narciso (2008), Mishra et al. (2008), Ferrantino et al. (2004), Stoyanov (2012), Bouët and Roy (2011), and Patnaik et al. (2012).

capitalize on black market premiums (Barnett, 2003; Biswas and Marjit, 2005). This stratagem is closely intertwined with capital flight, which is often triggered by deteriorating political or economic conditions within a country (Cuddington, 1986; Kar and Freitas, 2012). Empirical evidence indicates that in economies with lax capital controls, capital flight is more likely to occur through formal financial channels. Moreover, interest rate differentials—indicative of higher prospective returns abroad—further exacerbate the phenomenon of capital flight from low-interest-rate economies. However, Fofack and Ndikumana (2014) found no significant relationship between interest rates and capital flight in their study on African countries. Conversely, Patnaik et al. (2012) demonstrated that real interest rate differentials have a substantial influence on export misinvoicing, particularly in industrialized nations.

Lastly, the enforcement-related motives for trade misinvoicing are predominantly driven by the desire to evade customs duties and circumvent bureaucratic requirements. To elucidate, Yang (2008) captured the strategic shifts among importers who redirected their orders to regions with duty exemptions, following the Philippine government’s decision to employ private firms for pre-shipment inspections in select countries. In a parallel vein, Pohit and Taneja (2003) found that informal cross-border trade between India and Bangladesh is primarily fueled by the intention to sidestep administrative impediments, such as procedural delays and cumbersome paperwork, which otherwise result in deferred payments.

2.2 Research Motivation and Switzerland

Emerging from the rich tapestry of literature on trade misinvoicing, it becomes evident that traditional factors like tariff rates and Black Market Premiums (BMP) have been well-explored. However, this scholarship often sidelines country-specific characteristics, such as corporate income taxes, corruption, accounting standards, and capital controls, which can also influence the proclivity for misreporting trade (Slemrod, 2007; Johannesen & Zucman, 2014; Devereux, 2019). This omission is the impetus for our research. We aim to delve into these less-studied, but equally salient, country and commodity characteristics that can only be identified at the national level.

Our inquiry possesses a universal applicability, extending across countries at disparate stages of economic development. Moreover, we nuance these overarching findings by stratifying trade misinvoicing according to income levels, commodity-based production status, and production costs, thereby offering a more segmented understanding of the issue (Ndikumana et al., 2015; Clough et al., 2014).

Given its unique blend of economic features, Switzerland serves as an especially instructive case study within this broader research agenda. Not only is the country an influential player in global trade, but its intricate fiscal policies, robust auditing standards, and low corruption levels make it an interesting laboratory for understanding how country-specific variables can influence trade misinvoicing. Transitioning from the broader research objectives, we now turn our attention to the empirical aspect of our study, leveraging a unique dataset. While previous studies have typically relied on aggregate trade statistics that blend multiple commodities and trading partners, our research employs a more granular approach. Utilizing country-level import transaction data provided by the Swiss Federal Customs Administration (FCA)—which encompasses trade with an extensive set of 154 partner countries—we focus specifically on select hard (gold, copper) and soft (coffee, cocoa) commodities. This enables us to identify the unique country and commodity characteristics influencing trade misinvoicing through abnormal pricing activities (Fuest and Riedel, 2009; Nitsch, 2012).

Switzerland serves as a particularly intriguing focal point for this study, given its dual role as a global hub for both commodity trading and financial services. Research by the Institute for Human Rights and Business (2017) indicates that Switzerland is host to 496 firms engaged primarily in commodity trading or associated sectors. These firms are geographically concentrated in three key regions: the Lake Geneva area, central Switzerland, particularly in Zug, and Lugano in Ticino. According to data from the Swiss Trading and Shipping Association (STSA), this sector directly employs over 13,000 individuals and generates an additional 20,000 indirect jobs within Switzerland. More importantly, Swiss trading firms control a substantial share of global trade in key commodities, including 35% of cocoa, 60% of metals, 35% of oil, 60% of grains, 50% of sugar, and 50% of coffee (Jungbluth & Meili, 2018).

Switzerland stands as a cornerstone in the global precious metals market- it is home to four principal refineries accredited by the London Bullion Market Association's Good Delivery List, serving as a major hub for the gold trade. Remarkably, Switzerland imported 2,385 tons of unwrought gold in 2017, constituting a staggering 75% of the global gold production for that year, according to data from the United States Geological Survey (USGS, 2017).

In addition to its monumental role in the commodities and precious metals sectors, Switzerland also excels as a financial services stronghold. The country provides a comprehensive suite of services—ranging from trade financing and insurance to logistics and legal support—that are indispensable to trading firms (Institute for Human Rights and Business, 2017). These sectors are interlinked and mutually beneficial, operating under a regulatory framework that encompasses both federal and cantonal laws. The favorable tax environment, coupled with Switzerland's stable political and economic landscape, adds to the country's allure as a locus for trading activities (ibid).

Building upon Switzerland's prominence in global commodity trading, it is crucial to address the empirical challenges that come with investigating this sector. One primary hindrance is the predominance of transit or merchant trade activities, in which commodities are frequently bought and sold beyond the purview of Swiss Customs. This renders much of the trade data elusive in the Swiss Federal Customs Administration's records. While the Swiss National Bank (SNB) does offer some aggregated data on merchanting in its balance of payments reports, this is far from satisfactory for nuanced analysis (Jungbluth & Meili, 2018). The data amalgamates commodities with other sectors like pharmaceuticals and chemicals and also incorporates service costs such as storage and insurance, diluting the focus on commodities alone (ibid).

Furthermore, the absence of systematic firm-level data exacerbates these challenges. Notably, the Swiss Classification of Industries (NOGA) lacks a dedicated category for the trading sector, highlighting the institutional gaps in capturing this industry's intricacies (STSA, 2019). Additionally, the majority of these firms are privately owned, and they typically withhold financial details due to competitive sensitivities (Institute for Human Rights and Business, 2017). In light of these constraints, our study leverages the micro-data sourced from the Swiss Federal Customs Administration. While this dataset may not provide a comprehensive view, it offers invaluable granular insights into the pricing strategies of commodities traded within the Swiss jurisdiction.

While Switzerland's robust trading and financial sectors confer several economic benefits, they also come with ethical quandaries that necessitate immediate attention. A case in point is the pervasive risk of corruption among commodities trading companies, as highlighted by a 2015 report from Switzerland's Interdepartmental Coordinating Group on Combating Money Laundering (CGMF). The report underscores

the vulnerability of these companies to engage in corrupt activities, especially when operating in politically sensitive jurisdictions. For example, Gunvor in Congo Brazzaville has been implicated in corrupt payments related to oil contracts, while Vitol in Kazakhstan and Trafigura in Angola have entered partnerships with 'politically exposed persons' (PEPs), indicating a high-risk appetite and questionable business practices (CGMF, 2015).

Further exacerbating these concerns are instances involving Swiss commodities companies in human rights violations and environmental degradation. A 2016 report by Public Eye laid bare the role of Swiss traders in supplying fuel with alarmingly high sulfur content to West African countries like Nigeria and Ghana. These actions illustrate how firms exploit weak legislative frameworks to maximize profits while disregarding environmental and human well-being (Public Eye, 2016). The Swiss authorities' inertia in addressing these issues has not escaped international scrutiny. In its 2018 evaluation, the Organisation for Economic Co-operation and Development (OECD) urged Switzerland to implement "suitable and binding regulations" to tackle these pressing concerns (OECD, 2018).

The pertinence of this research extends beyond the boundaries of Switzerland and the trading sector. Given that natural resource rents constitute a critical revenue stream for many governments, especially those in developing countries, the consequences of trade misinvoicing are far-reaching. The loss of tax revenues due to such activities can have cascading effects—resulting in either reduced public services or a hike in taxes levied on capital or labor income (Kim and Kose, 2014). Furthermore, this loss can precipitate an increase in international aid outflows to these countries, exacerbating aid dependency (Collier and Venables, 2011). Hence, insights into how variables like corporate income tax rates, corruption, and development levels influence misreporting can significantly bolster enforcement mechanisms and enhance revenue collection.

Transitioning from the macroeconomic implications of trade misinvoicing to a more nuanced issue, Domestic Resource Mobilization (DRM)—achieved through enhanced tax and revenue collection—stands as a vital strategy for natural resource-rich economies. Yet, the tax-to-GDP ratio in developing countries lags significantly behind that in developed nations, indicating the persistent challenges surrounding DRM (Umar and Tsubira, 2017; Ortiz-Ospina and Roser, 2018). These challenges encompass a myriad of issues including inconsistent tax policies, limited administrative capacity, a sprawling informal sector, and eroded public trust in governmental institutions (Mascani, Monkam, and Nell, 2016; World Bank, 2016). Furthermore, inadequately designed tax policies exacerbate disparities between domestic and multinational corporations, thereby encouraging predatory behavior in the private sector (Le Billon, 2011).

Building on the aforementioned issues of enforcement and Domestic Resource Mobilization, it is imperative to scrutinize one of the most pervasive forms of illicit financial activities—tax evasion. Within the tax evasion landscape, trade misinvoicing emerges as a critical conduit, constituting an estimated 60 to 75 percent of all illicit financial flows (IFFs) over the past decade (Kar and Spanjers, 2014). The rationale behind its widespread occurrence lies in the convenience it offers and the relatively low risk of detection, especially in countries with weaker governance structures (Beja, 2006; Carbonnier and Cadena, 2015). To offer a sense of scale, the United Nations Economic Commission for Africa (UNECA) quantifies losses from trade misinvoicing at a staggering USD 407 billion (UNECA, 2012). Other research suggests that governments may forfeit between 7 to 12 percent of their annual tax revenue due to such activities (Clough et al., 2014).

Transitioning from the scale and impacts of IFFs, it's imperative to address the inherent limitations in quantifying these flows. A key issue is that estimates of IFFs are often derived as residuals, calculated as the

difference between the reported unit price and the free-market price. This approach introduces a range of measurement errors, including those stemming from industry-specific pricing agreements or unique pricing structures (Forstater, 2018). Moreover, official trade statistics may capture only a fraction of misinvoicing activities, given that most estimation methods do not account for IFFs originating from illegal activities. As a result, these limitations offer merely a partial view of the total volume of IFFs. It is also worth noting that our study, like most in this area, cannot identify the misclassification of commodities. What is observable is purely mispricing—instances where firms have reported a value to trade authorities that diverges from the actual free-market transaction value.

3 Data

3.1 Swiss Imports Data: 2011-17

For the analysis spanning 2011 to 2017, the primary dataset employed comes from the Swiss Federal Customs Administration. While these data originally have a daily granularity, they are consolidated on an annual basis for panel regression modeling. Notably, detailed statistics on gold imports by trading partners only became publicly accessible starting in 2012. Before that, such data remained undisclosed for various political and economic reasons.²

The selected commodities and their corresponding HS codes, as per Swiss Federal Customs Administration tariff guidelines³, are: Non-monetary, unwrought Gold (HS code: 7108.12), Refined Copper cathodes (HS codes: 7403.11), Unroasted Coffee Beans (HS code: 901.11, 901.12), Cocoa Beans (HS code: 1801.00). Summary statistics of these commodities are presented in Figure 1

3.2 Commodity price data: 2011-17

We obtain commodity price data from Datastream, a global database on financial and macroeconomic indicators produced by Thomson Reuters. The specific commodity exchanges for each commodity are :

- Gold: London Bullion Market Association (LBMA) - Gold Bullion LBM (\$t oz)
LBMA is the global authority in the over-the-counter market for gold and silver. The association sets quality and trading standards and its prices serve as a global reference. It is particularly known for its Gold Bullion LBM prices quoted in troy ounces.
- Copper: London Metals Exchange - LME-Copper, Grade A 3 Months (U\$MT)
The London Metals Exchange (LME) is the world's largest market in options and futures contracts for base and other metals. LME-Copper specifically deals with Grade A Copper and its three-month futures prices are widely considered the global benchmark for copper trading.

²Reportedly, the rationales behind withholding this data ranged from protecting sensitive commercial information to fortifying Zurich's competitive edge against London in the commodities exchange market. It also involved concealing potentially controversial trade affiliations with countries like apartheid-era South Africa and the Soviet Union. Refer to: https://www.swissinfo.ch/eng/business/international-trade_counting_-_gold_-_in_-_switzerland/41417986

³List of Tariff Headings document available at: <https://www.ezv.admin.ch/ezv/en/home/information-companies/customs-tariff-ares.html>

- **Cocoa Beans:** The International Cocoa Organization (ICCO) - Cocoa-ICCO Daily Price (US\$MT)
ICCO is the main global organization for cocoa, aiming to sustain the global cocoa economy by providing transparent market statistics. Their daily price metrics for cocoa beans are highly regarded and are quoted in U.S. dollars per metric ton.
- **Coffee:** International Coffee Organization - Coffee-ICO Composite Daily ICA (c/lb)
The International Coffee Organization (ICO) is the main reference for coffee policies and data worldwide. The ICO Composite Daily ICA is a weighted average of coffee prices, usually quoted in cents per pound, and is considered the most reliable price indicator for coffee globally.

Trade data holds considerable economic weight for a multitude of reasons. Not only does it shape a country’s economic landscape, but it also contributes to a sizable chunk of governmental revenue via customs duties. Scholars have further leveraged trade data to study an array of issues, ranging from corruption and capital flight to the mispricing of trade transactions. As previously elaborated, mispricing in the trade of commodities serves as a key avenue for tax-base erosion, particularly in resource-rich developing nations. To quantify this, the research community has either scrutinized anomalies in transaction-level data or explored asymmetrical patterns in partner-country trade statistics. In this section, we delve into the price-filter analysis methods based on the interquartile price range and free market price range.

3.3 Measuring import misinvoicing: Price Filter Analysis

Price filter analysis offers a nuanced lens through which to scrutinize anomalous pricing in global trade, a methodology that gained traction through the work of Zdanowicz et al. (1999), Hong et al. (2014), and Hong and Pak (2017). By delving into a country’s granular, transaction-level data—coded under the Harmonized Commodity Description and Coding System (HS code)—this approach identifies a ‘fair market’ price range for each commodity. From there, it distinguishes between transactions falling within and outside this ‘arm’s length’ range. Two core strategies shape this method, outlined below.

In the methodology of the Inter-Quartile Range (IQR) Price Filter, the arm’s-length price range is statistically defined by the 25th and 75th percentiles of observed unit prices for a given commodity. When the declared unit value exceeds the upper-quartile price, the transaction is classified as overpriced; the excessive amount is calculated as the deviation from this upper boundary. Conversely, if the declared unit value is below the lower-quartile price, the transaction is classified as underpriced, with the shortfall calculated as the difference from this lower threshold. The degree of undervaluation or overvaluation is calculated as:

$$\text{Undervalued Amount} = \text{Quantity} \times \max(0, P_{Low} - P)$$

$$\text{Overvalued Amount} = \text{Quantity} \times \max(0, P - P_{High})$$

where P represents the declared unit value price, P_{Low} is the lower-quartile price, and P_{High} is the upper-quartile price.

It’s important to note that this method will inherently flag a certain percentage of transactions as mispriced, given that the interquartile range is derived from the observed data itself. As such, the results should

be interpreted cautiously and contextualized with additional factors such as product specifications or market conditions. For instance, the purity level of a precious metal, or current political and economic circumstances, can significantly influence whether a transaction price is within the estimated interquartile range.

In the Free-Market Price Filter approach, the unit prices for individual commodities are juxtaposed with prevailing market prices. A pre-defined range is set around this market price to accommodate variables like specific product features, transportation expenses, and fluctuating market conditions. Prices falling within this designated range are considered to be at arm's length and thus deemed normal. Any deviation beyond this accepted range is classified as either undervalued or overvalued.

For mathematical specificity, the extent of undervaluation or overvaluation for each transaction is determined as follows:

$$\text{Undervalued Amount} = \text{Quantity} \times \max(0, P_{Low} - P)$$

$$\text{Overvalued Amount} = \text{Quantity} \times \max(0, P - P_{High})$$

Analogously, under the Free Market approach, P_{Low} is the lower bound of the free market price, and P_{High} is the upper bound of the free market price while P continues to be the declared price.

A significant merit of this approach is its independence from the need to estimate arm's-length prices based on transaction data, rendering it uninfluenced by related-party transactions. Nonetheless, a key constraint is the requirement for easily accessible and universally accepted benchmark prices, a condition not always met, especially for commodities lacking an established market.

Drawing on insights from Reuter (2012) and Carbonnier and Zweynert de Cadena (2015), it's evident that while price filter analysis offers an intuitive framework for dissecting trade data, it's not without its pitfalls. The method often falters when applied to products with a high degree of variance in quality and pricing. For instance, luxury goods might be misclassified as overpriced, while bargain items could be mistakenly tagged as undervalued. Even items priced within a moderate range can be erroneously labeled as normally priced. Furthermore, this methodology inherently generates some level of overpricing and underpricing, owing to its reliance on observed trade data to set quartile boundaries. Lastly, the focus on unit pricing often overlooks the skewing impact of misreported quantities.

In our execution of this methodology, we've incorporated several advancements to counteract these shortcomings. A cornerstone of our approach involves comprehensive research into commodity sectors and consultations with industry experts both within and outside Switzerland. This rich data pool allows us to make more informed choices when setting price filters based on free-market values. Our analysis is deeply rooted in understanding the nuances of product diversity, prevailing market conditions, contract stipulations, and logistical expenses. Additional data sources related to commodity production and trade have also been integrated to fine-tune our estimates for arm's-length pricing. This is further elaborated below:

Gold

The arm's length price range is based on the daily spot price series for refined gold bars as provided by the London Bullion Market Association (LBMA). This serves as our global benchmark for gold pricing. Similarly, for copper, the London Metals Exchange (LME) provides the daily price series which serves as our benchmark.

To quantify the typical deviations around this benchmark, we utilize industry research and expert consultations to factor in transportation and operational costs as follows. Conventionally, the cost of imported goods is recorded on a Cost, Insurance, and Freight (CIF) basis. In mainstream trade economics, the costs associated with these elements are often assumed to be around 10% of the import values. However, gold being an extraordinarily valuable metal, these costs are proportionally less. For instance, Cadot et al. (2013) indicated that the costs for shipping gold across continents can be up to 2% of the shipment's total value. This upper limit was confirmed by industry experts in the gold trade (Swiss Trading and Shipping Association, personal communication, July 2019).

The transaction prices can also fluctuate due to variations in production costs and the fiscal terms of mining contracts at both the mine and country levels. For instance, the costs associated with gold ore extraction, processing, storage, and insurance can substantially differ based on the source country. Additionally, large mining corporations often engage in advance pricing agreements with local governments, which can further affect transaction values. Hence, we consider a price deviation of up to 5% from the benchmark as acceptable (Metals Focus Gold Silver Dore Database, 2019).

Based on these considerations, we adopt a conservative approach, setting the arm's length price range at plus or minus 5% around the LBMA daily spot price for refined gold bars.

Copper

Data sourced from the Swiss Federal Customs Administration reveals that the volume of recorded imports of refined copper into Switzerland is relatively small, amounting to an annual average of CHF 4.2 million between 2011 and 2017. Furthermore, the sparse number of transactions—totaling 359 from the rest of the world over the seven years—limits the feasibility of conducting a reliable price filter analysis

Cocoa and Coffee

Our investigation incorporates data from 2011 to 2017 for both cocoa and unroasted coffee beans—non-decaffeinated and decaffeinated (HS codes 901.11 and 901.12). We employ the Cocoa-ICCO Daily Price and the ICO Daily Price as benchmark prices, recorded by the International Cocoa Organization (ICCO) and the International Coffee Organization (ICO), respectively.

For cocoa, the ICCO daily price series incorporates an average of cocoa prices from various regions. Key international suppliers include Ivory Coast and Ghana. Between 2011-2017, Ivory Coast cocoa prices surpassed ICCO averages by 11% (with a standard deviation of 4%), while Ghana exceeded the ICCO average by 14% (standard deviation of 4%).

For coffee, the ICO daily price series is an amalgam of different coffee types, primarily Arabicas and Ro-

bustas. Data from 2011-2017 shows that Arabica prices were 24% above the ICO average (standard deviation of 6%), while Robusta prices were 31% lower (standard deviation of 10%).

In light of this, our baseline estimates attribute a 10% variation for cocoa and a 20% variation for coffee around the free-market price due to product heterogeneity. Both commodities are subject to processing and storage costs that can substantially affect final consumer prices. Therefore, we expect some natural fluctuations in transaction values, which we estimate to be around 10% for both cocoa and coffee due to ordinary business conditions. We allocate an additional 10% to the import valuation for both cocoa and coffee to account for transportation and insurance expenses. Given these considerations, we set an arm's length price range of 30% for cocoa and 40% for coffee around the free-market prices.

4 Empirical strategy

In our empirical framework, we employ the logarithmically transformed measure of abnormal pricing as the dependent variable. This log-normalization serves a dual purpose: first, it rescales the dependent variable, thereby mitigating the effects of its highly positively skewed distribution (Gujarati, 2004); second, it enhances interpretability by allowing the coefficients to be interpreted in terms of semi-elasticities (Wooldridge, 2010).

To account for the heteroskedasticity inherent in cross-country data, we opt for clustering the standard errors at the country level. This approach is predicated on the rationale that the bulk of variation in our variables emanates from between-country differences and temporal fluctuations, rather than intra-country dynamics (Cameron & Miller, 2015).

Further enhancing the robustness of our model, we incorporate both country-commodity and year-fixed effects. The former captures unobserved, time-invariant characteristics associated with each country-commodity pair, thereby serving as a control for latent heterogeneity (Angrist & Pischke, 2009). Year-fixed effects, on the other hand, absorb shocks common to all entities in a given period—be it a reform in customs administration or a systemic decrease in corruption levels (Deaton, 1997). Consequently, these fixed effects offer a mechanism to control for global influences such as technological advancements in customs processing or salary increases for export revenue authorities that might otherwise confound the relationship between the independent and dependent variables.

Our research agenda takes a deep dive into the intricacies of corporate taxation as a pivotal driver of trade misinvoicing. The central hypothesis posits that the divergence in tax rates between Switzerland and its trading partners serves as a conduit for firms to circumvent domestic tax liabilities and reallocate profits to more favorable jurisdictions (Reuter, 2012; Johannesen & Zucman, 2014). We operationalize this through our primary variable of interest, the total tax rate on commercial profits, which encompasses the full spectrum of taxes and mandatory contributions incumbent upon businesses after adjusting for allowable deductions and exemptions (World Bank, 2020).

The elasticity of trade misinvoicing with respect to corporate tax rates is potentially bidirectional. A higher corporate tax rate could lead firms to overstate both imports and exports to inflate costs and reduce taxable income. Conversely, firms may also understate these values to minimize their apparent profitability and hence, their tax liability. This dual nature of corporate tax rates as both a deterrent and an incentive for trade misinvoicing makes the statutory corporate tax rate a particularly pertinent variable for our inquiry.

We use the preceding discussion and the literature to identify some of the key factors expected to drive import misinvoicing. The rationale behind the inclusion of each variable is presented below, the variables are sourced from the World Bank's World Development Indicators Database⁴:

- **GDP growth rate:** Higher real GDP growth rates signal the presence of attractive investment opportunities at home; such opportunities encourage firms to undertake more domestic investment, reducing the incentive to misinvoice and send capital abroad (Conesa, 1987; Lessard & Williamson, 1987). It can also be posited that trade misinvoicing causes a shortfall of investible funds and contributes to foreign exchange shortages, which ultimately restrain economic growth. Thus, there may exist a simultaneous causal relationship between trade misinvoicing and GDP growth.⁵
- **Natural resource rents:** Through the appreciation of the real exchange rate and the ensuing contraction of the traded sector, the oft-cited Dutch disease highlights the pernicious effect natural resource dependence can have. With higher potential resource rents and exhaustible resources, firms may be incentivized to illegally extract higher than permitted quantities and misinvoice their transactions to maximize their short-term gains (Van Der Ploeg, 2011).
- **Foreign direct investment:** Foreign direct investment can encourage trade misinvoicing by furnishing foreign exchange, which provides liquidity to support the flight of capital (Boyce, 1992; Lensink et al., 2000). Furthermore, the supply of foreign exchange causes local currency to appreciate in the short run, which may not be sustainable in the long run. Hence, anticipating an eventual depreciation, firms may switch out of domestic assets. Finally, foreign investment typically finances a large number of investment projects and, since there exists only a limited number of domestic investment opportunities, there arises a 'crowding out' effect that could push domestic capital abroad (Conesa, 1987; Boyce, 1992).
- **Domestic Inflation:** Increases in the domestic price level vis-a-vis the foreign price level can cause the real value of domestically held assets to erode faster than foreign assets. Therefore, rational firms will be incentivized to engage in trade misinvoicing to protect their assets against this loss by transferring them to countries with lower inflation rates (Cuddington, 1986; Dooley, 1988; Lessard & Williamson, 1987).
- **Current account balance:** A high current account deficit can be the manifestation of economic instability, inducing firms to engage in trade misinvoicing to move capital abroad. A country faced with a persistent current account deficit is likely to undertake a devaluation to improve the current account balance, or raise resources internally by engineering a transfer from the private sector through appropriation of private assets or generating seigniorage revenue through an inflation tax (Patnaik et al., 2012).
- **Yearly Exchange Rates:** Fluctuations in exchange rates exert a palpable influence on the incentives for trade misinvoicing, by either amplifying or attenuating the potential gains from such activities (Aizenman & Jinjara, 2009; Gaulier & Zignago, 2010). A depreciation in the domestic currency

⁴ Accessible at <https://databank.worldbank.org/source/world-development-indicators>

⁵ Tornell & Velasco (1992) proves, in a mathematical model, that in an economy that is characterized by weak property rights and an open capital account, the rate of economic growth and the magnitude of capital flight are inversely related.

vis-a-vis its trading partner could make over-invoicing of imports or under-invoicing of exports financially advantageous, as this would allow firms to accrue more foreign currency (Dell'Anno & Villa, 2013). Conversely, an appreciating domestic currency could have the opposite effect, discouraging misinvoicing due to reduced profitability (Reuter & Truman, 2004). Additionally, erratic exchange rate movements can introduce uncertainty into international trade, potentially motivating firms to engage in trade misinvoicing as a form of risk mitigation (Bahmani-Oskooee & Goswami, 2005). Therefore, yearly exchange rates serve as a salient control variable in this study, capturing the macroeconomic conditions that shape the risks and rewards associated with trade misinvoicing.

To fully capture the complexities inherent in the phenomenon of trade misinvoicing, we employ a panel data framework that integrates both country and commodity dimensions over time. The specified model can be formally represented as:

$$Y_{ikt} = \alpha + \beta_1(C_{ikt}) + \beta_2(X_{ikt}) + \epsilon_i + u_t + \alpha_k + \omega_{ikt}$$

where

- Y_{ikt} : This is our dependent variable, representing the logarithmically transformed measure of abnormal pricing for country i , year t , and commodity k
- C_{it} : The primary independent variable of interest, denotes the total tax rate as a percentage of commercial profits for country i at time t .
- X_{it} : This vector captures country-level exogenous variables for country i at time t , including real GDP growth rate, natural resource rents, foreign direct investment, domestic inflation, and current account balance.
- $\epsilon_i, u_t, \alpha_k$: These terms represent the unobserved, time-invariant country, year effects, and commodity fixed effects, respectively.
- ω_{ikt} : Idiosyncratic error term.

5 Results

5.1 Baseline results

Our baseline results offer compelling evidence on the role of tax rate divergence in shaping abnormal pricing behaviors, a critical conduit for illicit financial flows (IFFs) in commodity trade with Switzerland. The findings are presented in three specifications to ensure robustness and to control for a range of confounding factors (Table 3).

Starting with the most parsimonious model, the coefficient for "Tax rate divergence" stands at 0.321 and is statistically significant at the 1% level. Econometrically, this implies that for a percentage point increase in the tax rate divergence between Switzerland and its trading partners, abnormal pricing—our chosen proxy for IFFs—increases by 0.32%.

From an economic standpoint, this result is consistent with the notion that higher tax rate differentials create incentives for firms to engage in tax evasion or avoidance activities, including trade misinvoicing (Johannesen and Zucman, 2014; Tørsløv et al., 2018). The substantial magnitude of the coefficient indicates that tax rate divergence could be a significant driver of IFFs.

Contextually, the finding resonates with Switzerland's unique position as a major commodity trading hub. The country's complex tax treaties and lower corporate tax rates compared to many of its trading partners could make it a particularly attractive location for tax-motivated transfer mispricing (Forstater, 2016).

Incorporating year and country fixed effects into the model, the coefficient declines to 0.296 but remains significant. Economically, this suggests a 0.29% increase in abnormal pricing for a percentage point increase in tax rate divergence. The smaller standard error compared to the baseline model may indicate that the inclusion of fixed effects has accounted for some unobserved heterogeneity, making the estimate more precise (Wooldridge, 2010). The reduction in the coefficient's magnitude upon the inclusion of fixed effects hints at the role of time-invariant country characteristics or global shocks in abnormal pricing. This is in line with recent research that considers how unobserved institutional factors can influence IFFs (Gara et al., 2019).

In the third specification, which includes the array of control variables, the coefficient further declines to 0.279. This indicates a 0.27% increase in abnormal pricing for every percentage point increase in tax rate divergence. The decrease in the coefficient upon the inclusion of additional controls may suggest that factors like economic growth, foreign direct investment, or trade policies also play a role in abnormal pricing, consistent with findings by Cobham et al. (2015).

5.2 Income and Product Differentiation

In our analysis, we further investigate the heterogeneity in illicit financial flows (IFFs) by considering income classification and product differentiation. Specifically, we extend our baseline models to include interaction terms for tax rate divergence with high-income classification and differentiated products.

We utilize the World Bank's income classification⁶ which assigns economies into four income groups: high, upper-middle, lower-middle, and low.

We have chosen to include a single dummy variable for high-income countries for two main reasons. First, the principle of parsimony in econometric modeling advises against overcomplicating the model with multiple income-level dummies (Cameron & Trivedi, 2005). A single dummy for high-income countries simplifies interpretation and focuses on extracting policy-relevant insights. Second, statistical power considerations favor fewer degrees of freedom, particularly crucial given the limited representation of lower-income categories in Swiss trade (Wooldridge, 2010). Thus, the use of a single high-income dummy is both methodologically sound and aligned with Switzerland's specific trade patterns.

We delve deeper into the mechanics of abnormal pricing by investigating the role of product differentiation, specifically differentiating between commodities like gold and copper, and agricultural goods like cocoa and coffee. This distinction is significant in the context of trade misinvoicing due to the varying degrees of price transparency these goods exhibit. Drawing upon the dichotomy between homogeneous and differentiated goods proposed by Rauch (1999) and extended by Javorcik and Narciso (2008), we consider gold and

⁶This assignment is based on GNI per capita, calculated using the Atlas method. See: <https://blogs.worldbank.org/opendata/new-country-classifications-income-level-2018-2019>

copper as homogeneous goods. These are commodities traded on organized exchanges with readily available reference prices. On the other hand, cocoa and coffee are considered as differentiated goods, characterized by their absence from organized exchanges and the lack of transparent reference prices. The rationale behind this is rooted in the inherent complexities of valuing differentiated goods, which offer more scope for under-reporting due to the absence of standardized, transparent pricing mechanisms (Javorcik and Narciso, 2008; Nitsch, 2012).

Starting with income classification, the coefficient on the interaction term between tax rate difference and high-income indicator is -0.123 , with a standard error of 0.158 (Table 4). While this value is not statistically significant, it holds economic and contextual relevance. It suggests that a percentage point increase in tax rate divergence is associated with a 0.123% decrease in abnormal pricing for high-income countries compared to their lower-income counterparts. This counter-intuitive result could potentially be explained by the high level of scrutiny and compliance requirements that multinational corporations (MNCs) and commodity trading firms face when dealing with high-income jurisdictions. This finding aligns with the theoretical frameworks developed by Johannesen and Zucman (2014), who argue that the propensity for IFFs may be lower in countries with more robust financial systems.

Turning to product differentiation, the interaction term has a coefficient of 0.252 and holds statistical significance at 5% . This suggests that a percentage point increase in tax rate divergence leads to a 0.252% increase in abnormal pricing for differentiated products, compared to non-differentiated products (Table 4). The econometric implication here is that the model captures the added complexity of valuing differentiated products, which often provides firms more leeway to manipulate prices for tax evasion or profit shifting. This aligns with the general observation that differentiated goods are more vulnerable to illicit financial flows due to the complexities in determining their true market value (Maur, 2008; Fisman and Wei, 2004; Nitsch, 2012).

It is worth noting that both interaction terms do not substantially alter the main effect of tax rate divergence on abnormal pricing, which remains significant and positive across both models. This underscores the robustness of our main findings and implies that while the magnitude may vary, the positive relationship between tax rate divergence and abnormal pricing persists across different income levels and types of products.

5.3 Producer and Firm Ownership

To examine the extent of foreign ownership in mining, we create a continuous variable named Foreign Owned Share using data from the SNL Metals and Mining database. This database provides comprehensive information on the location and ownership history of mines for minerals, including gold and copper. Our variable measures the proportion of mines in a given country that are owned by foreign-based companies. Specifically, the variable is constructed as follows:

This variable is then scaled between 0 and 1 , where 0 signifies no foreign ownership and 1 signifies complete foreign ownership. Values between 0 and 1 represent the fractional foreign ownership of mines. The scaling ensures comparability across countries and facilitates straightforward interpretations.

In addition, we introduce a binary indicator variable named Foreign Owned. It takes the value 1 if more than 50% of the mines in a country are foreign-owned and 0 otherwise. This threshold-based measure allows for a more focused analysis of the impact of majority foreign ownership on abnormal pricing and IFFs.

The rationale behind this is to examine the impact of foreign control in a country's mining sector, particularly for commodities such as gold and copper. In economies where foreign ownership is more pervasive, we might anticipate an uptick in misinvoicing activities. This presumption is founded on the economic rationale that foreign firms, operating with a global profit-maximizing strategy, might exploit their financial and technical capacities to navigate around stringent regulations. Such strategic behavior is especially plausible when firms operate under limited investment horizons, making immediate profit extraction more appealing. This is consistent with the seminal work by Sachs and Warner (1997), which posits that foreign entities in the natural resource sectors often employ tactics that might not align with long-term domestic policy interests. Furthermore, given the complexities of the international financial system, countries where foreign firms hold the majority of mining interests could be uniquely susceptible to illicit financial flows (IFFs). Majority foreign ownership amplifies the channels through which profit can be shifted and capital can be illicitly moved across borders. This concept is reinforced by the findings of Ndikumana et al. (2015), who explore the facilitative role that foreign firms often play in enabling capital flight from resource-rich countries.

Finally, a binary indicator named 'Producer Status' is constructed to capture whether a country is a producer of cocoa or coffee. The variable takes the value 1 if the country is a producer of either commodity and 0 otherwise. In countries endowed with such natural resources, the variable serves as a marker for potential vulnerability to trade-based financial crimes. This stems from the idea that commodities with significant value, especially those that are easily tradable, often become targets for money laundering activities. Vezina (2015) provides empirical support for this claim, suggesting that rich natural endowments can inadvertently make countries hotspots for abnormal pricing and trade-based money laundering.

In Column I, the interaction term with Producer Status yields an inconclusive result, with a coefficient of 0.232 that isn't statistically significant (Table 5). This suggests that being a producer of specific commodities like cocoa and coffee does not significantly modify the impact of tax rate divergence on abnormal pricing, contrary to what might be expected from the resource curse literature (Auty and Warhurst, 1993; Vezina, 2015).

Column II introduces an interaction term with Foreign Owned, which turns out to be negative and highly significant (-0.175). This result is counterintuitive, suggesting that the presence of foreign ownership in a trading partner's mining sector seems to moderate the impact of tax rate divergence on abnormal pricing. One possible explanation could be that foreign-owned firms have more sophisticated financial management practices that include legal tax avoidance strategies, thereby reducing the need for trade misinvoicing (Desai and Dharmapala, 2006; Fuest and Riedel, 2009). Finally, Column III employs a binary indicator for foreign ownership. The coefficient is -0.115 and is statistically significant, which corroborates the findings in Column II. The use of a binary indicator, in this case, may capture more systemic effects of foreign ownership on trade misinvoicing, such as the creation of transfer pricing hubs (Cobham et al., 2019).

5.4 Corruption and Political Stability

We integrate two critical variables that have been empirically established as salient predictors of capital flight and trade misinvoicing: corruption and political instability. To capture corruption, we employ the Corruption Perceptions Index (CPI) from Transparency International, a widely recognized metric that aggregates expert assessments and opinion surveys to evaluate the pervasiveness of corruption across countries. Grounded in the notion that corruption entails the abuse of public power for personal gain, the CPI scores nations on

a scale from 0 to 10. A rise in the score signifies advancements in combating corruption, thereby offering an ordinal measure that allows for comparative analyses across time and space (Transparency International, 2011).

For assessing political stability, we draw upon the World Governance Indicators dataset, compiled by Kaufmann, Kraay, and Mastruzzi (2013). This dataset amalgamates 32 distinct data sources into key facets of governance quality, presenting scores that range from -2.9 to 2.9. Higher scores are indicative of increased political stability and reduced likelihood of politically motivated violence or terrorism, thus providing a comprehensive gauge for the political milieu within which trade activities occur.

The integration of these variables is motivated by a growing body of economic literature that emphasizes their consequential role in influencing trade misinvoicing practices. For example, corruption, often manifested through a high CPI score, not only corrodes institutional integrity but also facilitates the flouting of customs rules and procedures, thus creating a conducive environment for trade misinvoicing (Buehn and Eichler, 2011; Fisman and Wei, 2007).

Similarly, heightened political instability, as indicated by lower scores on the World Governance Indicators, can act as a catalyst for capital flight via trade misinvoicing. In a politically volatile environment, firms are incentivized to shield their assets from potential expropriation or depreciation due to looming crises (Patnaik et al., 2012). This dual focus on corruption and political stability adds a layer of complexity to our analysis, allowing us to dissect the socio-political underpinnings that often go hand-in-hand with the economic incentives for trade misinvoicing.

In Column I, the interaction between tax rate divergence and the Corruption Perception Index (CPI) yields a coefficient of -0.120, which is statistically significant (Table 6). This suggests that an increase in the tax rate divergence when conditioned on better governance (as indicated by a higher CPI score), would lead to a 0.12% decrease in abnormal pricing. This augments the widely-held belief that improved governance reduces illicit financial flows (Reuter, 2012). It could be posited that better-governed countries may have more robust tax enforcement mechanisms, making tax evasion through abnormal pricing less attractive (Slemrod, 2007).

Column II introduces the interaction term with Political Stability, but the coefficient is statistically insignificant. Nevertheless, the coefficient sign indicates a positive relationship between political stability and abnormal pricing, adjusted for tax divergence. This could be interpreted as countries with stable political environments being more susceptible to specific types of illicit financial flows, possibly due to complacency in regulatory oversight or because they act as 'safe havens' (Haberly & Wójcik, 2015).

5.5 Transfer Pricing Strength, Capital Account Openness, and Trade Facilitation Indicators

We explore the effect of transfer pricing regulation, capital account openness, and trade facilitation on abnormal pricing activity.

There is ample empirical evidence for the presence of tax-motivated transfer mispricing. Most of these studies estimate how the price wedge between the arm's-length price observed for unrelated transactions and the transfer price used for related party transactions varies with the statutory corporate income tax rates in the destination country relative to the origin country. Studies for the The US, UK, and France find evidence for significant responses of the price wedge to the tax rate differential, as supportive evidence for tax-motivated

transfer mispricing by MNCs (Bernard, Jensen, and Schott, 2006; Clausing, 2003; Cristea and Nguyen, 2016; Davies et al., 2018; Liu, Schmidt-Eisenlohr, and Guo, 2017; Vicard, 2015).

To limit transfer mispricing, several countries have introduced transfer pricing regulations (TPRs). These offer guidance in the implementation of the arm's length principle and often include various specific requirements. For instance, they limit the methods that can be used by an MNC for establishing an arm's length price; specify requirements for the documentation needed to support the transfer price used by an MNC; and set transfer-pricing specific penalties if mispricing is detected or adequate documentation not provided. Stricter regulations could increase the cost of transfer mispricing and, indeed, are found to be effective in curbing the extent of profit shifting in advanced economies. While the nature of our data does not allow us to directly test for transfer mispricing, we use a country's transfer pricing regime as a rough proxy for its regulatory strength and its ability to keep up with changes in global tax regimes, an evolution often exploited by multinational firms through sophisticated schemes. Furthermore, since high-income countries comprise almost half our sample, we believe this exercise could provide preliminary evidence on the role of transfer pricing regulation in curbing other forms of tax evasion and profit shifting.

To capture the impact of TPRs, we use an index of TPR strictness developed by Mescall and Klassen (2014). The index is based on 15 detailed features in the regulation and its enforcement (see also Saunders-Scott (2013))⁷. Mescall and Klassen (2014) use these features to explain the variation in the perception of 76 transfer pricing experts regarding the transfer pricing risk in 59 countries⁸, as revealed in a survey conducted in 2010. This variable measures the overall strictness of the transfer pricing rule and ranges between 0.76 and 4.04 in our sample countries, with higher values reflecting more stringent TPR. However, since this measure does not cover all of the countries in our sample we lose approximately half our sample and are left with 966 observations.

Moving to the domain of capital account openness, extant literature has delineated the intricate interplay between trade liberalization and capital account liberalization (Aizenman, 2008; Aizenman and Noy, 2009). Specifically, Aizenman (2004) posits that greater trade integration in countries with capital account restrictions generates more avenues for capital shifting. We deploy the index developed by Chinn and Ito (2006) to quantify the level of financial openness, positing that an open capital account may serve as a deterrent for trade-based money laundering and capital flight. The index is the first principal component of the binary variables pertaining to cross-border financial transactions, based on the International Monetary Fund's (IMF) categorical enumeration reported in the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The index ranges from 2.54 to 2.54 and a higher value of the index indicates greater financial openness.

⁷These detailed TPR features include 12 regulatory variables on whether: (1) the government allows advance pricing agreements, (2) benchmark data are available to taxpayers, (3) the government requires contemporaneous documentation, (4) cost-contribution arrangement is allowed, (5) commissionaire arrangement is allowed, (6) foreign comparables are allowed to estimate transfer prices, (7) related party setoffs (bundling of transactions) are allowed, (8) the taxpayer is required to pay the tax assessment before going to the competent authority, (9) the government identifies an order of transfer pricing methods to use, (10) the government requires disclosure on the tax return concerning related party transactions, (11) the government allows a self-initiated adjustment, (12) transfer pricing documentation is required. It also contains 3 enforcement variables on: (13) whether the government has discretion over penalty reduction, (14) whether the government uses proprietary tax data to calculate a "revised" transfer price, and (15) the assessed degree of transfer pricing enforcement as a percentage based on transfer pricing experts' 1 to 5 assessment of enforcement strictness, where a score of 1.0 (5 out of 5) is the most strict and 0.2 (1 out of 5) is the least strict.

⁸This measure is available for countries whose country-specific detailed TPR characteristics are documented in Deloitte's Global Transfer Pricing Country Guide.

Trade facilitation data for this study are derived from the OECD's Trade Facilitation Indicators (TFIs), a comprehensive dataset designed to evaluate the full spectrum of regulatory and procedural measures affecting international trade across countries. The TFIs are designed to be directly mapped to the articles of the World Trade Organization's Trade Facilitation Agreement (WTO TFA), thereby providing a robust framework for assessing a country's compliance with international best practices in trade facilitation (Moisé and Sorescu, 2013b).

The TFIs comprise 16 key indicators that collectively encapsulate 97 variables. These variables are drawn from publicly available data sources and are subsequently cross-verified with the respective governments to ensure accuracy and reliability. The indicators address a wide range of issues, including but not limited to, customs procedures, information availability, the involvement of the trade community, advance rulings, appeal procedures, fees and charges, formalities, and governance and impartiality (Moisé and Sorescu, 2015).

Given the intricacies of trade facilitation and its potential impact on trade misinvoicing and tax evasion, the OECD TFIs serve as a valuable source of nuanced, internationally comparable data for this study. The indicators allow for the exploration of how variations in trade facilitation measures may influence abnormal pricing behaviors, particularly in the context of high-income countries that constitute a significant portion of the sample.

In column I, the coefficient for the interaction term between tax rate divergence and TPR is statistically insignificant at 0.020 with a standard error of 0.020 (Table 7). This finding resonates with the complexity and heterogeneity of TPRs across countries, as described by Mescall and Klassen (2014) and Beer and Loeprick (2015). Evidently, the mere existence of stringent TPRs does not automatically translate into curbing abnormal pricing behavior, thereby underscoring the need for further examination into the quality and enforcement of these regulations (Klassen and Laplante, 2012).

Column II reveals a somewhat contrasting scenario. The interaction term between tax rate divergence and CAO is positive and statistically insignificant at 0.118, with a standard error of 0.070. This result hints at a possible mechanism where capital account liberalization may exacerbate the extent of abnormal pricing, a result that is counterintuitive to the theory proposed by Aizenman and Noy (2009). It suggests that, while an open capital account might deter capital flight, it may inadvertently incentivize abnormal pricing as a form of capital control circumvention (Gropp and Kostial, 2000).

The most striking result appears in column III, where the interaction between tax rate divergence and TFI is highly significant at 0.121. This finding is consistent with the idea that effective trade facilitation measures may indeed reduce the scope for abnormal pricing activities (Moisé and Sorescu, 2013b; 2015). The significance of this interaction term is indicative of the potential for trade facilitation measures to serve as a policy lever in mitigating trade-based financial anomalies (Schneider, 2005).

It's worth noting that the sample size in column I is significantly smaller than in columns II and III. This discrepancy arises from the data limitations surrounding TPR, affirming the need for broader and more granular data in future research.

6 Robustness Checks

6.1 Alternate Dependent Variable: Interquartile Range

Given the pronounced product heterogeneity, especially in commodities like coffee and cocoa, the utility of free-market price filter methods can become restricted. Such methods necessitate a globally acknowledged reference price, which is often missing for commodities that exhibit significant regional price variations due to factors like quality and associated production and transportation costs. Consequently, we employ the Interquartile Range Price Filter approach. As sanctioned by the OECD Transfer Pricing Guidelines (paragraph 3.57, OECD, 2017), we determine the interquartile range of unit prices by product, country of origin, and year—capturing all Swiss import transactions for each respective commodity sourced from a particular country within a year.

When switching the dependent variable from free-market price estimates to Interquartile Range (IQR) estimates of abnormal pricing, several changes are expected. The IQR is a measure of statistical dispersion and is less sensitive to outliers or extreme values compared to using average free-market prices. Therefore, it provides a different perspective on the data, one that aids in the robustness of the results (Wilcox, 2012; Hubert & Vandervieren, 2008).

The coefficients for tax rate divergence across all three models (I, II, and III) are statistically significant, suggesting a strong positive association between tax rate divergence and abnormal pricing (Table 8). The magnitude of the coefficients ranges from 0.227 to 0.229, which is slightly lower than those in the main results using free-market prices. This confirms our expectation that the IQR approach could moderate the observed relationship due to its robust nature (Leys et al., 2013).

6.2 Alternate Arm's Length Price Range

The arm's length price range is essentially a confidence interval around the free-market price, within which transactions are considered "normal" or "fair." Varying this range is crucial for robustness checks as it allows us to explore the sensitivity of our main findings to different assumptions about what constitutes a "normal" transaction.

Given the high market liquidity and relatively standardized quality, gold often has a narrower price range. However, an increase to 10% can account for other variables such as additional transaction costs, geopolitical factors, and minor quality variations that might not have been captured in the baseline model.

Unlike gold, cocoa has a wide range of quality and type variations. Increasing the arm's length price range to 40% could capture this heterogeneity and also factor in the costs related to its storage, processing, and transportation, which can be significant. Similar to cocoa, coffee also varies greatly in quality (Arabica, Robusta, etc.) and origin. A 50% increase in the arm's length price range can accommodate these variations as well as additional costs related to processing, storing, and shipping the beans.

The coefficients for tax rate divergence across all three models (I, II, III) are positive and significant at the 5% level (Table 9). Their magnitudes range from 0.181 to 0.190, which is lower than the coefficients in the main results. This reduction was anticipated, as a wider arm's length price range should include more transactions as "normal," thus diminishing the perceived impact of tax rate divergence on abnormal pricing.

6.3 Alternate Dependent Variable: 30-Day Moving Average of Free-Market Prices

The use of a 30-day moving average as a benchmark price aims to address the time lag between the completion of business transactions and their subsequent recording by customs authorities. Prices in commodity markets like gold, cocoa, and coffee can be volatile, and a simple point estimate of the price on the transaction date may not adequately reflect market conditions when the import is recorded.

A 30-day moving average helps to smooth out short-term fluctuations in price and provides a more stable benchmark. This approach should offer a better representation of "normal" pricing over a period, rather than at a specific point in time. By using this method, we aim to capture a more realistic picture of what could be considered abnormal pricing, taking into account natural market volatility and administrative lags.

The coefficients for tax rate divergence in all models are positive and significant at the 5% level. The coefficients are smaller than those in the main model, consistent with our expectations that the 30-day moving average would reduce sensitivity to short-term volatility (Table 10). The robustness check using a 30-day moving average adds another layer of validation to our main results. The relationship between tax rate divergence and abnormal pricing remains positive and significant, even when accounting for market volatility and time lags, thus reinforcing the reliability and robustness of our main findings.

7 Conclusion

This research has endeavored to unravel the complexities of trade misinvoicing, an economic phenomenon that often perpetuates the resource curse plaguing many nations rich in natural commodities but poor in governance and institutional efficacy (Venables, 2016; Mehlum et al., 2006; Sachs and Warner, 2001). Situated against the backdrop of Illicit Financial Flows (IFFs)—a term encompassing a broad spectrum of cross-border capital movements linked with illegal activities (World Bank, 2016)—our study uniquely focuses on Switzerland. As a central yet often opaque player in the global commodities trade, Switzerland's low corporate tax regime has recently attracted increased regulatory scrutiny (Sharman, 2010; Shaxson, 2011). The primary objective of this study was to investigate the determinants of abnormal pricing patterns in Switzerland's imports of key commodities, specifically coffee, cocoa, gold, and copper. By employing transaction-level data sourced from the Swiss Federal Customs Administration (FCA), we have offered a nuanced understanding of the drivers of trade misinvoicing across different types of commodities. The primary independent variable of interest, the tax rate divergence between Switzerland and its trading partners, was found to significantly influence abnormal pricing. Specifically, a one-percentage-point increase in this tax rate divergence leads to a 0.27% to 0.32% increase in abnormal pricing activity, thereby confirming our central hypothesis.

The study's motivations and theoretical considerations emerge from a rich scholarly background that has grappled with the intricacies of trade misinvoicing for decades. This subject has garnered increasing attention, particularly in the context of developing economies in Africa and Asia (Ndikumana et al., 2015; Beja, 2006). Classical theoretical frameworks have probed the welfare implications of illicit trade (Bhagwati and Hansen, 1973; Pitt, 1981), challenging the perception that such activities enhance economic welfare by evading tariffs. These theories suggest that illegal trade, by incurring costs like smuggling, may not offer efficiency gains and thus fails to improve overall welfare.

Emerging from this discourse is a focus on the determinants of trade misinvoicing. This represents the second major line of inquiry in the theoretical framework, with burgeoning empirical literature seeking to substantiate these constructs (Javorcik and Narciso, 2008; Ferrantino et al., 2004). Financial incentives, customs considerations, and enforcement-related factors have emerged as the dominant driving forces behind trade misinvoicing (Buehn and Eichler, 2011; Patnaik et al., 2012). Interestingly, foreign exchange controls and capital flight have also been identified as catalysts, especially in economies with lax capital controls (Barnett, 2003; Biswas and Marjit, 2005).

Our study is motivated by a need to delve into less-explored but equally salient determinants that can only be identified at the national level, such as corporate income taxes, corruption, and accounting standards. Switzerland, with its unique blend of economic features, serves as an ideal case for examining how such country-specific variables influence trade misinvoicing. We leverage transaction-level data from the Swiss Federal Customs Administration to explore these influences in a Swiss context, focusing on select commodities like gold, copper, coffee, and cocoa. This granular approach enables us to offer a more segmented understanding of trade misinvoicing, based on factors like income levels, commodity-based production status, and production costs.

The findings of our study bear significant policy implications, particularly for Switzerland and its trading partners. Our results indicate that abnormal pricing activities are influenced by the differential in tax rates between Switzerland and its trading partners, thereby providing a catalyst for trade misinvoicing. This has direct consequences for tax revenue collection and governance in these countries. One key policy recommendation for Swiss authorities would be to enhance regulatory scrutiny on transaction-level data, especially for commodities like gold, copper, coffee, and cocoa, which have shown higher susceptibility to misinvoicing. Implementing more stringent transfer pricing regulations and leveraging machine learning algorithms to detect anomalous pricing activities could be effective measures.

For Switzerland's trading partners, particularly those that are resource-rich but governance-poor, our findings signal the need for a multi-pronged approach. This includes improving governance structures, enhancing customs enforcement, and possibly revisiting tax treaties with Switzerland to mitigate the incentives for trade misinvoicing. Public-private partnerships could be a viable strategy for sharing the burden of enhanced enforcement and capacity building in customs departments.

While our study contributes to the understanding of trade misinvoicing, it is not without limitations. The primary constraint lies in the dataset used, which, though granular, is not entirely comprehensive. It captures only the transactions reported to the Swiss Federal Customs Administration, leaving out transit or merchant trade activities. Additionally, the study's timeframe may not reflect long-term trends or account for policy changes that have occurred after the period of analysis. Methodologically, our focus on abnormal pricing as a proxy for trade misinvoicing may omit other forms of illicit financial flows.

Future research could aim to include more countries and commodities for a more global perspective. Longitudinal studies that track changes over time could provide insights into the effectiveness of policy interventions. Another avenue could be the incorporation of firm-level data to understand the corporate strategies behind misinvoicing, which our study could not capture due to data limitations.

In summary, this study makes a significant contribution to the field of economics, particularly in the realm of trade misinvoicing and tax evasion. By focusing on Switzerland—a major player in global commodity trading—we have shed light on the complex interplay of tax rates, governance structures, and commodity-

specific factors that influence abnormal pricing activities. Our interdisciplinary approach bridges gaps in existing literature, offering a nuanced understanding that has far-reaching implications for policymakers in Switzerland and its trading partners. The study's findings serve as a stepping stone for further academic inquiry and practical policy interventions aimed at curbing illicit financial flows and enhancing governance in the international trading system.

8 References

- AfDB (African Development Bank), OECD (Organisation for Economic Co-operation and Development), UNDP (United Nations Development Programme) and UNECA (United Nations Economic Commission for Africa). (2012). African Economic Outlook. Paris: OECD.
- Almoussor, A. (2005). A Development Comparative Approach to Capital Flight: The Case of the Middle East and North Africa, 1970–2002. In *Capital Flight and Capital Controls in Developing Countries*, 234–61. Cheltenham, UK: Edward Elgar
- Andriamananjara, S., Dean, J. M., Ferrantino, M. J., Feinberg, R. M., Ludema, R. D., & Tsigas, M. E. (2004). The effects of non-tariff measures on prices, trade, and welfare: CGE implementation of policy-based price comparisons. *Trade, and Welfare: CGE Implementation of Policy-Based Price Comparisons* (April 2004).
- Angrist, J. D., & Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.
- Aizenman, J. (2008). On the hidden links between financial and trade opening. *Journal of International Money and Finance*, 27(3), 372-386.
- Aizenman, J. (2004). Financial opening: evidence and policy options. In *Challenges to globalization: Analyzing the economics* (pp. 473-498). University of Chicago Press.
- Aizenman, J., & Noy, I. (2009). Endogenous financial and trade openness. *Review of Development Economics*, 13(2), 175-189.
- Auty, R., & Warhurst, A. (1993). Sustainable development in mineral exporting economies. *Resources Policy*, 19(1), 14-29.
- Bahmani-Oskooee, M., Economidou, C., & Gobinda Goswami, G. (2005). How sensitive are Britain's inpayments and outpayments to the value of the British pound. *Journal of Economic Studies*, 32(6), 455-467.
- Baker, R., Clough, C., Kar, D., LeBlanc, B. and Simmons, J. (2014). *Hiding in Plain Sight: Trade Misinvoicing and the Impact of Revenue Loss in Ghana, Kenya, Mozambique, Tanzania, and Uganda: 2002-2011*. Washington DC: Global Financial Integrity.
- Baker, R., and M. Kodi. (2010). *Illicit Financial Flows from Africa. Meeting Summary*, Chatham House, London, 10 May.
- Barnett, R. C. (2003). Smuggling, Non-fundamental Uncertainty, and Parallel Market Exchange Rate Volatility. *Canadian Journal of Economics*, 36 (3), 701-727.
- Beer, S., & Loeprick, J. (2015). Profit shifting: drivers of transfer (mis) pricing and the potential of countermeasures. *International Tax and Public Finance*, 22(3), 426-451.
- Beja, E. L. (2006). Was capital fleeing Southeast Asia? Estimates from Indonesia, Malaysia, the Philippines, and Thailand. *Asia Pacific Business Review*, 12 (3), 261-283.
- Berger, H. and Nitsch, V. (2012). Gotcha! A Profile of Smuggling in International Trade. In C. Costa Storti and p. De Grauwe (Eds.), *Illicit Trade and the Global Economy* (pp. 49-72): CESifo Seminar Series. Cambridge and London: MIT Press.
- Bhagwati, J. (1964). On the underinvoicing of imports [with application to recent Turkish experience]. *Bulletin of the Institute of Economics and Statistics (Oxford University)*, 26, 389-397.
- Bhagwati, J. N. (1974). On the underinvoicing of imports. In *Illegal transactions in international trade* (pp. 138-147). North-Holland.
- Bhagwati, J., & Hansen, B. (1973). A theoretical analysis of smuggling. *The Quarterly Journal of Economics*, 87(2), 172-187.
- Biswas, A. K. and Marjit, S. (2005). Mis-invoicing and Trade Policy. *The Journal of Policy Reform*, 8 (3), 189-205.
- Buehn, A. and Eichler, S. (2011). Trade Misinvoicing: The Dark Side of World Trade. *World Economy*, 34 (8), 1263-1287.
- Bernard, A.B., J.B. Jensen, and P.K. Schott (2006). 'Transfer Pricing by U.S.-Based Multinational Firms'. NBER Working Paper 12493. Cambridge, MA: National Bureau of Economic Research
- Boyce, J. K. (1992). The revolving door? External debt and capital flight: A Philippine case study. *World Development*, 20(3), 335-349.
- Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: methods and applications*. Cambridge university press.
- Cameron, A. C., & Miller, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of human resources*, 50(2), 317-372.
- Cadot, O., Conde, Dyai. (2013). *The Precious Metals Industry in Switzerland's Economy: Institut de Macroeconomie Appliquee*.
- Celásun, M., & Rodrik, D. (1989). Trade regime and an anatomy of export performance. In *Developing Country Debt and Economic Performance, Volume 3: Country Studies-Indonesia, Korea, Philippines, Turkey* (pp. 716-731). University of Chicago Press.
- CMFG. (2015). *Report on the national assessment of the risks of money laundering and terrorist financing in Switzerland*.
- Cobham, A., Janský, P., & Meinzer, M. (2015). The financial secrecy index: Shedding new light on the geography of secrecy. *Economic geography*, 91(3), 281-303.
- Cobham, A., & Janský, P. (2019). *Measuring misalignment: The location of US multinationals' economic activity versus the location of their profits*.

Development Policy Review, 37(1), 91-110.

Collier, P., & Venables, A. J. (2011). Illusory revenues: import tariffs in resource-rich and aid-rich economies. *Journal of Development Economics*, 94(2), 202-206.

Collier, P., Hoeffler, A., & Pattillo, C. (2001). Flight capital as a portfolio choice. *the world bank economic review*, 15(1), 55-80.

Collier, P., & Hoeffler, A. (2004). Aid, policy and growth in post-conflict societies. *European economic review*, 48(5), 1125-1145.

Cristea, A., and D. Nguyen (2016). 'Transfer Pricing by Multinational Firms: New Evidence from Foreign Firm Ownerships'. *American Economic Journal: Economic Policy*, 8(3): 170-202.

Clausing, K.A. (2003). 'Tax-motivated Transfer Pricing and US Intrafirm Trade Prices'. *Journal of Public Economics*, 87(9): 2207-23.

Davies, R.B., J. Martin, M. Parenti, and F. Toubal (2018). 'Knocking on Tax Haven's Door: Multinational Firms and Transfer Pricing'. *Review of Economics and Statistics*, 100(1): 120-34.

Deaton, A. (1997). *The analysis of household surveys: a microeconomic approach to development policy*. World Bank Publications.

Devereux, M. P. (2019). How should business profit be taxed? Some thoughts on conceptual developments during the lifetime of the IFS. *Fiscal Studies*, 40(4), 591-619.

Desai, M. A., & Dharmapala, D. (2006). Corporate tax avoidance and high-powered incentives. *Journal of financial Economics*, 79(1), 145-179.

Dooley, M. P. (1988). Capital flight: a response to differences in financial risks. *Staff Papers*, 35(3), 422-436.

Lessard, D. R., & Williamson, J. (1987). *Capital flight and third world debt*. (No Title).

Lensink, R., Hermes, N., & Murinde, V. (2000). Capital flight and political risk. *Journal of international Money and Finance*, 19(1), 73-92.

Liu, L., T Schmidt-Eisenlohr, and D. Guo (2017). 'International Transfer Pricing and Tax Avoidance: Evidence from the Linked Tax-Trade Statistics in the UK'.

Chalendard, C., Raballand, G., & Rakotoarisoa, A. (2016). *The use of detailed statistical data in customs reform: the case of Madagascar*. The World Bank.

Carbonnier, G, Wagner, N., & Brugger, F. (2011). *Oil, Gas and Minerals: The Impact of Resource-Dependence and Governance on Sustainable Development*. CCDP Working Paper 8, 36.

Carbonnier, G., & Zweynert de Cadena, A. (2015). *Commodity Trading and Illicit Financial Flows*. *International Development Policy— Revue internationale de politique de développement*.

Chinn, M. D., & Ito, H. (2008). A new measure of financial openness. *Journal of comparative policy analysis*, 10(3), 309-322.

Cuddington, John T. (1986). *Capital flight: Estimates, issues, and explanations*. Princeton, NJ: International Finance Section, Department of Economics, Princeton University

Dell'Anno, R., & Villa, S. (2013). Growth in transition countries: big bang versus gradualism. *Economics of Transition*, 21(3), 381-417.

Gaulier, G., & Zignago, S. (2010). *Baci: international trade database at the product-level (the 1994-2007 version)*.

Gara, M., Giammatteo, M., & Tosti, E. (2019). Magic mirror in my hand... How trade mirror statistics can help us detect illegal financial flows. *The World Economy*, 42(11), 3120-3147.

Gujarati, D. N., Bernier, B., Bernier, B. (2004). *Econométrie* (pp. 17-5). Brussels: De Boeck.

Gropp, R., & Kostial, K. (2000). The disappearing tax base: is foreign direct investment eroding corporate income taxes?. Available at SSRN 355624.

Fisman, R. & Wei, S.J. (2007). *The Smuggling of Art, and the Art of Smuggling: Uncovering the Illicit Trade in Cultural Property and Antiques*. NBER Working Paper, No. 13446.

Fisman, R., & Wei, S. J. (2004). Tax rates and tax evasion: evidence from "missing imports" in China. *Journal of Political Economy*, 112(2), 471-496.

Fofack, H., & Ndikumana, L. (2014). *Capital flight and monetary policy in African countries*.

Forstater, M. (2018). *Illicit Financial Flows, Trade Misinvoicing, and Multinational Tax Avoidance: The Same or Different?*. CGD policy paper, 123.

Fuest, C., & Riedel, N. (2009). *Tax evasion, tax avoidance and tax expenditures in developing countries: A review of the literature*. Report prepared for the UK Department for International Development (DFID), 44.

Haberly, D., & Wójcik, D. (2015). Tax havens and the production of offshore FDI: an empirical analysis. *Journal of Economic Geography*, 15(1), 75-101.

Harding, T., & Venables, A. J. (2016). The implications of natural resource exports for nonresource trade. *IMF Economic Review*, 64(2), 268-

- 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.
- Hong, K. P., & Pak, S. J. (2017). Estimating trade misinvoicing from bilateral trade statistics: The devil is in the details. *The International Trade Journal*, 31(1), 3-28.
- Hubert, M., & Vandervieren, E. (2008). An adjusted boxplot for skewed distributions. *Computational statistics data analysis*, 52(12), 5186-5201.
- Index, C. P. (2010). Transparency international. URL: <http://www.transparency.org/>.
- Institute for Human Rights and Business, “The Swiss Commodities Trading Industry: A Mapping Study” (March 2017).
- Javorcik, B. S., & Narciso, G. (2008). Differentiated products and evasion of import tariffs. *Journal of International Economics*, 76(2), 208-222.
- Jha, R. and Truong, D. N. (2014). Trade Misinvoicing and Macroeconomic Outcomes in India. The Australian National University, Australia South Asia Research Centre, ASARC Working Papers.
- Johannesen, N., & Zucman, G. (2014). The end of bank secrecy? An evaluation of the G20 tax haven crackdown. *American Economic Journal: Economic Policy*, 6(1), 65-91.
- Johannesen, N., & Pirttilä, J. (2016). Capital flight and development: An overview of concepts, methods, and data sources.
- Jungbluth, N., & Meili, C. (2018). Pilot-study for the analysis of the environmental impacts of commodities traded in Switzerland. ESU-services Ltd., Schaffhausen, Switzerland, www.esu-services.ch/de/publications.
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2013). World governance indicators. The World Bank.
- Kar, D., & Freitas, S. (2012). Illicit financial flows from Developing Countries: 2001-2010. Washington, DC: Global Financial Integrity.
- Kar, D., & Spanjers, J. (2014). Illicit financial flows from developing countries: 2003-2012 (Vol. 20). Washington, DC: Global Financial Integrity.
- Kar, D., Cartwright-Smith, D., & Hollingshead, A. (2010). The Absorption of Illicit Financial Flows from Developing Countries: 2002-2006. Available at SSRN 2335028.
- Keen, M., & Slemrod, J. (2017). Optimal tax administration. *Journal of Public Economics*, 152, 133-142.
- Kellenberg, D., & Levinson, A. (2018). Misreporting trade: tariff evasion, corruption, and auditing standards (No. w22593). National Bureau of Economic Research.
- Kim, S. H., & Kose, M. A. (2014). Welfare implications of trade liberalization and fiscal reform: A quantitative experiment. *Journal of International Economics*, 92(1), 198-209.
- Klassen, K. J., & Laplante, S. K. (2012). Are US multinational corporations becoming more aggressive income shifters?. *Journal of Accounting Research*, 50(5), 1245-1285.
- Le Billon, P. (2011). Extractive sectors and illicit financial flows: What role for revenue governance initiatives?. U4 Issue, 2011(13).
- Mascagni, G., Monkam, N., & Nell, C. (2016). Unlocking the potential of administrative data in Africa: Tax compliance and progressivity in Rwanda.
- Maur, J. C. (2008). Regionalism and trade facilitation: a primer. World Bank Publications.
- Mehlum, H., Moene, K., & Torvik, R. (2006). Institutions and the resource curse. *The economic journal*, 116(508), 1-20.
- Mehrotra, M., & Carbonnier, G. (2020). Abnormal Pricing in International Commodity Trade: Empirical Evidence from Switzerland. Graduate Institute of International and Development Studies. Working Paper.
- Mescall, D., & Klassen, K. J. (2018). How does transfer pricing risk affect premiums in cross-border mergers and acquisitions?. *Contemporary Accounting Research*, 35(2), 830-865.
- Mishra, P., Subramanian, A., & Topalova, P. (2008). Tariffs, enforcement, and customs evasion: Evidence from India. *Journal of Public Economics*, 92(10-11), 1907-1925.
- Moisé, E., & Sorescu, S. (2013). Trade facilitation indicators: The potential impact of trade facilitation on developing countries' trade.
- Moisé, E., & Sorescu, S. (2015). Contribution of trade facilitation measures to the operation of supply chains.
- Ndiaye, A. S., & Siri, A. (2016). Capital flight from Burkina Faso: drivers and impact on tax revenue. *African Development Review*, 28(S1), 100-112.
- Ndikumana, L. (2016). Trade Misinvoicing in Primary Commodities in Developing Countries: The cases of Chile, Cote d'Ivoire, Nigeria, South Africa and Zambia. Geneva: UNCTAD
- Ndikumana, L. and Boyce, J. K. (2010). Measurement of capital flight: Methodology and results for sub-Saharan African countries. *African Development Review*, 22(1), 1-15.

opment Review, 22 (4), 471-481.

Ndikumana, L., Boyce, J. K. and Ndiaye, A. S. (2015). Capital flight from Africa: Measurement and drivers. In S. I. Ajayi and L. Ndikumana (Eds.), *Capital Flight from Africa: Causes, Effects and Policy Issues* (pp. 15-54). Oxford: Oxford University Press.

Nitsch, V. (2012). Trade mispricing and illicit flows. *Draining development*.

Nitsch, V. (2017). Trade misinvoicing in developing countries. *CGD Policy Paper*, 103.

OECD. (2018). *Implementing The OECD Anti-Bribery Convention Phase 4 Report: Switzerland*.

Ortiz-Ospina, E., Beltekian, D., & Roser, M. (2018). Trade and globalization. *Our World in Data*.

Patnaik, I., Gupta, A. S., & Shah, A. (2012). Determinants of trade misinvoicing. *Open Economies Review*, 23(5), 891-910.

Pitt, M. M. (1981). Smuggling and price disparity. *Journal of International Economics*, 11(4), 447-458.

Ploeg, F. V. D. (2011). Natural resources: curse or blessing?. *Journal of Economic literature*, 49(2), 366-420.

Pohit, S., & Taneja, N. (2003). India's informal trade with Bangladesh: A qualitative assessment. *World Economy*, 26(8), 1187-1214.

Public Eye. (2016). *Dirty Diesel How Swiss Traders Flood Africa with Toxic Fuels*.

Rauch, J. E. (1999). Networks versus markets in international trade. *Journal of international Economics*, 48(1), 7-35.

Reuter, P. (Ed.). (2012). *Draining development?: Controlling flows of illicit funds from developing countries*. World Bank Publications.

Ross, M. (1999). The Political Economy of the Resource Curse. *World Politics*, 51(2), 297-322.

Ross, M. L. (2001). Does oil hinder democracy?. *World politics*, 53(3), 325-361.

Rotunno, L., & Vézina, P. L. (2015). Quota-hopping in-bond diversion. *Economic Inquiry*, 53(1), 34-48.

Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European economic review*, 45(4-6), 827-838.

Sachs, J. D., & Warner, A. M. (1997). Sources of slow growth in African economies. *Journal of African economies*, 6(3), 335-376.

Saunders-Scott, M. (2013). How does transfer-pricing enforcement affect reported profits. *Job Market Paper*.

Sharman, J. C. (2010). Dysfunctional policy transfer in national tax blacklists. *Governance*, 23(4), 623-639.

Shaxson, N. (2011). *Treasure islands: Tax havens and the men who stole the world*. Random House.

Slemrod, J. (2007). Cheating ourselves: The economics of tax evasion. *Journal of Economic perspectives*, 21(1), 25-48.

Thursby, M., Jensen, R., & Thursby, J. (1991). Smuggling, camouflaging, and market structure. *The Quarterly Journal of Economics*, 106(3), 789-814.

Torgler, B., & Schneider, F. (2009). The impact of tax morale and institutional quality on the shadow economy. *Journal of Economic Psychology*, 30(2), 228-245.

Truman, E. M., & Reuter, P. (2004). *Chasing dirty money: The fight against anti-money laundering*. Peterson Institute Press: All Books.

Torslov, T., Wier, L., & Zucman, G. (2018). WP18/12.

Umar, M. A., & Tusubira, N. F. (2017). Challenges of Tax Administration in Developing Countries: Insights from the 5th Annual Tax Administration Research Centre Workshop, 2017. *Journal of Tax Administration*, 3(2), 108-123.

Vézina, P. L. (2015). Illegal trade in natural resources: Evidence from missing exports. *International Economics*, 142, 152-160.

Vicard, V. (2015). 'Transfer Pricing of Multinational Companies and Aggregate Trade'. *Banque de France Working Paper No. 555*.

World Bank (2012), *World Development Indicators 2012*, World Bank Publications.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Yang, D. (2008). Can enforcement backfire? Crime displacement in the context of customs reform in the Philippines. *The Review of Economics and Statistics*, 90(1), 1-14.

Zdanowicz, J., Pak, S., & Sullivan, M. (1999). Brazil-United States trade: capital flight through abnormal pricing. *The International Trade Journal*, 13(4), 423-443.

Appendices

I Tables

I.1 Summary Statistics: Commodities

Table 1: Summary statistics of selected commodities

HS Code: 7108.12	Gold: Non-monetary, Other unwrought forms				
	Observations	Mean	Std. Dev.	Maximum	Minimum
Quantity (kg)	55,986	273.0	775.5	13,764	0.00100
Value (CHF)	55,986	8,625,000	24,730,000	507,300,000	1
Unit Price (CHF/kg)	55,986	39,263	906,764	203,500,000	0.0614
HS Code: 7403.11	Refined copper: Cathodes and sections of cathodes				
	Observations	Mean	Std. Dev.	Maximum	Minimum
Quantity (kg)	359	12,095	11,992	31,460	0.0900
Value (CHF)	359	83,112	79,008	242,194	80
Unit Price (CHF/kg)	359	651.4	1811	15,320	1.501
HS Code: 1801.00	Cocoa beans, whole or broken, raw or roasted				
	Observations	Mean	Std. Dev.	Maximum	Minimum
Quantity (kg)	13,121	22,190	21,693	246,875	0.0600
Value (CHF)	13,121	70,467	66,876	780,975	1
Unit Price (CHF/kg)	13,121	10.89	34.55	2990	0.172
HS Code: 901.11	Coffee, not roasted, not decaffeinated				
	Observations	Mean	Std. Dev.	Maximum	Minimum
Quantity (kg)	38,483	24,252	23,920	289,800	0.0440
Value (CHF)	38,483	102,892	103,471	1,890,000	1
Unit Price (CHF/kg)	38,483	6.171	30.91	5227	0.0783
HS Code: 901.12	Coffee, not roasted, decaffeinated				
	Observations	Mean	Std. Dev.	Maximum	Minimum
Quantity (kg)	3890	18,136	10,110	60,000	0.165
Value (CHF)	3890	101,764	63,944	334,208	2
Unit Price (CHF/kg)	3890	8.859	40.38	2098	0.0968

1.2 Summary Statistics: Variables

Table 2: Summary Statistics of Variables

Variable:	Mean	Std. dev.	Min	Max	Obs
Ln(Abnormal pricing)					
Overall	8.17	5.80	0	22.90	N = 1866
Between		4.33	0	17.94	n = 154
Within		4.81	-5.95	21.08	T-bar = 12.1169
Tax rate divergence					
Overall	16.79	19.68	-17.5	310.2	N = 1788
Between		17.27	-17.5	96.95	n = 149
Within		10.62	-54.36	230.03	T-bar = 12
Total natural resource rents (% of GDP)					
Overall	5.39	8.34	0	60.12	N = 1552
Between		.52	1.6	5	n = 154
Within		.78	.10	5.67	T-bar = 12.11
Foreign direct investment (% of GDP)					
Overall	4.87	11.55	-37.16	252.30	N = 1835
Between		8.27	-1.85	63.99	n = 148
Within		8.00	-48.51	193.17	T-bar = 12.39
Inflation, consumer prices					
Overall	4.40	13.90	-3.74	379.84	N = 1808
Between		14.05	-.78	144.20	n = 145
Within		10.00	-139.83	240.04	T-bar = 12.46
GDP growth (annual %)					
Overall	3.14	3.43	-37.14	29.32	N = 1852
Between		2.97	-16.71	9.69	n = 152
Within		2.33	-24.12	27.36	T-bar = 12.18
Current account balance (% of GDP)					
Overall	-1.46	7.95	-86.08	26.02	N = 1744
Between		10.20	-57.19	18.38	n = 141
Within		3.72	-50.75	27.42	T-bar = 12.36

Note: The table shows descriptive statistics of the gross sample. The sample period is 2011 to 2017.

1.3 Baseline Results

Table 3: Baseline regressions

	Ln (Abnormal pricing)		
	I	II	III
Tax rate divergence	0.321*** (0.112)	0.296*** (0.112)	0.279** (0.119)
Observations	1,770	1,770	1,770
Adj. R-squared	0.34	0.33	0.33
Year Fixed Effects		✓	✓
Country Fixed Effects		✓	✓
Controls			✓

Robust standard errors in parentheses, clustered at the country-year level.
 * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.4 Income and Product Differentiation

Table 4: Heterogeneity Based on Income Classification and Product Differentiation

	Ln (Abnormal pricing)	
	I	II
Tax rate divergence	0.329*** (0.139)	0.301*** (0.138)
Tax Divergence*High-Income	-0.123 (0.158)	
Tax Divergence*Differentiated		0.252** (0.128)
Observations	1,770	1,770
Adj. R-squared	0.34	0.34
Year Fixed Effects	✓	✓
Country Fixed Effects	✓	✓
Controls	✓	✓

Robust standard errors in parentheses, clustered at the country-year level.
 * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.5 Producer Status and Firm Ownership

Table 5: Producer Status and Firm Ownership

	Ln (Abnormal pricing)		
	I	II	III
Tax rate divergence	0.380*** (0.148)	0.365*** (0.137)	0.365*** (0.140)
Tax Divergence*Producer Status	0.232 (0.192)		
Tax Divergence*Foreign Owned		-0.175*** (0.059)	
Tax Divergence*Foreign Owned (Binary)			-0.115*** (0.038)
Observations	1,770	1,770	1,770
Adj. R-squared	0.33	0.33	0.33
Year Fixed Effects	✓	✓	✓
Country Fixed Effects	✓	✓	✓
Controls	✓	✓	✓

Robust standard errors in parentheses, clustered at the country-year level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.6 Corruption and Political Stability

Table 6: Corruption and Political Stability

	Ln (Abnormal pricing)		
	I	II	III
Tax rate divergence	0.350*** (.116)	0.338** (0.135)	0.335** (0.180)
Tax rate divergence*CPI	-0.120** (0.050)		
Tax rate divergence*Political Stability		0.180 (0.170)	
Observations	1,770	1,770	1,770
Adj. R-squared	0.24	0.24	0.24
Year Fixed Effects	✓	✓	✓
Country Fixed Effects	✓	✓	✓
Controls	✓	✓	✓

Robust standard errors in parentheses, clustered at the country-year level.
 * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.7 Transfer Pricing and Trade Facilitation

Table 7: Transfer Pricing, Capital Accounts, and Trade Facilitation

	Ln (Abnormal pricing)		
	I	II	III
Tax rate divergence	0.390** (0.192)	0.366** (0.155)	0.350** (0.180)
Tax rate divergence*TPR	0.020 (0.020)		
Tax rate divergence*CAO		0.118 (0.070)	
Tax rate divergence*TFI			0.121*** (0.011)
Observations	966	1,770	1,770
Adj. R-squared	0.22	0.30	0.30
Year Fixed Effects	✓	✓	✓
Country Fixed Effects	✓	✓	✓
Controls	✓	✓	✓

Robust standard errors in parentheses, clustered at the country-year level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.8 Robustness Checks

Table 8: Robustness: Interquartile Range Estimates

	Ln (Abnormal pricing)		
	I	II	III
Tax rate divergence	0.229*** (0.021)	0.227*** (0.021)	0.227** (0.019)
Observations	1,770	1,770	1,770
Adj. R-squared	0.41	0.39	0.39
Year Fixed Effects		✓	✓
Country Fixed Effects		✓	✓
Controls			✓

Robust standard errors in parentheses, clustered at the country-year level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Robustness: Alternate Arm's Length Price Range

	Ln (Abnormal pricing)		
	I	II	III
Tax rate divergence Tax rate divergence	0.190** (0.082)	0.185** (0.086)	0.181** (0.098)
Observations	1,770	1,770	1,770
Adj. R-squared	0.34	0.33	0.33
Year Fixed Effects		✓	✓
Country Fixed Effects		✓	✓
Controls			✓

Robust standard errors in parentheses, clustered at the country-year level.
 * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Robustness: 30-Day Moving Average of Free-Market Prices

	Ln (Abnormal pricing)		
	I	II	III
Tax rate divergence	0.170** (0.070)	0.165** (0.071)	0.160** (0.072)
Observations	1,770	1,770	1,770
Adj. R-squared	0.21	0.23	0.23
Year Fixed Effects		✓	✓
Country Fixed Effects		✓	✓
Controls			✓

Robust standard errors in parentheses, clustered at the country-year level.
 * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$