

Estimating Illicit Flows of Capital via Trade Mispricing: A Forensic Analysis of Data on Switzerland

Alex Cobham with Petr Janský and Alex Prats

Abstract

This paper assesses the role of Switzerland, as the leading hub for global commodities trading, in terms of the patterns of prices received by original exporting countries and subsequently by Switzerland and other jurisdictions. We find support for the hypotheses that (i) the average prices for commodity exports from developing countries to Switzerland are lower than those to other jurisdictions; and that (ii) Switzerland declares higher (re-)export prices for those commodities than do other jurisdictions. This pattern implies a potential capital loss for commodity exporting developing countries, and we provide a range of estimates of that loss – each of which suggests the scale is substantial (the most conservative is around \$8 billion a year) and that the issue merits greater research and policy attention. An important first step would be a Swiss commitment to meet international norms of trade transparency.

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Introduction

In the past two decades, Switzerland has become the world's largest commodity hub. According to the Swiss NGO, The Berne Declaration (2011), the companies operating in Switzerland have at least a 15-25 per cent share by value of the global trade in commodities. The Berne Declaration (2011, p.39) cites figures from trade body the Geneva Trading and Shipping Association which show that Switzerland has eclipsed major financial centres including London to become the biggest player in leading commodities from oil (35% compared to London's 25%) and grain and oil seeds (35% compared to 20% in the next biggest hub, Singapore), to coffee (60% compared to 20% in the next biggest hub, Hamburg) and sugar (50% compared to London's 20%).

Switzerland is also a major secrecy jurisdiction (a term preferred to the more common 'tax haven', for reasons outlined in Cobham, 2012), with a long history of providing banking secrecy in particular.

There is anecdotal evidence, which we discuss below, to suggest that developing countries trading with Switzerland may have suffered illicit outflows of capital through trade mispricing.

In this paper we aim to assess whether there is evidence of any systematic element of mispricing in commodity trade with Switzerland. First, in section I, we consider the unique features of the Swiss economy and the reasons for its rise in commodity trading.

In section II we assess the main research approaches that have been taken to trade mispricing, and briefly consider their strengths and weaknesses. The main approaches have either used detailed pricing data from one country and used a range such as the inter-quartile range to identify outlying transactions deemed to be 'abnormally' priced, or else relied on national-level data to identify anomalies thought to reflect mispricing.

As we discuss in section III, our approach differs somewhat. We use data on bilateral trade (from UN Comtrade), aggregated by commodity category. To identify abnormal pricing, we establish benchmarks based on the trading performance of other jurisdictions and compare these with observed Swiss pricing. We use a range of benchmarks, since there is no objective basis on which to identify a 'perfect' benchmark.

Looking across 244 jurisdictions and 2,596 commodity categories, in section IV we find support for the hypotheses that (i) the average prices for commodity exports to Switzerland are lower than those to other jurisdictions; and that (ii) Switzerland declares higher (re-)export prices for those commodities than do other jurisdictions. Our findings imply a potential capital loss for countries exporting commodities to Switzerland, and we present a range of estimates of this loss. We consider alternative explanations for our findings, and discuss caveats that relate to data quality and consistency.

In addition, we document the extent of a separate discrepancy in trade statistics, due to Swiss 'transit trade', which means that it is not possible to trace either the path or the price of a significant proportion of the commodity exports destined on paper for

Switzerland. We extend our estimates of capital loss to consider the implications of making the (somewhat heroic) assumption that the excess margin on Swiss trade is no larger, and no smaller, in the trade which cannot be traced in our data than in that which we are able to track.

We conclude that the scale of even our most conservative estimates suggest that the phenomenon should concern policy makers in Switzerland and internationally. The reliability of Swiss customs data and the absence of transit trade data together present a major obstacle to countries' efforts to mobilise domestic resources, particularly in the developing world, to fight corruption and to ensure that they receive the benefits of their resource wealth. Finally, we discuss the possibility that there may be sufficient evidence for a group of countries to seek redress through a legal approach under World Trade Organisation rules.

I. The Swiss Role in Commodity Trade

There are practical reasons to explain other important commodity hubs, such as Rotterdam, Houston or Hong Kong: resource proximity, port facilities or location, for example. There is little immediately to suggest why Switzerland, a small and expensive landlocked country, should play such an important role in the commodity business.

It is important to understand that most commodity trade with Switzerland does not involve physical shipments, but instead 'merchanting' or 'transit trade'. In this model, 'contracts may be concluded, deliveries scheduled and ships chartered from Swiss offices, but the actual goods ... never touch Swiss soil' (Berne Declaration, 2011, p.44). In transit trade, a company in the domestic economy purchases goods or services from a supplier abroad and sells these on to a buyer, also abroad, without the goods ever entering the domestic economy, and without the goods having been transformed between purchase and resale.

One consequence is that the flow of goods eludes the official statistics of the Swiss Federal Customs Administration, with transit trade being recorded instead by the Swiss National Bank, as an export of services.

According to statistics published by the Swiss National Bank (SNB, 2012), receipts from transit trade increased from 2001 to 2011 by a factor of fifteen, almost as much as in the previous four decades. Indeed, since 2011, receipts from transit trade have replaced receipts from Swiss banks' financial services abroad as the leading services export. Turnover by merchanting traders based in Switzerland was 36 per cent higher in 2011 than Switzerland's gross domestic product (GDP). Most of the goods sold by Swiss-based merchanting traders were commodities (94 per cent), in particular energy commodities (59 per cent). Mineral commodities represented 20 per cent, and agricultural commodities 15 per cent. Today, Swiss companies conduct 35 per cent of global oil trading, selling, for example, up to 50 per cent of Kazakh oil and 75 per cent of Russian oil (Berne Declaration, 2011).

Despite the extent of growth, the SNB states that the changes have been little noticed even in Switzerland. In fact, the SNB's description of this major feature of their own economy is striking – especially for a central bank:

‘The transformation of merchanting into an extremely important industry within the Swiss economy has gone almost unnoticed by the general public. Most companies active in merchanting are not listed and therefore do not have to publish financial statements. This circumstance, the complexity of the business and the fact that only the most important key figures are collected in connection with the current account complicate any analysis’ (SNB, 2012, p.39).

The Berne Declaration suggests three main factors contributing to Switzerland's rise as a commodity hub. One, which also explains much of Singapore and London's appeal, is the existence of a financial centre with large domestic and foreign banks and free movement of capital. Commodity traders have found in Switzerland, mainly in the past two decades, specialised financial and insurance companies, consulting firms, security, logistics and haulage services, and the world's largest inspection and verification company (SGS) – although there is a co-evolution of commodity trading and the corresponding support services.

A second and more specific reason for Swiss dominance may be found in the country's particular institutional position: hand in hand with its history of neutrality in wartime, Switzerland has pursued political ‘neutrality’ and tended to stay outside blocs – from the European Union to the United Nations (the former still valid and the latter until as late as 2002). The resulting context was one in which the imposition of commercial constraints for political reasons has been highly unlikely, at least compared to other major hubs.

The best known example is the Swiss government's decision not to support the international boycott against the apartheid regime in South Africa; see for example Sekinger et al (2005) on the importance of the Swiss role in South Africa's gold trade and the influence of major Swiss banks in setting relevant policy during this period, including with respect to the transparency of this trade. Disputes in relation to Switzerland's role in regard to international sanctions efforts continue, with repeated clashes in recent years, for example, with the US and EU over the extent of sanctions against Iran (see for example SwissInfo, 2012).

The third reason put forward for Swiss dominance is the set of special tax rules that allowed commodity traders to minimise their tax payments and so to maximise net profits. Again, causality is unclear. On the one hand competition to attract this business is likely to have driven policy decisions, while on the other the political power of this business, once entrenched, is likely to have resulted in more favourable fiscal treatment.

Taking a longer view, Farquet (2012) argues that Switzerland's neutrality and stability through the First World War made it an attractive destination for foreign capital which, in combination with its conservatism, increased the likelihood of a policy agenda which

advantaged its financial centre. The absence of exchange controls, a relatively orthodox monetary policy and limited state interventionism offered foreigners the investment conditions similar to those which prevailed before the Second World War.

Switzerland's offer of tax advantages for non-residents dates back to the 1920s and 1930s, a period when most of the financial centres granted significant tax benefits for imported capital, while the limited degree of inter-state cooperation and banking secrecy provisions prevented the taxation of exported assets. This combination of financial opacity with tax and regulatory advantages offered to non-residents alone are the defining features of a 'secrecy jurisdiction' (Cobham, 2012), and have been maintained in Switzerland since – albeit with growing pressure for transparency from the US and EU since the present financial crisis began.

By 1929, Switzerland already had the highest level of bank deposits per capita in the world (Farquet, 2012). In 2010, the twenty European regions with the lowest corporate tax rates included eight Swiss cantons, as the decentralised tax system has led to internal competition to attract foreign capital through tax policy (Berne Declaration, 2011). Switzerland's advantageous tax conditions for holding companies are also remarkable: holding companies' profits are exempt from tax in the cantons, holdings being subject only to a negligible charge calculated on the basis of the share capital recorded in the commercial register. For instance, the rate that applies in the canton of Zug is 0.002 per cent (Berne Declaration, 2011).

It is not only low tax rates that have made Switzerland attractive to transit traders; its light regulation, weak control mechanisms, and banking secrecy have played an important role. Since 2011, Switzerland has sat at the top of the Financial Secrecy Index, a ranking produced by the Tax Justice Network and Christian Aid which reflects the role of each jurisdiction in global financial flows and the scale of secrecy offered (Tax Justice Network, 2011; 2013).

In 1956, Philipp Brothers, then the world's largest trading company for minerals and metals, moved to Switzerland. This marked the beginning of trading in hard commodities. From the Philipp Brothers Company emerged another key actor in the consolidation of Switzerland as a commodity trade hub: Marc Rich, the founder of today's Glencore (called GlencoreXstrata as of May 2013 following its merger with a mining company). Over decades, Rich and his partner Pincus Green pioneered an aggressive model of commodity trading and financing, developing a political reach that allowed them access to natural resources across the globe.

A Congressional report (2002) that documented their activities stated that a central part of the business during its growth was the circumvention of sanctions: most notably, buying oil from US-embargoed Iran, and selling it to the variously-sanctioned and sanctioning Israeli and South African governments.

In 1983, Rich and Green were indicted in the US for 51 crimes including organised crime and tax evasion of millions of dollars. The criminal investigation into their activities

stemmed from their operations as a reseller of crude oil, and their alleged circumvention of the US Department of Energy's limits on the permissible profit margin under the 1973 Emergency Petroleum Allocation Act. Rich and Green were charged with conspiring with others to obscure the real price being charged in multiple transactions, and then to channel the profits to secret offshore companies and accounts through a further series of sham transactions that purported to show a loss on the US side. The government investigator who uncovered the scam described it to a Congressional committee as 'the biggest tax fraud in history'.

Both men fled the country rather than face trial and remained fugitives from US justice for 17 years until pardoned by President Bill Clinton in circumstances controversial enough to lead to a Congressional report into what had taken place. Their companies, however, pleaded guilty to tax evasion and were fined US\$150 million as well as US\$21 million in fines for contempt.

It is worth noting here that there were two central elements of the criminal scheme: the use of secrecy jurisdictions to hide ownership of income and assets and the relationship between parties to a transaction; and the manipulation of trade prices to facilitate illicit flows.

The business Marc Rich & Co was bought out by management in 1994 and has operated since then as the major Swiss-based trader, Glencore.

By the late 2000s, with Glencore soon to float on the London Stock Exchange, an audit was carried out on its Mopani mine business in Zambia. A draft of the audit report (Grant Thornton and Econ Poyry, 2010) was subsequently leaked. It listed a number of damning allegations that were surprisingly direct for this type of study.

In terms of Mopani's claimed costs, the report alleged that 'the existence of Mopani expenses are in doubt' (p.2) in relation to eight major items, including labour, fuel, mining, insurance, security and freight charges. The implication is that costs have been inflated, reducing declared profits (and hence tax liabilities).

With respect to Mopani's claimed revenues, the report alleged that 'the completeness of Mopani's revenues is in doubt'(p.3). The auditors presented evidence to support their conclusions that the declared prices are not consistent with market pricing between unrelated parties ("arm's length pricing", the principle on which OECD transfer pricing rests), again reducing declared profit – and so allege that the company's apparent mispricing has reduced the tax due to the Zambian authorities.

Alongside discrepancies in reported price hedging and in reported production, the report bluntly alleged the following: 'We believe that the related party sales and pricing mechanisms are not in accordance with the agreement disclosed, or the arms length principle. This should have impact on the tax assessments for the period under review' (p.3). The auditors conclude:

‘Last, but not least, the pilot audit has shown that there is a high need for implementing punitive measures against

- companies that do not pay taxes on time
- companies that does [sic] not cooperate with the [Zambian Revenue Authority] and make audits more expensive and lengthier than needed.’

In quite different countries and contexts, separated by three decades, we find a major Swiss-based commodities company accused of manipulating trade prices to extract illicitly-obtained profits from that country.

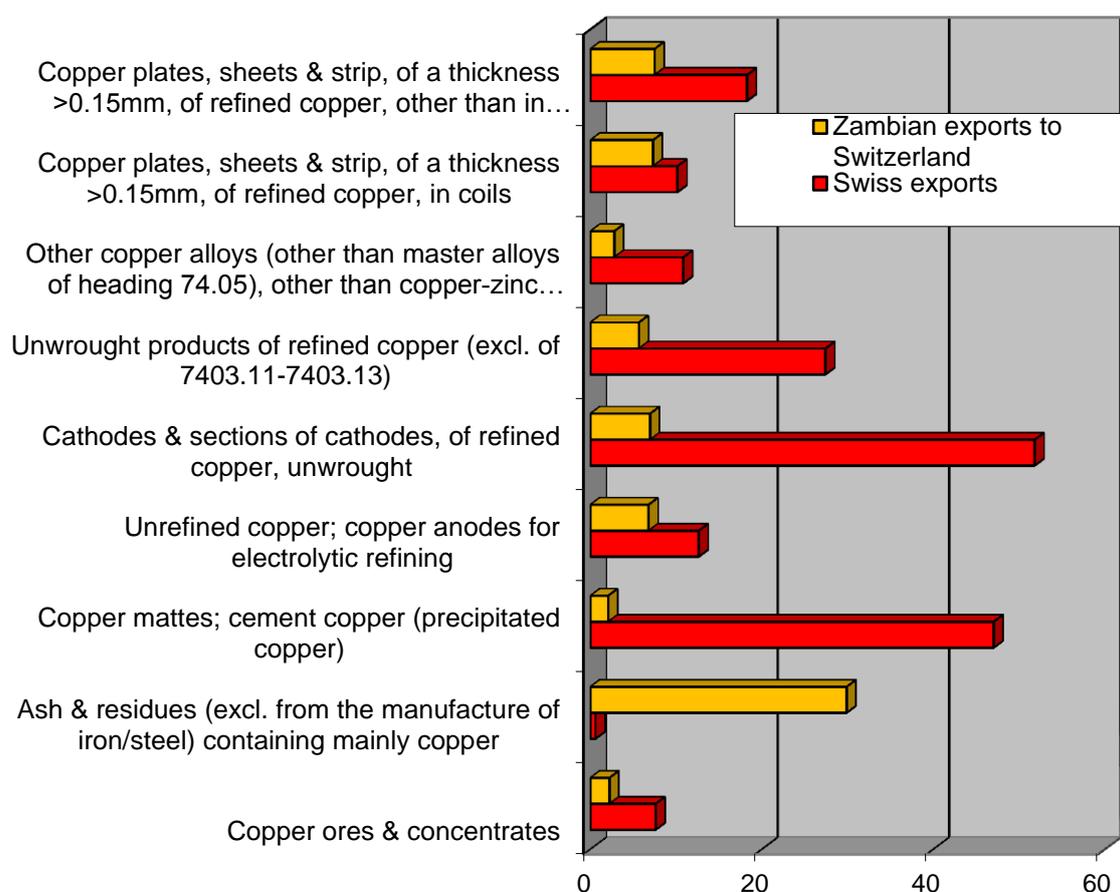
There is no suggestion that Glencore is a criminal enterprise, nor that it has undertaken any other inappropriate activity. The allegations in the pilot audit concerns a single subsidiary in a particular period only, and Glencore (2011, p.1) has defended its actions:

The draft provisional report contains fundamental factual errors and both Mopani and Glencore have publicly refuted its ‘conclusions’ on numerous occasions. In particular the authors, in their findings, did not take into account that almost half of Mopani’s copper output is third party ore processed in return for a small tolling fee. As they assumed Mopani had exposure to the copper price and revenue for 100 per cent of its production, they were unable to make sense of the company’s numbers. In addition other errors are detailed below. Mopani is confident that the amount of tax that it has paid has been correctly calculated and discussions continue with the Zambian Revenue Authority [...] to clarify and resolve these matters.

Our interest is not in the activities of any one company but with the country that is at the heart of the two stories. Switzerland’s dominance of commodity trading, combined with the financial secrecy it offers, may create a significant risk to appropriate pricing in international trade. Given the corruption and lost tax revenues that may be entailed, this risk should be taken seriously. In addition, given the importance of commodity trade to a number of developing countries, this risk may be most directly relevant for development.

Previous work published by Christian Aid (Hogg et al., 2010) analysed the national-level picture in relation to one country and one commodity: Zambia and its copper resources. The data show that, as Zambia’s production grew and the world price of copper rose with the commodity boom of the 2000s, Switzerland came to account for more than half of Zambia’s exports (from a base of zero).

Figure 1: Copper export price per kilogram, 2008



Source: Hogg et al., 2010 (p.23).

At the same time, a curious pattern emerged in respect of the prices being declared for Zambia's copper at the point of export. The price declared by Switzerland for subsequent exports of copper in the same detailed copper commodity categories was much higher than that received by Zambia. Figure 1 shows the pattern in 2008. If Zambia had received the same prices in each category as Switzerland, its GDP would have increased from \$14.3 billion to \$25.7 billion, an increase of 80 per cent. At the time, approximately 80 per cent of Zambia's people lived on less than \$2 a day.

This analysis has limitations, of course. First, the underlying data are subject to error. Second, given transport costs, some price differential between the original exporter and a subsequent re-exporter would be expected. Third, because of the transit trade, the great majority of Zambian exports to Switzerland never arrive there. This results in an important inconsistency in how trade is recorded, which can prevent exporting countries from tracing their products through the market and obscure the actual value. Exports from Zambia traded via Swiss-based companies may be recorded in Zambia as exports to Switzerland but are not recorded in Switzerland as imports from Zambia.

The calculation used in the figure above is based on the declared export price of the limited volume of copper which does, apparently reach Switzerland before being re-exported (without, according to the declared categorisation, any processing that would be likely to affect its value). In fact, the eventual price fetched by the majority of Zambian copper exported via Swiss transit trade cannot be ascertained from the international database, UN Comtrade. The opacity of Swiss transit trade means that declared Swiss (re)export prices cannot necessarily be used directly to calculate a Zambian capital loss through mispricing.

In the current study we explore whether, and if so to what extent, the same pattern applies to the Swiss role in trading other commodities with other countries. In doing so, we are able to look across global data and benchmark Swiss pricing performance against other intermediate jurisdictions, in order to establish – given data weaknesses and transport costs – whether the Zambia findings are likely to reflect anomalous data, or if there is a systematic pattern in relation to Switzerland in particular. In the following section, we situate this approach in relation to the main literature on trade mispricing.

II. Trade Mispricing Approaches

Trade pricing occurs whenever two companies trade with each other across international borders, and is called transfer pricing when the trade occurs between two related companies (for example subsidiaries of the same multinational enterprise).

Trade mispricing, including transfer mispricing, is the manipulation of international trade prices. Trade mispricing is estimated to be the most important source of illicit flows of capital out of developing countries (see for example Kar & Freitas, 2012), and can provide a channel for laundering the proceeds of crime, for making and receiving corrupt payments, and for stealing public assets. Incentives for transfer mispricing include the maximisation of net, rather than gross, global profit (whether through tax evasion or tax avoidance, in relation to customs duties or profit taxes, for example); and the evasion or avoidance of other regulations, for example on profit reinvestment and repatriation or other forms of capital control.

Various approaches have been used to explore the scale of trade mispricing. Baker (2005) drew on personal knowledge of false invoicing in his business career to inform a series of more than 500 confidential interviews with professionals involved in trade, generating consistent evidence of abuse. These estimates formed the basis for Christian Aid's global estimate in Hogg et al (2008) of \$160 billion a year of lost revenue in developing countries.

As he acknowledges, Baker's estimates can be criticised because of the difficulties of replication and independent confirmation, and the representativeness and size of the sample; but there is no question that this pioneering work raised the issue for public policy in the US for the first time.

Academic studies have used trade data, ideally at the transaction level (Clausing, 2003; de Boyrie et al, 2005a and 2005b, Pak, 2007; Zdanowicz, 2009), and there is broad support

for seeing tax as a motivation for intra-firm pricing decisions and for the scale of trade mispricing as a channel of illicit flows. Similar methods were applied by Christian Aid (McNair et al. 2009), which confirmed the reasonableness of the \$160 billion estimate for revenue losses from trade mispricing while providing much greater detail about the highest-risk areas.

The report used Pak's price filter analysis method, in which upper and lower quartile prices are calculated for every commodity classification between trading countries, and every record in the trade database is then evaluated for mispricing against the inter-quartile range for the relevant commodity.

This approach assumes that the price range between an upper quartile price and a lower quartile price is legitimate, in the sense of reflecting pricing that would occur between unrelated parties operating at arm's length. If the declared price of a particular transaction falls within the inter-quartile price range, it is assumed to be an arm's length transaction, that is, it is considered to be normal. If a price is above the upper quartile price, the overpriced amount is assumed to be the deviation from the upper quartile price. Similarly, if a price is below the lower quartile price, the underpriced amount is assumed to be the deviation from the lower quartile price. This approach estimates the mispriced amount for each transaction record, enabling an estimation of total capital flows into rich countries as the total of all overpriced import amounts and underpriced export amounts of all trades by other countries.

The advantage of the price filter analysis method is that the mispriced amount of each transaction is directly estimated using rich countries' trade data and, therefore, the level of accuracy does not depend on trade data from other countries. Where available records are grouped (for example by month, by port, etc), this method is likely to understate the amount of mispricing since overpriced transactions and underpriced transactions in a grouped record may offset each other.

There are also disadvantages. An important, but in some sense arbitrary assumption, is that the estimated inter-quartile price range is an arm's length price range. While this follows the Internal Revenue Service approach to identifying potentially abnormal pricing, it implies that any data set will be deemed to include some abnormally priced transactions. This will have an effect of overstating the estimated mispriced amounts (underpriced or overpriced). On the other hand, transactions in large quantity with declared prices which are only marginally different from arm's length prices may not be detected if the declared abnormal prices fall within the interquartile range, but the total mispriced amounts may be substantial. This will have an effect of understating the estimated mispriced amounts (underpriced or overpriced).

The approach will also be sensitive to the detail of commodity categories and to movements in market prices. Results will be more compelling for the most detailed commodity categories, where there is strongest support for the assumption of identical ranges of price per kilogram for each good within the category. Broader categories, in terms of the quality of commodities, for example, may result in legitimate transactions

involving high-end products being classified as overpriced, and legitimate transactions of low-end products classified as underpriced, while abnormally priced transactions of mid-range products may be classified as legitimate. (The transaction misclassification of the high-end and the low-end products as abnormally priced may offset each other as may the misclassification of the mid-range products.)

Finally, where prices are grouped over a given time period, such as a month, volatile markets – for example in highly traded commodities such as oil – may result in genuine market prices being identified as abnormal.

The other leading approach to estimating trade mispricing comes from the research by Global Financial Integrity, a project established by Raymond Baker in association with his 2005 book. In their most recent global study, Kar & Freitas (2012) also find that most illicit flows of capital are associated with trade mispricing. Their estimates are based on IMF Direction of Trade Statistics, and use the ‘gross excluding reversals’ specification to compare at the national level the reported exports and imports with those recorded by all potential partners globally.

Using higher-level aggregate data of this sort has risks, including in terms of data quality, but has the clear advantage of generating consistent global findings. Global Financial Integrity have in this way provided clear figures over a number of years and gained traction with policy makers and media.

Further critique of trade mispricing approaches can be found in Fuest & Riedel (2012) and Nitsch (2012). Generally, three types of problems have been highlighted, relating to assumptions, interpretation and policy. Given data constraints, the methods necessarily rely on assumptions that may be hard to verify. The estimates may not always allow straightforward interpretation; and they may point more to the need for global attention than to clear policy recommendations for specific country measures.

One final, overarching criticism aimed at all the leading studies of trade mispricing is that they produce gross rather than net figures: that is, they assess the extent of import overpricing and export underpricing to establish a capital loss, but do not net off opposing flows in the form of import underpricing and export overpricing.

The decision to use gross or net figures should reflect the focus of the research question. A primary concern with the resources available to each country supports a focus on the net capital flow, for example; concern with the damage to standards of governance and accountability caused by illicit financial flows implies that the overall scale of illicit activity matters, and so supports a focus on gross figures.

If the primary concern is with the effects of illicit flows on taxable profits, then it might be appropriate to look at net flows, which determine the net level of profits.¹ A concern

¹ Further research with transaction-level data is needed, however, to explore such a claim. It may be, for example, that there are asymmetric effects on declared profit from illicit outflows and illicit inflows, with the former more likely

with revenues more broadly, to include the effects of manipulation of import tariffs and export subsidies, implies that underpricing and overpricing do not necessarily cancel out (both illicit inflows and outflows may reduce revenues), and so gross flows are likely to be more revealing.

There are, therefore, reasons to be concerned about the gross level of illicit flows, and not merely the net effect of underpricing and overpricing, which suggest that focusing only on net flows misses important issues. As Kar & Freitas (2012, p.iv) neatly put it, ‘there is no such thing as “net crime”’. Where overall estimates of scale are sought, however, presenting net flows reflects a more conservative approach.

In the following section, we discuss the UN Comtrade data that we use in this study and set out the methodology we followed. In the context of this discussion of differing approaches, it may be useful to set out the key points of our approach. In terms of granularity, our data lies between the national level and transaction level used by the main approaches: we use commodity-level data for bilateral trade.

The main question we face is that of the appropriate benchmark: what type of pricing should be deemed ‘abnormal’? As discussed, this area has seen particular criticism of transaction-level data approaches. Here, we use the trade pricing patterns of (i) all other countries and (ii) Switzerland’s major neighbours, to establish a benchmark. Deviations from this are treated as abnormal, but we emphasise the net rather than gross results – so that a normal distribution of Swiss prices either side of benchmark means should not systematically give rise to findings of abnormal capital movements.

This does, however, create a different problem. Our focus is on the under-pricing of exports from developing countries, representing an illicit capital flow to Switzerland. We would reasonably expect also to see illicit capital flows out of a secrecy jurisdiction such as Switzerland. This is because trade mispricing can also provide a way to bring ‘home’, and to launder, funds which have previously been hidden. In this case, one would expect to see over-priced exports to Switzerland (or on the other side, under-priced imports from Switzerland).

Our analysis will effectively net off illicit flows from Switzerland via overpriced exports, against illicit flows to Switzerland via underpriced exports. Our estimates will be, per Kar & Freitas (2012), ‘net crime’: we will net illicit inflows from illicit outflows, rather than summing these to obtain the total illicit flow. This allows us to be confident that we are not capturing normal price variation around the mean as indicative of illicit flows, but is likely to bias our results in a conservative direction.

Below we make explicit the assumptions contained in our approach. Finally, note that our analysis rests on trade prices for Swiss trade as recorded in UN Comtrade: that is, from customs data for physical trade, because of the absence of reporting of Swiss transit trade.

to depress declared profits than are the latter to increase them. Since each reflects a financially motivated choice, illicit inflows might be – for example – more likely to occur when there are losses against which to set the imported profit.

III. Data and Methodology

The current study aims to focus on a more specific issue than the leading studies discussed, namely on the role of Switzerland. To examine the pattern around Swiss commodity trade, we use UN Comtrade data as in Hogg et al (2010). We use the most detailed data possible for global analysis, which follows the Harmonized System categorisation at the six-digit level. The Comtrade database collates, standardises and makes available data from national authorities (typically customs authorities) on the annual quantity, value and trade partner country of commodity trade.

Complications in the data collation process mean that there are some limitations to what can be expected of the dataset. Comtrade lists six limitations in particular, which can be summarised as follows:

- Confidentiality results in some data on detailed commodity categories not being available, although this is still captured in data on higher-level aggregates.
- Coverage is not complete; that is, while the database runs from 1961 to the present, not all countries report all of their trade for every year.
- Classifications vary – that is, different commodity classifications are used by different countries in different periods, so comparisons cannot always be exact.
- Conversion cannot always be precise; that is, where the database includes data that has been converted from one classification to another, these will not always map precisely one on to the other and hence imprecision may result.
- Consistency between reporters of the same trade is not guaranteed: that is, exporter and importer country will record the same trade differently “due to various factors including valuation (imports CIF (cost, insurance and freight), exports FOB (free on board)), differences in inclusions/ exclusions of particular commodities, timing etc.”
- Country of origin rules mean that the ‘partner country’ recorded for imports will generally be the country of origin and need not imply a direct trading relationship.

These limitations mean that caution is required, but do not prevent reasonable use of the data, as explained below. Finally, the approach taken means that we can only provide estimates where data is available for both weight and value of commodity trade, and where quality differences are likely to be limited within the same product being exported from the same country (for example copper cathode from Zambia).

The UN Comtrade data we use cover 244 countries or trade jurisdictions and 2,596 commodity codes, which we selected as those most appropriate in terms of allowing price by weight comparison and likely to have relatively limited quality variation. Inevitably, this is heroic in some cases: but we believe it is legitimate in the absence of global, transaction-level data on bilateral trade with identifiers that would allow the tracking of particular shipments and their pricing; and that the broad consistency of findings across multiple commodities guards against the likelihood that our results rest on quality differences.

We took data for the most recent four years available: 2007- 2010 (when we began this research, the 2011 sample was incomplete, though it is now available). We use currency values in year 2010 dollars, having adjusted earlier years for inflation using the US GDP deflator from the Bureau of Economic Analysis (February 2012 update). A full list of the countries and commodities used, and their HS codes, is available on request.

To understand whether exporter countries experience capital losses when trading with (or via) Switzerland, it is necessary to establish a benchmark. In the absence of any distortions, the Swiss declared (re)export price of a particular commodity would exceed the original export price, with the margin between the two reflecting costs such as transport, storage and insurance. The existence of such costs, and uncertainty over their true value, means that a non-zero trade margin cannot be interpreted as evidence of an illicit capital shift.

Without additional information it would be impossible to explain what proportion of discrepancies reflect genuine trade costs (or data issues), as opposed to illicit capital shifts. One approach to this problem would therefore be to rely on estimated trade costs, if these were consistently available on a country-pair-commodity basis. The World Bank/UNESCP Trade Costs Database may provide such an opportunity for future work. However, costs are only estimated for agriculture and manufactured goods, which would permit a more limited analysis than we attempt here. In addition, costs are estimated from an inverse gravity model based on (possibly distorted) bilateral trade data, so further assessment would be needed to ensure that the distortions we assess here are not in turn distorting estimated costs in this dataset.

We take an alternative approach, based on establishing benchmarks for ‘reasonable’ trade margins. This involves looking at the trade of individual commodity exporters with all other partner countries, and using this to determine a reasonable value for two things: (i) the ‘trade margin’ – the difference between the original export price and the subsequent re-export price by any given partner country; and (ii) the untraced volume – the difference between the volume of trade declared as exports to a given partner country, and the volume declared as imports by that partner country. We can then explore whether, in comparison with all other partners, trade with Switzerland exhibits excess trade margins (and hence capital shifts) and/or excess untraced volume (missing trade) – so making the explicit (but conservative) assumption that there is zero distortion in trade with non-Swiss partners.

For robustness, we also calculate the excess price margin in comparison to the major economies with which Switzerland shares a border: Austria, France, Germany and Italy. In this way we can confirm that the results are robust to accounting for any transport costs that might apply for commodities reaching this location, in case this is a distorting factor, or any other location-specific costs.

Similarly, we can use the untraceable volumes of trade with all other partners, and with Switzerland’s major neighbours, to create two benchmarks against which to calculate the excess untraced volume of trade with Switzerland. With the same assumption that trade

with these other countries is completely undistorted (implying in this case that benchmark levels of untraceable trade reflect either data problems alone, or a combination of data problems and more opaque transit trade), we calculate the excess untraced volume, which we believe to be due to the particular reporting issues with Swiss transit trade.

Again, we assess the same phenomenon for all other countries and for Switzerland's neighbours separately, in order to confirm that the findings are not an artefact of the limitations of the data.

The assumption on which these calculations rely, that there is no distortion at all in countries' trade with any non-Swiss partner (or with Switzerland's neighbours), is of course heroic. The implication is to artificially depress estimates of the distortion in Swiss trade, compared to what we would find if we could genuinely compare with a zero-distortion baseline, giving the resultant estimates of both capital shift and untraced volume a conservative bias.

A potentially counteracting weakness of the methodology is that it does not allow for there being (genuine) high costs that are specific to doing business in Switzerland. That is, by using the average price margin from the world or Switzerland's neighbours to set the benchmark, we exclude the possibility that a higher margin would be reasonable because of Switzerland simply being an expensive jurisdiction to trade with. If there is a genuine cost differential, including against major Swiss neighbours however, it does not follow that developing country exporters should in effect pay for this – instead, other countries should have been able to undercut Switzerland and reduce the latter's dominance in commodity trading.

It therefore seems unlikely that this is a central explanation for our findings; or alternatively, in the case that it is, our estimates will reflect not an illicit capital shift *per se* but rather what countries trading with Switzerland are paying in order to subsidise its excess costs. This would remain of public policy interest. The question would also arise of whether there is some, possibly illicit, premium available to (some of) those involved in such trades, which would justify an apparently less efficient trade structure.

There are other assumptions contained in the approach. Because our data are aggregated on an annual basis, they do not reflect the variations in prices within each year. By using the benchmarks outlined here, we assume in effect that there are no systematic differences in timing: that there are sufficient transactions of Swiss trade, and separately that of all other countries or of Switzerland's major neighbours, for the timing of transactions to be sufficiently well distributed over the year, or over cyclical price movements, for this not to be a source of systematic bias. We return to the question of timing when we discuss the findings below.

In practice, when we undertook the research, we came upon a further problem. As noted, we proceeded on the basis that re-export prices were undistorted, and therefore a

legitimate measure of the value of the original exports (once some average margin reflecting trade costs, *inter alia*, was taken into account).

We found, however, that the declared prices for many commodity exports leaving Switzerland are far above the equivalent prices for exports and re-exports from all other countries.

In other research one would likely consider these as outliers and remove them from the main analysis. In this case, however, it is precisely their anomalous nature that is of interest. One possible explanation for this pattern is that Swiss re-exports are systematically over-priced, to shift capital illicitly into Switzerland (for example, to facilitate tax evasion from high-income country trading partners).² In this case, the declared prices would reflect an important distortion, but would no longer provide a useful indication of the genuine value of the original commodity exports.

Higher re-export prices are the major part of the higher Swiss trade margin, as we will see, but the other element is also non-trivial. This is the phenomenon of, on average, commodity-exporting countries receiving a lower price for that part of their exports that are declared as destined for Switzerland.

Focusing only on this aspect of trade ignores all subsequent pricing further along the supply chain and so would imply what we consider to be an unreasonably conservative assumption: namely, that the (non-Swiss) market for original commodity exports is without distortion. While we outlined reasons in section 1 to expect a particular distortion in the Swiss case, we do not think it likely that that no distortions exist elsewhere.

Nevertheless, when faced with Swiss re-export prices that seem themselves indefensible, we fall back on this approach. We take the following steps. We start by eliminating the few cases in which reported Swiss (re-)export prices are more than one thousand times higher than those of the original exporter. We believe these may raise questions for the Swiss authorities, as to how they could have been accepted as reasonable at customs; but the balance of probabilities supports their being more likely to reflect either data errors or illicit flows in the Swiss export, rather than in the Swiss import, transaction.

In these cases then we consider only the original export price differential received on transactions with Switzerland or without. Treating all other Swiss (re-)export prices as valid, we calculate the capital shift in these cases, and together these give us our upper estimates, which we refer to as Model I. Model I excludes the most egregious Swiss price outliers and assesses whether there is an excess Swiss trade margin, and whether there is an excess untraceable volume of trade with Switzerland, against the benchmarks of trade with all other partners, and trade with major Swiss neighbours only.

² Recent years have seen the Inland Revenue Service of the United States, for example, uncover evidence of US tax evasion being facilitated by multiple Swiss banks – leading to the oldest Swiss bank (Wegelin) being shut down, to a \$780 million fine for UBS, to a number of ongoing criminal cases, and to Switzerland agreeing for the first time to provide some measure of automatic tax information exchange.

We repeat this exercise, becoming more circumspect each time, to eliminate those cases where the Swiss export price is more than one hundred times higher than that of the original exporter (Model II); and where it is more than ten times higher (Model III). Finally, we produce an absolute low-end estimate in which we ignore all Swiss (re-)export prices, so the counterfactual is that each exporter country would have received the average price declared on its exports to other trading partners, rather than the price declared for exports to Switzerland (Model IV). The four models are presented algebraically in the Appendix.

We go on to estimate the two versions of each of the four models in two different ways: first, using only the volume of exports that Swiss customs declarations show as having been physically received as imports; and then using the total volume of exports declared as destined for Switzerland.

The first of these will provide the more precise estimate of capital losses, since it is limited to that trade which is physically recorded as arriving in Switzerland. The second relies on the heroic assumption that the level of distortion of pricing is identical in transit trade, where the exports are lost from statistical view, as in the physical trade which can be traced to Switzerland. On the one hand, this may be conservative since less transparency may be thought unlikely to be associated with less illicit behaviour. On the other hand, the (re-)export prices for physical trade may be thought more likely than those in transit trade to be distorted upwards by illicit capital flows, including corporate profit-shifting, into Switzerland – in which case the transit trade might be associated with less distorted (re-)export prices. As noted in the previous section, however, there is also the possibility of under-priced physical (re-)exports being used to shift illicit capital out of Switzerland and back to the owner. In the absence of any data on this question, this must remain open. On balance, we feel the assumption of equivalent distortion in transit trade and physical trade is the best available basis from which to consider the potential scale of the total phenomenon.

To identify the importance of the ‘outliers’ that are removed at each stage, we calculate the effective value of the trade to which these calculations apply. This confirms the importance of this phenomenon, and explains why the lower estimates should not be considered as reasonable (because of the scale of trade which is effectively labelled as ‘hidden’ while being assumed to contain no illicit capital shift).

Finally, note again that throughout we focus on net rather than gross figures. Although we find the arguments for the gross approach taken in most mispricing analysis (discussed in the previous section) broadly compelling, we nonetheless emphasise the net figures since these provide a more conservative estimate. This should limit any effects of a random distribution of Swiss pricing above and below benchmark levels, and ensure our findings reflect systematic patterns only – though it will also net illicit inflows off against illicit outflows, and so understate the true overall magnitude of illicit flows.

IV. Results

Table 1 presents the first estimates of the scale of capital apparently shifted out of countries through their commodity trade with Switzerland. These results are based on the excess price margin in Swiss trade, applied only to that share of exports to Switzerland which is confirmed by Swiss customs as physically arriving.

The first striking feature is that the overall totals are large and negative: Models I-III estimate illicit capital inflows, over the four-year sample period, of more than \$2 trillion. The breakdown shows that this is entirely because of inflows to high-income OECD countries, and we discuss this below.

The developing country findings are consistent with the original hypotheses. Starting with Model IV, which treats all Swiss customs data as unreliable and so calculates the difference in export values had the prices of non-Swiss importers applied, we find an apparent capital loss of some \$34 billion (using the price for exports to all other countries for the benchmark) to \$61 billion (using only export prices to Switzerland's major neighbours for the benchmark). We consider this implausibly conservative, but it serves to indicate that even allowing for the possibility that all information accepted by Swiss customs and provided on that basis to the UN system is false, there is still clearly a significant shift of resources from developing countries to Switzerland hidden in the commodity trade. In this scenario, of course, there would be a strong case to examine Swiss-declared (re-)export prices as potentially covering illicit capital inflows to Switzerland.

If we accept Swiss customs (re-)export values when these are less than ten times the original export price, but only consider the impact for the quantity of exports which are physically received in Switzerland, the range narrows a little to \$32-\$52 billion. Extending the acceptable Swiss prices further in Models II and I, the range of estimates rises to \$73-\$92 billion of capital loss from developing countries.

However, the two benchmarks (the rest of the world, or only Swiss neighbours) have quite a different disaggregation. With neighbours as the benchmark, there is near-zero capital loss estimated for low-income countries, some \$10-\$20 billion for lower-middle income countries, and the majority for upper-middle income countries. With the rest of the world as the benchmark, lower-middle income countries account for little but low-income countries (on the basis of receiving lower prices for their exports to Switzerland) see a consistent \$16 billion loss.

The implication is that prices for exports to Switzerland vary substantially from those to Switzerland's neighbours for middle income but not low income countries; that is, low income exporters receive equivalent prices for exports to Switzerland as to its neighbours, while middle income countries receive lower prices. Prices for exports to Switzerland vary substantially from those to the rest of the world for low and upper-middle income countries, but not for lower-middle income countries; that is, lower-

middle income exporters receive equivalent prices for exports to Switzerland as to the rest of the world, but others do not.

The consistent finding is that upper-middle income countries receive lower prices for exports to Switzerland than to elsewhere, irrespective of the benchmark chosen; while the results for low- and lower-middle income countries depend on the benchmark. Since the results are not insensitive to the choice of benchmark, further research might usefully consider further the most appropriate benchmark for Switzerland.

Table 2 shows the estimates when we apply the calculated excess margins to the entire volume of trade declared as exports to Switzerland (that is, we include transit trade, with the assumption that the distortion here is equivalent). Model IV is of course unchanged, but the remaining estimates are much higher – as would be expected.

The developing country total for the upper estimate (Model I), for the period 2007-2010, using the ‘rest of the world’ benchmark, is US\$578 billion (with a further US\$316 billion shifted from high-income countries). When we ‘normalise’ the cases where Swiss export prices are more than one hundred times those of original exporters (Model II), the estimate is US\$441 billion for developing countries (US\$194 billion for high-income). When we ‘normalise’ all cases where Swiss export prices are more than ten times those of original exporters (Model III), the estimate is US\$154 billion (and US\$84 billion).

Again we see consistent differences when the neighbours benchmark is applied, with a near-zero loss for low-income countries but a higher loss for upper-middle income countries.

Returning to the question of illicit flows in Swiss trade with high-income OECD countries, the estimates in Table 2 show these as positive where in Table 1 they were very large and negative. The implication is that, on that part of trade for these countries where there are physical exports to Switzerland, there may be large capital shifts into high-income countries disguised through over-pricing of the exports. When all trade is considered, as in Table 2 where the calculation of relative price margins is extended to include all of our commodity categories as they feature in Swiss transit trade, the pattern that dominates is the same observed for developing countries: an excess price margin is found in the Swiss trade which would imply a capital loss for high-income OECD countries also. Further research is warranted here.

We also calculated the value of exports that are excluded from the capital shift calculation that looks at the excess Swiss price margin, and the results confirm that this is far from being a small correction. As Table 3 shows, even treating separately only those exports with a price where the corresponding Swiss export price is more than a thousand times higher excludes from the main analysis more than 40 million metric tons of trade (including more than 10 per cent of all lower-middle income country exports to Switzerland). If priced highly conservatively at the actual declared price for exports to Switzerland, the value of developing country trade excluded is more than US\$50 billion (closer to \$100 billion when high-income countries are also included).

The numbers increase only marginally at the next step, implying that the extent of Swiss export pricing between 100 and 1,000 times greater than that of the original exports is not very large. Table 3's final columns show the extent of trade excluded from the main analysis when we look only at commodities with Swiss export prices less than ten times higher than the original exports. This is seen to affect around 85 million metric tons of commodities, with a conservative value of around \$116 billion. This excludes from the main analysis 8 per cent of all declared exports to Switzerland, including 12-15 per cent of those from lower-middle and upper-middle income countries. Accepting the lower estimate of Model IV as reasonable implies accepting the assumption that there is likely to be no significant illicit capital shift in the related transactions which are excluded precisely for being abnormally priced – we consider this self-evidently unlikely.

Table 4 presents the main estimates of the scale of the untraceable volume of exports, the amount of trade which leaves other countries with the declared destination of Switzerland but is never declared there as an import.

The most dramatic statistic is that a proportion of over 90 per cent of developing country commodity exports to Switzerland, in the categories used in this analysis, simply is not recorded as imports arriving there. As discussed, however, this is likely largely to reflect the opacity of Swiss transit trade.

To be sure that these results are not somehow a reflection of data limitations, the final columns of Table 4 consider the situation for trade with Switzerland's neighbours. Rather than showing simply a smaller problem, as might have been expected, the value of the untraceable trade actually reverses. That is, Switzerland's neighbours record significantly more in imports, from developing countries above all, than are declared as being exported there.

This result is in fact not surprising given the country of origin rules, which mean that, for example, Zambian copper arriving in Germany via the Netherlands can still be recorded as an import from Zambia – but in Zambia as an export to the Netherlands.

On average, untraceable trade with Switzerland accounts for less than half of 1 per cent of these commodity exports. We find these curiously low, given that Swiss transit trade is said to account for 15-25% of global commodity trade. The implication may be that a non-trivial part of the transit trade is in fact recorded in customs statistics (or that claims of Swiss transit trade dominance are unfounded); again, without further transparency, it is difficult to say more.

The extremes show a picture more consistent with the apparent scale of transit trade. Table 5 shows a breakdown by country and commodity for the top ten cases. The biggest 'loser', in terms of the opacity of their overall trade, is the copper exporter Zambia, which has seen more than a quarter of its total exports affected. The biggest losers, in terms of pure volume of trade, are Russia, Kazakhstan and Brazil, which between them have seen more than 100 million metric tons become untraceable over the period.

V. Discussion

We have discussed caveats and concerns throughout this paper, relating to general weaknesses of the data; to treatment of specific problems with Swiss data; and to the methodology in general. At each step, we have given priority to more conservative methods (for example presenting net rather than gross flows, and providing estimates that exclude Swiss data as unreliable, where its inclusion greatly inflates the estimated capital shifts out of commodity-exporting countries).

We are left with results which, even in the lowest-value estimate of those in the most conservative model, suggest a capital shift out of developing countries of more than \$8 billion a year. This is equivalent to the total aid provided by a major bilateral donor, for example; Swiss ODA was \$3.02 billion in 2012 (OECD DAC, 2013). On the basis of the range of estimates, our expectation is that the real value of capital shift is substantially higher.

It is important to consider whether the underlying explanation is illicit capital shifting. Three main possibilities exist. One is that Swiss commodity traders, by virtue of skill, are able consistently to 'buy low' and 'sell high'. Anomalous prices – whether in terms of lower export prices received by countries trading with Switzerland, or higher re-export prices declared by Switzerland than other trading partners, are in this view not the result of any manipulation but stem from good timing of market trades.

A number of arguments can be put forward against this view. Among them, two stand out. One is that exporter countries appear to have choices – and choosing to trade with non-Swiss partners seems to yield a systematically higher price. Of course, however, we do not have evidence on the fungibility of this trade: if countries were to cease trade with Switzerland, presumably commodity traders would relocate, and the results might change. If the role of Swiss opacity (both financial and in regard to trade statistics) is unimportant, then trader skill would be likely to yield the same result wherever they were based.

The other counter-argument is that it is not clear why – if opacity plays no role – there is insufficient competition of skilled traders operating from other jurisdictions to reduce the extent of the observed Swiss anomalies. By this argument, for example, not only other high-income countries but developing country exporters in particular would also face major incentives to attract skilled traders and trade in their own right. With respect to both counter-arguments, the channels would be expected to strengthen if the situation were more transparent – so that if playing no other role, Swiss opacity may be limiting efficient competition by obscuring the benefits of trading.

Such an argument also raises a question about whether commodity-exporter countries could protect themselves at least to an extent from being on the wrong end of 'bad' trades, simply by refusing to trade with Switzerland.

A second possibility is that Swiss commodity traders do genuinely add significant value, not through manufacturing processes or the like but through the benefits of trading with

them: so that, for example, the reduced uncertainty of dealing with a Swiss trader may be worth a premium compared to dealing directly with a developing country commodity exporter, or the agglomeration benefits of Swiss commodity trading may somehow create other benefits for trading partners, and prices reflect this.

It is not clear, however, why such efficiencies should result in higher rather than lower margins for Swiss commodity traders, or why market pressures from London or Singapore traders, for example, should not force margins down, if there is a level playing field. In addition, this view provides no explanation for the consistently lower prices paid for exports with the declared destination of Switzerland – if the market is efficient, and the average price received for exports to other countries is higher, why do countries (or their export businesses) trade with Swiss commodity traders rather than any others? The possible role of trade between related parties is, unfortunately, one that the data do not allow us to explore here.

The other potential explanation for high Swiss (re-)export prices is that in many cases there is a physical value-adding process that largely eludes commodity categorisation. We deem this unlikely, since it would require the range of value-adding processes to be systematically uncaptured for Switzerland in comparison to all other re-exporting trade partners. At best, it would suggest large-scale and persistent failures in Swiss customs data recording – a finding which is of course supported here, but in a different context: that Swiss customs appear systematically to accept and declare (re-)export prices which are inconsistent with world and neighbour benchmarks, and suggestive of illicit capital inflows.

A final point to stress again is that Comtrade data does not distinguish between trade between related parties and trade at arm's length. Access to better data, allowing this distinction to be studied, would go a long way to improving our understanding of the phenomena identified here.

VI. Conclusions

The results presented here show systematic differences in the declared prices for commodity exports to and from Switzerland during 2007-2010, in relation to benchmarks based on the price patterns of all other countries, and of Switzerland's major neighbours.

Depending on the particular model applied and the particular assumptions made, the observed pattern of pricing implies average, annual capital shifts from developing countries to Switzerland in a range from around \$8 billion to more than \$120 billion.

The lower estimates rely purely on a comparison of export prices to Switzerland with those received for exports to other countries. The higher estimates use declared Swiss export prices to construct a 'fair' margin for developing country exporters. In the latter case, the same prices on physical trade imply large capital shifts to OECD countries from Switzerland (possibly exceeding \$500 billion a year on average); suggesting that much of the mispricing may involve the (illicit) retrieval of capital to OECD countries, rather than

necessarily illicit capital movements out of developing countries – although even the most conservative estimates of the illicit outflows from developing countries imply this should still be of substantial concern.

The range of estimates and the potential interpretations that the implied capital shifts affect primarily either developing countries or OECD members, means that the central conclusion of the study is not of a particular scale or direction of illicit flow. Rather, it is this: that the current lack of transparency of Swiss trade allows the possibility of large illicit capital movements.

More than 90 per cent of developing countries' declared exports to Switzerland cannot be found in the data, because of the lack of comparable statistics on the transit trade. The opacity that surrounds this trading appears to offer substantial scope for abuse. In addition, declared Swiss export prices for physical trade appear inconsistent in many cases with market prices – suggesting, if true, that there are large illicit capital movements in trade with OECD members.

Switzerland has a uniquely important position for developing countries as a commodity trading hub; but the lack of transparency that characterises both the country's financial sector and its commodity trading creates a serious risk of illicit capital movement.

A policy agenda reflecting the concerns raised here would begin with greater transparency from Switzerland in relation to its commodity trading. As discussed above, Swiss NGO The Berne Declaration (2011) has highlighted the phenomenon of Swiss transit trade, not recorded in customs since it does not physically reach the border, but captured elsewhere by the central bank as akin to a flow of services. A starting point would be for this data to be provided to the UN system (in addition to, and separately from the customs data used here).

There is also the possibility of direct measures to force progress. Legal analysis suggests that such price evidence could support a case against Switzerland at the World Trade Organisation (see Bastin, forthcoming). Given the extent of commodity price anomalies in the declarations accepted and published by Swiss customs, the option for one or a group of member states would be to pursue a case on the basis that Swiss actions result, systematically, in other member states being unable to obtain the full benefits of trade and in particular of their WTO membership. Such a group might include both developing country exporters and high-income OECD importers, to the extent that the data presented here may support the hypothesis of illicit capital flows to Switzerland in both channels.

UN Comtrade data provide a rich seam for researchers to tap – not least for developing country governments interested in exploring questions about whether they are receiving a fair price for their commodity exports. Read in conjunction with national data on the firms involved in commodity export, including their accounts and tax affairs, there may well be the potential for domestic criminal investigation.

For concerned bodies such as the G20, G8, OECD, UN Tax Committee or the Global Partnership for Effective Development Co-operation, there is scope to go one better. The opportunity exists to pilot joint use of transaction-level data between countries (for example, Nigeria and the UK are two of the three co-chairs) and identify precisely the extent of misinvoicing in trade between the two – as well as setting a precedent for development cooperation that others such as Switzerland could be encouraged to follow.³ Participants at the World Economic Forum, taking place annually in Davos, might feel that their own concerns with economic transparency and development should prompt conversations with their hosts.

³ This proposal is elaborated in the context of the Open Government Partnership in Cobham (2013).

References

- Baker, R., 2005, *Capitalism's Achilles Heel: Dirty money and how to renew the free-market system*, Hoboken: John Wiley & Sons.
- Bastin, L., forthcoming, 'Transfer (mis)pricing, customs valuation and WTO law' (presented at A4ID workshop on Tax and Development, Ashurst LLP London, 24 April 2013).
- Berne Declaration, 2011, *Commodities: Switzerland's most dangerous business*, e-book available at: <http://www.evb.ch/en/commodities>.
- de Boyrie, M., S. Pak, & J. Zdanowicz, 2005, 'Estimating the magnitude of capital flight due to abnormal pricing in international trade: The Russia–USA case', *Accounting Forum* 29(3). pp. 249–270.
- de Boyrie, M. S. Pak & J. Zdanowicz, 2005, 'The impact of Switzerland's money laundering law on capital flows through abnormal pricing in international trade', *Applied Financial Economics* 15(4), pp.217–230.
- Clausing, K., 2003, 'Tax-motivated transfer pricing and US intrafirm trade prices', *Journal of Public Economics* 87(9-10), pp.2207–2223.
- Cobham, A., 2012, 'Tax havens and illicit flows', in P. Reuter (ed.), *Draining Development? Controlling Flows of Illicit Funds from Developing Countries*, Washington, DC: World Bank.
- Cobham, A., 2013, 'Tax and illicit flows', in *Open Government Guide*: <http://www.opengovguide.com/topics/tax-and-illicit-flows/> [accessed 14 January 2014].
- Farquet, C., 2012, 'The rise of the Swiss tax haven in the interwar period: An international comparison', *Working Papers in Economic History* 27, University of Lausanne, European Historical Economics Society.
- Fuest, C. & N. Riedel, 2012, 'Tax evasion and tax avoidance: The role of international profit shifting', in P. Reuter (ed.), *Draining Development? Controlling Flows of Illicit Funds from Developing Countries*, Washington, DC: World Bank.
- Glencore, 2 June 2011, 'Glencore comments on Mopani tax payments', statement released online: [http://www.glencore.com/documents/Glencore Comments On Mopani.pdf](http://www.glencore.com/documents/Glencore%20Comments%20On%20Mopani.pdf).
- Grant Thornton and Econ Poyry, 2010, 'Pilot Audit Report – Mopani Copper Mines Plc'. A leaked, unofficial version of the report available here: http://www.miningwatch.ca/sites/www.miningwatch.ca/files/Audit_Mopani.pdf
- Hogg, A., J. Melby, A. Kwatra, S. Wilson, A. Cobham, R. Baird, D. McNair and M. Sowemimo, 2008, 'Death and taxes: The true toll of tax dodging', *Christian Aid Week Report*, London: Christian Aid: <http://www.christianaid.org.uk/images/deathandtaxes.pdf>.
- Hogg, A., R. Baird, N. Mathiason & A. Cobham, 2010, 'Blowing the whistle: Time's up for financial secrecy', *Christian Aid Week Report*, London: Christian Aid: <http://www.christianaid.org.uk/images/blowing-the-whistle-caweek-report.pdf>.
- House of Congress, 2002, 'Justice Undone: Clemency decisions in Clinton White House', *United States Congressional Series Set – House Report 454* (107th Congress, 2d session, January 23–November 22, 2002), Washington, DC: United States Government Printing Office.
- Kar, D. & S. Freitas, 2012, *Illicit Financial Flows from Developing Countries: 2001-2010*, Washington, DC: Global Financial Integrity.
- McNair, D. & A. Hogg with S. Pak, 2009, 'False profits: Robbing the poor to keep the rich tax-free', *Christian Aid Report*: <http://www.christianaid.org.uk/Images/false-profits.pdf>.
- Nitsch, V., 2012, 'Trade mispricing and illicit flows', in P. Reuter (ed.), *Draining Development? Controlling Flows of Illicit Funds from Developing Countries*, Washington, DC: World Bank.

- OECD DAC, 2013, Development Co-operation Report 2013, Paris: Organisation for Economic Cooperation and Development, Development Assistance Committee.
- Pak, S., 2007, 'Closing the floodgates: Collecting tax to pay for development', report commissioned by the Norwegian Ministry of Foreign Affairs and Tax Justice Network.
- Reuter, P. (ed.), 2012, Draining Development? Controlling Flows of Illicit Funds from Developing Countries, Washington, DC: World Bank.
- Sekinger, U., M. Madörin & M. Egli (trans. G. Bitterli), 2005, 'Collaboration with the Apartheid regime', Switzerland-South Africa Research Group Report: http://www.apartheid-reparations.ch/documents/reparationen/WSP_en_05.pdf.
- SwissInfo ('International Service of the Swiss Broadcasting Corporation'), 18 February 2012, 'Swiss come into US sights again over Iran': http://www.swissinfo.ch/eng/politics/Swiss_come_into_US_sights_again_over_Iran.html?cid=32122662.
- SNB, 2012, 'Swiss Balance of Payments 2011', Zurich: Swiss National Bank.
- Tax Justice Network, 2011. The Results and Methodology of the Financial Secrecy Index: <http://www.financialsecrecyindex.com/Archive2011/index.php?id=1> [accessed 14 January 2014].
- Tax Justice Network, 2013. The Results and Methodology of the Financial Secrecy Index: <http://www.financialsecrecyindex.com> [accessed 14 January 2014].
- Zdanowicz, J., 2009, 'Trade-based money laundering and terrorist financing', Review of Law and Economics 5(2), pp.854–878.

Table 1: Aggregate estimates of capital loss in exports to Switzerland (physical imports only), 2007-2010 (US\$ billion)

	MODEL	I: UPPER ESTIMATE		II		III		IV: LOWER ESTIMATE	
	Exclusions	<i>Swiss export price > 1000 * original</i>		<i>Swiss export price > 100 * original</i>		<i>Swiss export price > 10 * original</i>		<i>All Swiss export prices treated as unreliable</i>	
	Benchmark	World	Neighbours	World	Neighbours	World	Neighbours	World	Neighbours
	TOTAL	-2218.8	-2200.8	-2315.1	-2296.6	-2444.2	-2425.0	25.5	81.2
Region	Income level								
High-income		-2292.2	-2292.6	-2379.3	-2379.6	-2476.4	-2476.7	-8.5	19.9
East Asia & Pacific		6.1	7.9	3.7	5.4	-5.0	-3.2	-5.8	-3.3
Europe & Central Asia		26.9	28.2	26.4	27.6	6.0	7.2	5.1	8.1
Latin America and Middle East & North Africa		21.8	44.1	15.7	37.9	15.2	38.0	14.1	38.5
South Asia		1.4	-0.1	1.4	-0.2	1.3	-0.2	1.8	0.3
Sub-Saharan Africa		0.9	-4.9	0.9	-4.3	-1.3	-6.5	-0.2	-0.1
		16.2	16.5	16.2	16.5	16.1	16.5	19.0	17.7
	Non-defined	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low	16.4	0.1	16.4	0.1	16.2	0.0	16.0	0.1
	Lower-middle	2.6	14.8	2.2	15.0	-0.2	12.8	1.2	19.9
	Upper-middle	54.5	76.8	45.6	67.8	16.3	38.8	16.7	41.3
	High-income OECD	-2292.2	-2292.2	-2379.3	-2379.2	-2476.5	-2476.3	-7.5	21.7
	High-income non-	0.0	-0.3	0.0	-0.3	0.0	-0.4	-0.9	-1.8
Developing country totals		73.4	91.7	64.2	82.9	32.3	51.7	34.0	61.3

Source: calculations on UN Comtrade data, for 244 countries/trade jurisdictions, 2596 commodity codes (selected as those most appropriate for the other elements of this analysis, focusing on price by weight comparison) and the most recent four years of data available: 2007-2010. NB currency values are given in year 2010 dollars, with earlier years adjusted for inflation using the US GDP deflator from the Bureau of Economic Analysis (Feb.2012 update).

Table 2: Aggregate estimates of capital loss in all declared exports to Switzerland, 2007-2010 (US\$ billion)

	MODEL	I: UPPER ESTIMATE		II		III		IV: LOWER ESTIMATE	
Exclusions		<i>Swiss export price > 1000 * original</i>		<i>Swiss export price > 100 * original</i>		<i>Swiss export price > 10 * original</i>		<i>All Swiss export price treated as unreliable</i>	
Benchmark		World	Neighbours	World	Neighbours	World	Neighbours	World	Neighbours
TOTAL		893.7	884.6	635.5	631.6	238.6	254.9	25.5	81.2
Region	Income level								
High-income		315.7	324.5	194.1	203.9	84.2	99.3	-8.5	19.9
East Asia & Pacific		16.6	4.6	12.2	3.2	-2.3	-1.4	-5.8	-3.3
Europe & Central Asia		328.2	336.8	326.0	335.2	91.4	92.1	5.1	8.1
Latin America and Middle East & North Africa		150.6	160.9	32.8	43.7	18.9	41.5	14.1	38.5
South Asia		34.6	30.7	23.1	19.3	4.4	0.5	1.8	0.3
Sub-Saharan Africa		2.9	2.7	2.1	2.1	0.4	0.4	-0.2	-0.1
		45.2	24.3	45.1	24.3	41.6	22.5	19.0	17.7
	Non-defined	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low	18.7	1.0	18.7	0.9	17.4	0.8	16.0	0.1
	Lower-middle	47.4	33.9	43.4	33.0	27.1	25.7	1.2	19.9
	Upper-middle	512.0	525.2	379.3	393.8	109.9	129.2	16.7	41.3
	High-income OECD	315.5	326.5	194.0	205.8	85.3	101.2	-7.5	21.7
	High-income non-	0.2	-1.9	0.1	-1.9	-1.1	-2.0	-0.9	-1.8
Developing country totals		578.0	560.1	441.3	427.7	154.4	155.6	34.0	61.3

Source: calculations on UN Comtrade data, for 244 countries/trade jurisdictions, 2596 commodity codes (selected as those most appropriate for the other elements of this analysis, focusing on price by weight comparison) and the most recent four years of data available: 2007-2010. NB currency values are given in year 2010 dollars, with earlier years adjusted for inflation using the US GDP deflator from the Bureau of Economic Analysis (Feb.2012 update).

Table 3: Extent of trade excluded by addressing anomalous Swiss export prices (2007-2010)

MODEL	I			II			III		
Exclusions:	<i>Swiss export price > 1000 * original</i>			<i>Swiss export price > 100 * original</i>			<i>Swiss export price > 10 * original</i>		
	Million s of metric tons	% exports to Switz'd	US\$ billion	Million s of metric tons	% exports to Switz'd	US\$ billion	Million s of metric tons	% exports to Switz'd	US\$ billion
Total excluded	41.9	3.9%	96.5	48.7	4.6%	97.5	85.1	8.0%	116.0
Low	0.0	1.2%	4.3	0.0	1.2%	4.3	0.1	2.6%	4.4
Lower-middle	9.2	12.4%	5.1	9.7	13.1%	5.1	11.0	14.9%	5.9
Upper-middle	29.1	5.5%	42.0	33.7	6.3%	42.5	63.6	12.0%	55.9
High-income OECD	3.5	0.8%	40.4	5.4	1.2%	41.0	10.3	2.2%	45.2
High-income non-OECD	0.0	0.1%	4.6	0.0	0.1%	4.6	0.1	9.8%	4.6
Developing country total	38.3		51.5	43.4		51.9	74.7		66.2

Source: calculations on UN Comtrade data, for 244 countries/trade jurisdictions, 2596 commodity codes (selected as those most appropriate for the other elements of this analysis, focusing on price by weight comparison) and the most recent four years of data available: 2007-2010. NB currency values are given in year 2010 dollars, with earlier years adjusted for inflation using the US GDP deflator from the Bureau of Economic Analysis (Feb.2012 update).

Table 4: Scale of untraceable trade, 2007-2010

Scale of untraceable trade with Switzerland

Memo: Equivalent problem in trade with Switzerland's major neighbours

		Untraceable exports to Switzerland	Total exports to Switzerland	Untraceable share of exports to Switzerland	Total exports: World	Untraceable Swiss share of total exports	Untraceable exports to neighbours	Total exports to neighbours	Untraceable share of exports to neighbours
		Millions of metric tons	Millions of metric tons	%	Millions of metric tons	%	Millions of metric tons	Millions of metric tons	%
Total		117.1	267.0	43.9%	32612.4	0.4%	-620.2	3459.2	-17.9%
<i>Of which:</i>									
High-income countries		-11.0	114.6	-9.6%	17005.5	-0.1%	-148.7	2161.1	-6.9%
Developing countries		128.1	152.5	90.1%	15606.9	0.2%	-471.5	1298.1	-25.5%
By income level:									
	Low income	0.9	1.0	89.6%	80.2	1.1%	-14.6	3.2	-460.0%
	Lower-middle income	15.4	18.5	83.6%	3747.4	0.4%	-160.0	164.9	-97.0%
	Upper-middle income	111.8	133.0	84.1%	11779.3	0.9%	-296.8	1130.0	-26.3%
By region:									
	East Asia & Pacific	9.1	10.1	90.1%	3726.1	0.2%	-18.9	74.3	-25.5%
	Europe & Central Asia	95.3	103.8	91.8%	5226.7	1.8%	-62.5	619.8	-10.1%
	Latin America & Caribbean	24.0	26.0	92.4%	3783.7	0.6%	-62.5	239.4	-26.1%
	Middle East & North Africa	-5.8	3.8	-151.2%	1109.2	-0.5%	-213.4	247.1	-86.4%
	South Asia	0.6	0.9	69.3%	863.4	0.1%	-5.6	12.5	-44.4%
	Sub-Saharan Africa	4.9	7.8	62.3%	897.7	0.5%	-108.6	105.0	-103.4%

Source: calculations on UN Comtrade data, for 244 countries/trade jurisdictions, 2596 commodity codes (selected as those most appropriate for the other elements of this analysis, focusing on price by weight comparison) and the most recent four years of data available: 2007-2010.

Table 5a: Leading countries, by share of untraceable exports

		Millions of metric tons	% of exports to Switzerland	% of exports to world
1	Zambia	2.12	99.8%	27.7%
2	Burundi	0.04	97.3%	18.3%
3	Burkina Faso	0.30	100.0%	15.7%
4	Rep. of Moldova	0.38	99.4%	8.4%
5	Kazakhstan	32.24	87.2%	7.1%
6	Rwanda	0.02	99.8%	7.0%
7	Uganda	0.23	98.3%	4.5%
8	Paraguay	1.16	99.0%	3.7%
9	Tunisia	1.82	99.3%	3.6%
10	Greenland	0.02	99.7%	3.2%

Table 5b: Leading countries, by volume of untraceable exports

		Millions of metric tons	% of exports to Switzerland	% of exports to world
1	Russian Federation	60.80	98.7%	1.8%
2	Kazakhstan	32.24	87.2%	7.1%
3	Brazil	21.00	94.6%	1.2%
4	Indonesia	8.72	99.1%	0.6%
5	Norway	4.28	90.7%	0.5%
6	South Africa	3.69	83.9%	0.6%
7	Ukraine	3.17	98.3%	0.6%
8	Colombia	2.16	95.6%	0.6%
9	Zambia	2.12	99.8%	27.7%
10	Tunisia	1.82	99.3%	3.6%

Appendix: Model specifications

In this appendix we detail the four models set out in section III. We introduce some notation to explain the methodology. Let q_{ij} be the volume in kilograms of exports in a given commodity category from country i to country j , and p_{ij} the price per kilogram of those exports. Then let σ_{ij} be the volume in kilograms of re-exports in a given commodity category from country i to country j , and ρ_{ij} the price per kilogram of those exports.

If we assume that re-export prices are undistorted, then the focus of the analysis should be on how the original export price compares to the eventual re-export price of the same goods. The simplest analysis would compare a given export volume and value from a given country i to a given country j with the re-export volume and value from country j to all other countries ($b = 1, \dots, n; b \neq i, j$). The capital shift from country i to country j would then be calculated as:

$$k_{ij} = q_{ij} \left(\frac{\sum_{h=1}^n \rho_{jh} \cdot \sigma_{jh}}{\sum_{h=1}^n \sigma_{jh}} - p_{ij} \right) \quad \dots(1)$$

We can think of the element in brackets as the ‘trade margin’: the difference between the original export price paid, and the average re-export price received. The capital shift is then the trade margin multiplied by the volume of trade.

Note that our data do not allow us to exclude from the (re-)exported volume σ_{jh} any imports from countries other than i . In effect, we would be required to assume that there are no systematic quality differences between exports from country i and those from all other countries, for the expression (1) to be unbiased. This is not necessarily unreasonable, in particular if we take a global approach as far as the data allow, and net off apparent shifts in opposing directions.

Let the untraced volume of country i 's exports to intermediate country j be expressed as the proportionate difference between country i 's declared exports to country j , and country j 's declared imports from country i :

$$u_{ji} = \frac{q_{ij} - m_{ji}}{q_{ij}} \quad \dots(2)$$

The excess price margin for country i 's trade with Switzerland (labelled ‘S’), compared to the average margin for all other countries, can be expressed as:

$$\gamma_{Si, World} = \left(\frac{\sum_{h=1}^n \rho_{Sh} \cdot \sigma_{Sh}}{\sum_{h=1}^n \sigma_{Sh}} - p_{iS} \right) - \frac{\sum_{j=1}^n \left(\frac{\sum_{h=1}^n \rho_{jh} \cdot \sigma_{jh}}{\sum_{h=1}^n \sigma_{jh}} - p_{ij} \right) \cdot q_{ij}}{\sum_{j=1}^n q_{ij}} \quad \dots(3a)$$

Note that there is a double trade-weighting here: for the relative shares of jurisdiction j 's (re-)export partners in determining j 's average (re-)export price, and for the relative shares of the jurisdiction i 's original export partners (jurisdictions j) in determining the average (re-)export price that subsequently applies to i 's original exports.

For robustness, we also calculate the excess price margin in comparison to the major economies with which Switzerland shares a border: Austria, France, Germany and Italy (labelled A , F , G and I respectively). In this way we can confirm that the results are robust to accounting for any transport costs that might apply for commodities reaching this location, in case this is a distorting factor, or any other location-specific costs.

$$\gamma_{Si,Neighbours} = \left(\frac{\sum_{h=1}^n \rho_{Sh} \cdot \sigma_{Sh}}{\sum_{h=1}^n \sigma_{Sh}} - p_{iS} \right) - \frac{\sum_{j=A,F,G,I}^n \left(\frac{\sum_{h=1}^n \rho_{jh} \cdot \sigma_{jh}}{\sum_{h=1}^n \sigma_{jh}} - p_{ij} \right) \cdot q_{ij}}{\sum_{j=A,F,G,I}^n q_{ij}} \dots (3b)$$

By assuming in effect that there is no distortion at all in countries' trade with any non-Swiss partner (or with Switzerland's neighbours), we can revisit equation (1) and combine the excess margin with the known quantity of declared exports to Switzerland to generate an estimate of the effective capital lost by exporting countries by trading with Switzerland rather than any other country (or neighbour).

$$k_{iS,W} = q_{iS} \cdot \gamma_{Si,World} \dots (1a)$$

$$k_{iS,N} = q_{iS} \cdot \gamma_{Si,Neighbours} \dots (1b)$$

In a similar way, we can use the untraced volumes of trade with (a) all other partners, and (b) Switzerland's neighbours, to create two benchmarks against which to calculate the excess untraced volume of trade with Switzerland. With the same assumption that trade with these other countries is completely undistorted (implying in this case that the benchmark reflects data problems alone), the excess untraced volume, which we believe to be due to the particular reporting issues with Swiss transit trade.

Again, we assess the same phenomenon for all other countries and for Switzerland's neighbours separately, in order to confirm that the findings are not an artefact of the limitations of the data. The excess untraced volume of goods declared as exports to Switzerland can then be expressed as:

$$\mu_{Si,World} = u_{Si} - \left(\frac{\sum_{j=1}^n u_{ji} \cdot q_{ij}}{\sum_{j=1}^n q_{ij}} \right) \dots (2a)$$

$$\mu_{Si,Neighbours} = u_{Si} - \left(\frac{\sum_{j=A,F,G,I} u_{ji} \cdot q_{ij}}{\sum_{j=A,F,G,I} q_{ij}} \right) \dots (2b)$$

Given anomalous prices declared by Switzerland, to construct an alternative approach to estimating commodity exporters' capital loss in their trade with Switzerland we could deem the appropriate price simply to be the average received for exports to all other countries (or only to Switzerland's major neighbours).

$$k_{is} = q_{is} \left(\frac{\sum_{j=1}^n p \cdot q_{ij}}{\sum_{j=1}^n q_{ij}} - p_{is} \right) \quad \dots(1c)$$

$$k_{is} = q_{is} \left(\frac{\sum_{j=A,F,G,I} p \cdot q_{ij}}{\sum_{j=A,F,G,I} q_{ij}} - p_{is} \right) \quad \dots(1d)$$

where $i \neq j \neq S$. The term in brackets is the difference in export prices, positive where the price received for exports to Switzerland is lower.

For model I, we exclude cases where Swiss-declared export prices are more than one thousand times greater than prices declared by commodity exporters and replace the estimate of capital shift by that shown in equations (1c) and (1d), and so consider only the export price differential received on transactions with Switzerland or without. Treating all other Swiss (re-)export prices as valid, we use equations (1a) and (1b) to calculate the capital shift in these cases, and together these give us our upper estimates, which we refer to as Model I.

We repeat the exercise to eliminate those cases where the Swiss export price is more than one hundred times higher than that of the original exporter (Model II); and where it is more than ten times higher (Model III). Finally, we produce an absolute low-end estimate in which we ignore all Swiss (re-)export prices, so the counterfactual is that exporter country would have received the average price declared on its exports to other trading partners, rather than the price declared for exports to Switzerland (Model IV). The capital shift equation for each model is shown below, where $K_{S,W}$ and $K_{S,N}$ are the total capital shifts in commodity exports to Switzerland, using world and Swiss neighbour benchmarks respectively, expressed as the sum of shifts from countries i and comparing Swiss trade with countries j , where again $i \neq j \neq S$.

To enable the exclusion of Swiss (re-)export price outliers at different levels, we define three dummy variables so z_{000} takes the value 1 if the Swiss (re-)export price of a given commodity is less than a thousand times higher than country i 's export price, and zero otherwise; similarly z_{00} takes the value 1 if the Swiss (re-)export price of a given commodity is less than a hundred times higher than country i 's export price, and zero otherwise; and z_0 takes the value 1 if the Swiss (re-)export price of a given commodity is less than ten times higher than country i 's export price, and zero otherwise.

Model I

$$K_{S,W} = \sum_{i=1}^n \left(z_{000} \cdot q_{is} \cdot \gamma_{Si,World} + (1 - z_{000}) q_{is} \left(\frac{\sum_{j=1}^n p \cdot q_{ij}}{\sum_{j=1}^n q_{ij}} - p_{is} \right) \right) \quad \dots(1a-I)$$

$$K_{S,N} = \sum_{i=1}^n \left(z_{000} \cdot q_{is} \cdot \gamma_{Si,Neighbours} + (1 - z_{000}) q_{is} \left(\frac{\sum_{j=A,F,G,I} p \cdot q_{ij}}{\sum_{j=A,F,G,I} q_{ij}} - p_{is} \right) \right) \dots(1b-I)$$

Model II

$$K_{S,W} = \sum_{i=1}^n \left(z_{00} \cdot q_{is} \cdot \gamma_{Si,World} + (1 - z_{00}) q_{is} \left(\frac{\sum_{j=1}^n p \cdot q_{ij}}{\sum_{j=1}^n q_{ij}} - p_{is} \right) \right) \quad \dots(1a-II)$$

$$K_{S,N} = \sum_{i=1}^n \left(z_{00} \cdot q_{is} \cdot \gamma_{Si,Neighbours} + (1 - z_{00}) q_{is} \left(\frac{\sum_{j=A,F,G,I} p \cdot q_{ij}}{\sum_{j=A,F,G,I} q_{ij}} - p_{is} \right) \right) \quad \dots(1b-II)$$

Model III

$$K_{S,W} = \sum_{i=1}^n \left(z_0 \cdot q_{is} \cdot \gamma_{Si,World} + (1 - z_0) q_{is} \left(\frac{\sum_{j=1}^n p \cdot q_{ij}}{\sum_{j=1}^n q_{ij}} - p_{is} \right) \right) \quad \dots(1a-III)$$

$$K_{S,N} = \sum_{i=1}^n \left(z_0 \cdot q_{is} \cdot \gamma_{Si,Neighbours} + (1 - z_0) q_{is} \left(\frac{\sum_{j=A,F,G,I} p \cdot q_{ij}}{\sum_{j=A,F,G,I} q_{ij}} - p_{is} \right) \right) \quad \dots(1b-III)$$

Model IV

$$K_{S,W} = \sum_{i=1}^n q_{is} \left(\frac{\sum_{j=1}^n p \cdot q_{ij}}{\sum_{j=1}^n q_{ij}} - p_{is} \right) \quad \dots(1a-IV)$$

$$K_{S,N} = \sum_{i=1}^n q_{is} \left(\frac{\sum_{j=A,F,G,I} p \cdot q_{ij}}{\sum_{j=A,F,G,I} q_{ij}} - p_{is} \right) \quad \dots(1b-IV)$$