Mirror analysis as a support for risk management and valuation: a practical study

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Abstract

Among the methods of data analysis applicable to and used by customs administrations are mirror analyses, which aim to reconcile a country's import declaration data with exports reported by its partner countries.

This paper illustrates how mirror analyses can be used as a support for risk management, on the frontline as well as in post-clearance audits, and as a support for valuation, highlighting the tariff headings that most frequently experience a reduction in value or those defined as 'safe havens' because of a lower customs tariff.

After providing a methodological reminder, in particular about the importance of the level of disaggregation required for such an analysis as well as the data used and the importance of not being limited to only 'matched' declarations, an application is proposed on the basis of a year of anonymous customs declarations with specific targeting carried out over several chapters of the Harmonized System (HS).

1. Introduction

Mirror analyses, which seek to reconcile a country's import declaration data with exports reported by its partner countries, feature prominently among the data analysis methods used to support customs administrations. This paper demonstrates how mirror analyses can support customs administrations, highlighting the headings that most frequently experience a reduction in value or those defined as 'safe havens' because of their lower Customs tariff.

Section 2 discusses the measurement of discrepancies as a proxy for potential fraud. Section 3 discusses the statistical treatment of data selected for mirror analysis, specifying in particular the importance of orphan import flows and/or mirror exports that should be considered in such analyses. Section 4 emphasises the fundamental importance of levels of disaggregation by focusing on the different possible interpretations of discrepancies observed. Section 5 details the fields of application and highlights how mirror analysis can be useful for frontline and post-clearance controls and provide support for valuation. Section 6 details the results of the study, based on a year of anonymous customs declarations, anonymised for confidentiality reasons, with specific targeting on several chapters of the HS.

2. Mirror analysis: discrepancies as a source of fraud?

2.1 Definition

Mirror analyses are based on comparisons of the same trade flows on the importer's and exporter's sides. Traditionally, cost insurance freight (CIF) and free on board (FOB) ratios are referenced in literature on international trade focused on mirror data. This is because data from COMTRADE, a major source for mirror data[1], is CIF for imports and FOB for exports respectively (see Box 1 below for a discussion of the limits of COMTRADE data). Note that It should possible to directly refer to FOB import values for studies based on customs import declarations data as FOB values are normally recorded in the computerised customs clearance system. In an ideal world, exports reported by partner countries would correspond exactly to import declarations and the presumed ratio between (FOB) imports declared by importers and (FOB) mirror flows reported by exporters would henceforth be 1. This study focuses on data pertaining to import declarations, but we still had to consider CIF imports as FOB data were not available for the period of research. In an ideal world, the ratio between imports and exports would then be here about 1.06, to take into account the typical spread between CIF and FOB values (see Hummels & Lugovsky, 2006).

2.2 Interpretation of discrepancies as a source of fraud

A major challenge of mirror analysis lies in the precise identification of the origin of the observed deviations. These differences can indeed prove legitimate and be attributed to various logistical causes. Problems with customs procedures can also be at the root of such discrepancies. It is therefore essential to understand the reasons underlying the differences observed. Analysis of investigation services should make it possible to distinguish gaps that can be explained by potential irregularities from gaps attributable to logistical issues (see Cantens, 2015, for a guide on the use of mirror data).

The 'M–X' gap may not, in fact, be related to fraud. Import data are typically recorded with greater care than export data as tariffs are usually calculated on imports and not on exports. Transit or re-export situations may also create discrepancies, particularly if in the case of a re-exported commodity, the importers declare the country of origin while the exporter declares the last *known* destination of the goods, in accordance with the recommendations of the United Nations. Similarly, the minimum thresholds at which economic operators are forced to report their trade flows may differ from one country to another, also leading to sources of deviations that are not associated with deliberate fraud.

The 'M–X' gap may reveal deliberate fraud. The undervaluation of goods to reduce the amount of duties and taxes to be paid is a reason conventionally offered to explain a negative difference ($M < X$). Several econometric studies have empirically demonstrated a positive correlation between mirror deviations and the magnitude of the customs tariff (e.g. Fisman & Wei, 2004; Carrère & Grigoriou, 2015). There are also tariff shifts leading to the declaration of goods with a high rate of taxation under a different tariff heading in order to unduly benefit from a lower tariff. This results in a negative deviation for goods with high tax rates. Finally, there is also the case of smuggling and non-declarations whereby tariff descriptions are not declared on the import side, although they have been recorded on the export side. The overvaluation of imports may, on the contrary, be observed in the context of transfer pricing mechanisms or when an economic operator seeks to drive capital out of the country. The mechanism underlying the aforementioned tariff shifts could also lead to positive deviations for headings that will serve as 'safe havens' on account of their low tax rates.

Box 1: Use and limitations of COMTRADE data

Mirror data, or exports reported by partner countries, are sourced primarily from COMTRADE. This database is managed by UNCTAD, a United Nations body that centralises, harmonises and makes international customs trade flows publically available, provided that the customs administrations submit their data. This database can be accessed via the United Nations Statistics Office. The exports data refer to FOB values expressed in US dollars and weights. The data refer to subsections, i.e. HS6 product groupings, the maximum level of disaggregation for which there is a harmonised code at the global level.

Limits of COMTRADE data

The use of COMTRADE data has two limits: 1) the data compilation time and 2) the fact that certain data are not shared.

The collection and harmonisation of global customs data takes time. It takes at least one year to compile complete data from the year before, an absolute prerequisite for interpreting the gaps observed as potential sources of irregularities. This is not a problem if the goal is to provide information for post-clearance audit services that typically have up to three years after the declaration is filed to intervene. However, although the process of compiling one year's worth of data is long, it is possible to procure partial data more rapidly. UNCTAD's statistical department process and publish the data online if they receive them from the different customs administrations. They can then be used for comparative purposes, for example comparing the value and weight of certain headings. Some countries do not transmit their data to UNCTAD and, as a result, they do not appear in the mirror flows. This is the case, for example, with Afghanistan, Cuba and Gabon. Import declarations from the customs declaration databases of these countries are therefore not considered, as otherwise an artificial gap would be created. This would indeed involve reconciling headings with import declarations that contain no 'match' in the mirror data; simply because of an absence of information and not for any issue of tariff shifting, or under-declaration of value or origin etc. as it could be erroneously suspected. The volume of imports corresponding to exporting countries not transmitting their data to UNCTAD represents about 10 per cent of (non-petroleum) consumption for 2016. These data are removed from the imports that are examined within the mirror analysis framework.

3. Reconciliation of the data: going beyond 'matched' flows

Comparisons of import data with corresponding mirror flows reported by exporting countries reveals three potential situations, outlined below.

- Flows are said to be 'matched' when the correct tariff description is reported by both the importing and the exporting countries, the same flow being appropriately reported by the two partners.
- 'Orphan imports' occur when the trade flow is listed on the importing customs declaration, but is missing on the side of the partner country, thereby indicating either a tariff shift or origin fraud.
- 'Lost exports' refers to trade flows reported as exports by partner countries without any corresponding declaration being recorded in the import declarations data of the customs administration concerned, indicating potential smuggling or imports without declarations.

The analysis should not be limited to 'matched' trade flows as the subsequent mirror analysis would be biased, severely minimising the magnitude of the misdeclarations. Mirror analyses are however often limited to 'matched' trade flows as they are focused on the M_{ij}/X_{ji} ratios, which cannot be computed where mirror data are missing. This provides a partial view of reality as 'orphan import' or 'lost exports', which are serious indicators of tariff shifts, are then excluded from the analysis. The elimination of 'orphan import' and 'lost exports' for the analysis represents indeed a loss of a substantial amount of

information given the multiplication of such flows as the level of disaggregation increases (see Carrère & Grigoriou (2015) for an overview of the concepts of orphan imports and mirror exports, as well as a specific model for orphan imports).

4. The importance of disaggregated data (HS6)

The greatest level of disaggregation possible should be used for the purposes of analysis. If the analyses can be initiated at the chapter level, that is a big contributor to revenue, or represents a large volume of declarations or seems to contain irregularities (significant differences in $M_{ij} – X_{ji}$), it is essential to go down to the finest level of disaggregation (HS6), as similar gaps at the chapter level can conceal very different situations.

The deviation calculated at the chapter level (M–X) can conceal different situations at the section (HS4) and subsection (HS6) level (see Table 1 below). A neutral deviation ($M_{ij} = X_{ji}$) at the chapter level can reveal diametrically opposed cases. This neutral gap may correspond to a 'healthy' chapter, the volume of exports reported by the partner countries corresponding exactly to the imports declared by the importers. But this neutral gap can also conceal cases of under/over declarations of value or quantity (weight) or significant tariff slips in opposite directions from one section or subsection to the other which are balanced out when the sections/subsections are aggregated.

A neutral deviation at the chapter level may thus correspond to a situation whereby revenues are strongly impacted by fraud if the deviation conceals tariff heading shifts of the sections with the highest tax rates toward the lower tax rates. Chapters with deviations (M–X) that are positive (M > X) or negative (M < X) can also hide opposing situations, with sections or subsections with higher tax rates more likely to be affected by problems of under-declarations of value or tariff shifts. Not all chapter headings will be the subject of a possible investigation.

A large discrepancy should not systematically be equated with under/over declarations of value but can result from a tariff shift from one chapter to another or from a fraud on the origin. A negative deviation (M < X) of a chapter may for instance result from the aggregation of a 'healthy' section or subsection with another section which contains lost exports. Conversely, the positive deviation (M > X) of a chapter or section can result from the compilation of data of a 'health' section or sub-section with another section which contains orphan imports.

Table 1: Potential interpretations of gaps $M_{ij} – X_{ji}$ at the chapter level

Observed situation for a particular chapter	Potential explanation	Illustration in the case of a chapter with two sections
No significant gap ($M_{ij} = X_{ji}$)	'Healthy' chapter, no irregularity, declared imports actually correspond to what is reported by the trading partners	Exports to country A from country B exactly match imports declared by country A from country B for all the goods of the two sections of the considered chapter
	Agregation at the chapter (or section) level conceals gaps that would have been observed at a more disagregated level	Tarif shifting or fraud on the origin of opposite sign for the two sections of the chapter $M_{ij} < X_{ji}$ for goods with a high taxation rate (or at the limit: lost exports), e.g. the first section of the chapter $M_{ij} > X_{ji}$ for goods with low taxation rate (or at the limit: orphan imports), e.g. the 2nd section of the chapter. This mechanism can obviously also occure when aggregating from subsection to section.
$M_{ij} – X_{ji} <0$	Underdeclaration of at least a part of the chapter. It can result from underdeclaration of the values or quantities, or fraud on the origin or tarif shifting, (e.g for high tariff headings). The gap at the chapter level can also result from the aggregation of goods with lost exports with 'matched' goods.	1st case: the two sections have goods with substantial underdeclaration of values or quantities, leading to a global gap ($M_{ij} < X_{ji}$). 2nd case: the gap $M_{ij} – X_{ji} <0$ at the chapter level results from the agregation of the gaps of two sections with one of them having lost exports. As no import is reported by the trading partners for this section ($M = 0$), imports henceforth concern values for only one section while exports are reported for the two sections.
$M_{ij} – X_{ji} >0$	Overvaluation of at least a part of the chapter. Fraudulent situation related to transfer pricing or capital flights, notably for intra-group trade flows. This situation may correspond to tariff shifts 'at the benefit' of a lower-tarif chapter, or to a fraud on the origin to unduely take advantage of more favourable conditions in case of regional trade agreement. The gap at the chapter level can also result from the aggregation of goods with orphan imports with 'matched' goods.	1st case: the two sections have goods with substantial overvaluations or overdeclarations of quantities leading to a positive gap in each of the section of the chapter ($M_{ij} > X_{ji}$) and subsequently to a positive gap at the chapter level. 2nd case: the gap $M_{ij} – X_{ji} >0$ at the chapter level results from the agregation of the gaps of two sections with one of them having orphan imports: no exports is reported on the exporting side for this section ($X = 0$). Exports data henceforth concern the values of a single sections while imports data consider the values of two sections.

Note: interpretations can be processed similarly on the weights gap.

The positive deviation at the chapter or section level may result from the aggregation of a healthy section or subsection with one containing orphan imports. The same rationale governing the case of lost exports can induce a negative gap ($M_{ij} < X_{ji}$) when moving to a higher level of aggregation.

These mechanisms are true for any aggregation–disaggregation step, whether from chapter (HS2) to section (HS4) or from section to subsection (HS6).

5. Mirror analysis, from selective controls to a support for valuation

Mirror analyses as a support to customs administrations are in principle more suited to post-clearance audits because discrepancies cannot automatically be presumed to be offences. Results must therefore be examined by investigative services. Furthermore, the delays often inherent to the collection of mirror data imply a significant time lag between results obtained and future declarations, making the data more appropriate for a post-clearance audit than for frontline control services.

However, the immediacy of the operational implementation of these analyses can, in certain conditions, render mirror analysis quite effective for first line control also (see Raballand et al., 2013). These analyses do not have any particular IT requirements other than the automated clearance system, which is already present in almost all customs administrations, nor additional data requirements, such as feedback from physical controls. The use of mirror analyses can thus allow for the establishment of risk management for frontline control and ensure that declarations targeted for physical inspection are identified in an objective manner. It can also be used to provide more information on a target identified on the basis of scores formulated using the results of past controls.

Finally, mirror analysis provides significant support for valuation as it highlights headings experiencing the most value reduction and others acting as safe havens on account of the application of lower tariffs. This aspect of mirror analysis is all the more relevant in the context of the re-appropriation of customs-related powers by a number of customs administrations that had for many years outsourced these tasks to private companies under the Import Verification Program (IVP).

6. Mirror analysis as a support to customs administrations: application

This section illustrates the mirror analysis methodology from a study case relying on a year of customs declarations, anonymised for confidentiality reasons.

6.1 The global level

At the most aggregated level, that is, by comparing the sum of imports with the sum of exports (whether there is a match or not), we obtain the ratio of 0.74 from the ratio of values, and 1.01 from the ratio of weights, implying a missing sum of 25 to 30 per cent on the import side (see Table 2 below), if transport costs are taken as 6 per cent of the FOB value. This ratio denotes a major issue with regard to under-declaration of value, which is not found on the quantity side (ratio comes close to 1, as expected). This ratio, which is already considerably weak, conceals even wider gaps that would suggest the presence of value, tariff heading or origin fraud.

Table 2: Overall trade, exports and imports (2016)

Aggregated level	Value (rounded up to 100 for exports)	Weight (rounded up to 100 for exports)
Total imports (CIF)	74	101
Total exports (FOB)	100	100
Ratio	0.74	1.01

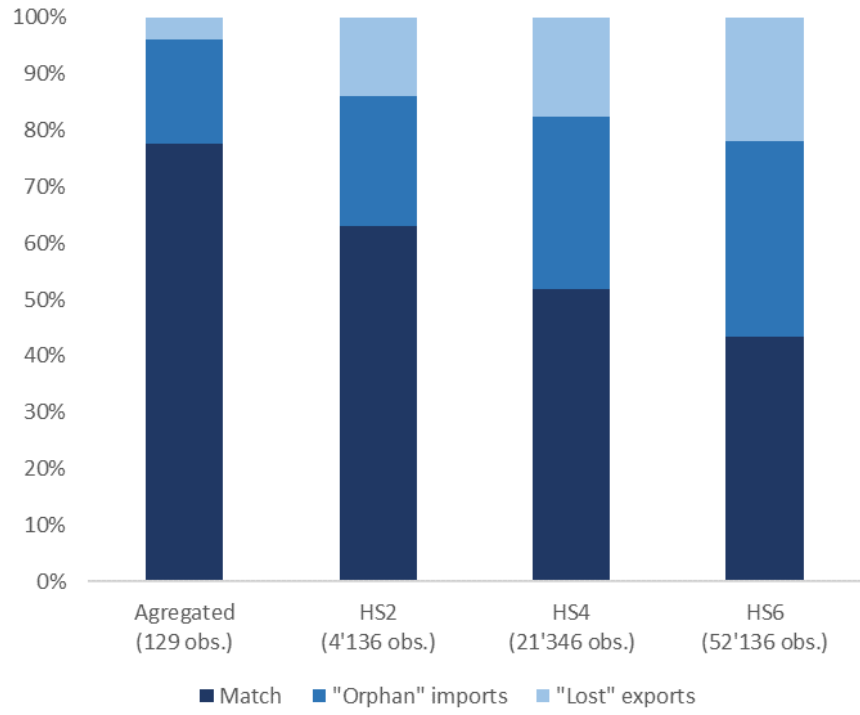
Source: Author's calculations on the basis of anonymised Customs and COMTRADE data.

Data normalised for an export total of 100 to maintain data anonymity.

The disaggregated analysis hints at significant gaps potentially linked to falsified value, tariff headings or origin in declarations.

Chart 2 below illustrates the splitting of trade flows between corresponding flows, orphan imports and lost exports according to the level of disaggregation (HS2, HS4, HS6). A flow corresponds to 'one line' (i.e. there are as many lines as there are partner countries at the aggregated level), and as many lines as partner countries, chapters at the HS2 level, etc.

Figure 1: Mirror analyses by partner country, different levels of aggregation, 2016



Source: author's calculations from anonymised Customs and COMTRADE data.

The bulk of trade flows are mirrored at the aggregated level. Eighty per cent of the lines represent matching flows (dark blue portion in Figure 1) while 15 per cent of the lines represent orphan imports and 5 per cent lost exports. But this global harmony at the aggregated level conceals large gaps, whether tariff shifts or origin fraud. Both partners report only 43 per cent of the lines when the most disaggregated level of mirror data (i.e. HS6), is considered. The remaining 57 per cent are either orphan imports (35) or lost exports (22%).

6.2 Selection of chapters to study and identification of specific tariff headings to investigate

The decision regarding which HS chapters should be examined can be made according to various criteria. First, it is important to observe the deviations associated with chapters as an indicator of potential irregularity. These can either be very positive (M > X) or very negative (M < X), with each case being associated with a separate potential fraud pattern. It should be noted that weight differences will be used primarily for bulk goods or where the value attributed to the goods is weight dependent. The magnitude of the gap, as a rule for analysing the chapter, can be combined with other elements contained within the chapter. For example, how significant a chapter is in terms of overall revenue or the overall volume of imports may warrant further investigation. The effective tax rate of the chapter can also be taken into account because of the fraud schemes that may be associated with it: a positive difference is expected when the effective rate is low and vice versa.

Once the chapter to be analysed is selected, the M–X deviations, the value of the orphan imports and the associated lost exports are observed. The next level of disaggregation, that is, the sections (HS4) are then identified. The aim is to identify those sections that are likely to make up the overall gap, focusing attention on both M–X differences by section and on orphan imports or lost exports. The analysis is then repeated at the next disaggregation level (subsection, HS6). This approach ensures that the gaps are disassembled within the chapter and accounts for possible shifts from one section or subsection to another that could be compensated for when moving to the higher level of aggregation.

6.3 Case study: application of the study to four identified chapters

The following tables illustrate this approach with an analysis of four chapters—85, 30, 29 and 25—relating to electrical appliances, pharmaceuticals, chemicals and mining products.

Case study 1: Electrical appliances (Chapter 85)

Chapter 85 deals with electrical appliances. It was selected because initial analysis revealed that it was one of the chapters with the strongest—'more negative'—M–X gap, with an effective tax rate of around 18 per cent, and accounted for a high percentage of imports, between 5 per cent and 10 per cent of the total import volume (excluding petroleum products). Table 3 hereunder reports the decomposed gap, withing the most striking sections and subsections of the chapter. Orphan imports and lost exports of the corresponding headings are also reported.

Table 3: Electrical appliances (Chapter 85)

Tariff heading			Gap M–X (in millions of USD)	Orphan imports (in millions of USD)	Lost exports (in millions of USD)	Effective tax rate
HS2	**HS4**	**HS6**				
85			**–1780.0**	**3.200**	**0.140**	**18.73%**
	8533		**–70.0**	**0.061**	**0.010**	**13.51%**
		853332	–65.0	0.010	1.500	14.37%
	8536		**–440.0**	**0.790**	**0.013**	**21.20%**
		853610	–44.8	0.072	0.970	19.05%
		853650	–40.2	0.360	0.002	23.85%
		853669	–79.4	0.061	0.033	23.51%
		853690	–245.0	0.203	0.010	19.38%
	8538		**–153.0**	**0.210**	**0.014**	**15.90%**
		853890	–152.0	0.206	0.014	16.48%
	8542		**–307.0**	**0.760**	**0.160**	**13.90%**
		854231	–59.5	0.660	**12.600**	13.11%
		854239	–42.6	0.070	0.001	16.31%
		854290	–181.0	0.002	0.035	7.32%
	8544		**–352.0**	**0.440**	**0.050**	**16.88%**
		854411	–18.2	0.016	0.014	17.86%
		854419	–12.0	0.017	0.300	16.64%
		854420	–10.0	0.010	3.300	0.25%
		854430	–134.0	0.170	0.060	0.22%
		854442	–78.3	0.113	0.001	24.30%
		854449	–75.6	0.500	1.030	11.10%
		854470	–15.5	0.019	0.170	16.23%
	8547		**–90.1**	**0.042**	**6.100**	**0.40%**
		854720	–87.0	0.0015	1.330	18.40%

Source: author's calculations from anonymised Customs and COMTRADE data.

The analysis shows that there are very few cases of orphan imports or lost exports for this chapter and it can therefore be induced that the differences result mainly from undervaluation. It also appears that the value differences between import declarations and their mirror data increase along with the effective tax rate.

Case study 2: Pharmaceutical products (Chapter 30)

Chapter 30 deals with drugs (pharmaceutical products). This is of course a very sensitive chapter as it revolves around public health issues, particularly as fraud involving medications has been steadily increasing in recent years. This case makes it possible to highlight how more aggregated levels can hide deviations in the opposite direction. Finally, this case also illustrates how aggregation can inflate the differences at the most aggregated level by integrating orphan imports with 'matched' flows.

Table 4: Pharmaceutical products (Chapter 30)

Tariff heading			Gap M–X (in thousand of tons)	Gap M-X (in millions of USD)	Orphan imports (in millions of USD)	Lost exports (in millions of USD)	Effective tax rates
HS2	**HS4**	**HS6**					
30			–1.000	–14.3	1.70	0.30	0.32%
	3002		0.000	–52.8	1.30	0.20	0.40%
		300210	–29.000	–55.7	1.00	0.10	0.00%
		300220	0.030	4.7	1.20	2.00	0.00%
		300230	0.002	–2.2	3.40	0.10	0.00%
	3003		1.800	110.0	26.20	0.10	0.00%
		300390	1.500	**108.0**	**31.70**	0.00	0.00%
	3004		–3.100	–93.4	1.10	2.10	0.01%
		300410	–	–	–	2.00	
		300420	–0.140	–8.4	0.60	5.20	0.01%
		300431	0.000	–2.3	8.80	1.20	0.00%
		300432	–0.050	–2.1	–	4.40	0.00%
		300439	–0.040	–7.9	0.30	6.60	0.01%
		300440	–0.003	–1.1	0.00	6.90	0.09%
		300450	–0.060	–2.9	0.50	0.50	0.01%
		300490	–2.400	–54.3	2.00	0.80	0.01%
	3006		–0.050	–3.8	0.36	0.13	5%

Source: author's calculations from anonymised Customs and COMTRADE data.

The analysis of the above data from Chapter 30 is indicative of the potential use of safe havens, as is often the case for fraud committed on this type of subheading (cosmetics etc.). If the M–X deviation at the chapter level (HS2) is moderate, either in value or in weight, significant differences in opposite directions occur at the section (HS4) or subsection level (HS6), for example section 3002 and 3004 versus section 3003 (wholesale versus packaged products). Such evidence reinforces the aforementioned argument for exploiting data at the most disaggregated level; it is clear that aggregated data can mask significant discrepancies. The exploitation of 'unrequited' data, whether for orphan imports or lost exports, is essential since it reinforces the idea of a tariff shift from one section to another. Consequently, there is a high level of orphan imports associated with Section 3003 (i.e. declarations of imported products from Section 3003 without a reported flow of corresponding exports by partner countries), accompanied by a significant amount of lost exports for Section 3004 (export flows reported by partner countries that are not found in the country's import declarations). Furthermore, the differences in weights, small in magnitude, are not consistent with the differences in values, which reinforces the idea of a shifting tariff.

Case study 3 – Chemical products (Chapter 29)

Chapter 29 deals with chemical products. This chapter is targeted among the chapters to be analysed due to its significant, and positive, M–X spread, whether with respect to over-declarations of values or the predominance of safe havens used to deliberately misclassify items on account of the lower-than-average effective tax rate of 11 per cent, which is significantly lower than the average rate for all imported items.

This chapter again illustrates the importance of focusing efforts on higher levels of disaggregation and across trade flows; not just on data matching according to the import and export mirror flows, but also on data that lack a corresponding mirror flow. The analysis shows that about half of the deviation observed at the aggregate level comes from orphan imports. The bulk of the orphan imports observed at the highest level of disaggregation (HS6) are associated with subsection 294110 with an effective tax rate of 6.30 per cent, a rate so low that it seems to validate the use of this heading as a safe haven.

Table 5: Case study 3: Chemical products (Chapter 29)

Tariff heading			Gap M–X (in millions of USD)	Orphan imports (in millions of USD)	Lost exports (in millions of USD)	Effective tax rate
HS2	**HS4**	**HS6**				
29			89.1	1.5	0.4	11.00%
	2905		**4.4**	**0.3**	**0.1**	**15.00%**
	2915		–	**12.7**	**–**	**17.60%**
		291531	–	2.5	–	18.50%
		291532	–	4.4	–	18.50%
		291533		1.3		18.50%
		291560		1.1		18.50%
		291590		1.3		18.50%
	2916		**1.9**	**0.4**	**0.0**	**18.50%**
	2917		**0.6**	**5.9**	**–**	**13.80%**
		291735		2.1		18.50%
		291739		2.5		6.40%
	2930		**8.0**	**0.0**	**0.0**	**12.50%**
		293040	0.2	5.0	0.1	8.24%
		293090	2.9	0.1	0.0	16.70%
	2933		**9.1**	**1.7**	**0.0**	**16.68%**
		293329	3.9	0.1	0.0	6.30%
		293339	2.2	0.0	0.1	6.90%
		293399	0.9	2.6	0.0	6.70%
	2941		**13.0**	**18.7**	**0.1**	**6.30%**
		294110	–	22.0	–	6.20%
		294150	–	3.4	–	6.30%
		291490	3.0	2.1	0.1	6.60%
	2942	294200	–0.9	–	1.7	6.00%

Source: author's calculations from anonymised Customs and COMTRADE data.

Case study 4: Mining products (Chapter 25)

Chapter 25 deals with mining products (salt, stones, and cement, which is a major import, particularly for many developing economies). This chapter is targeted as it is that with the highest level of under-reporting.

Table 6: Mining products (Chapter 25)

Tariff heading			Gap M–X (in thousand of tons)	Gap M-X (in millions of USD)	Orphan imports (in millions of USD)	Lost exports (in millions of USD)	Effective tax rate
HS2	**HS4**	**HS6**					
25			**–586.0**	**–31.0**	**1.1**	**9.1**	**20.60%**
	2503	**250300**	**–495.0**	**–28.0**	**3.1**	**6.7**	**18.50%**
	2511	**251110**	**–35.1**	**–2.9**	**0.3**	**–**	**13.20%**
	2515		**–2.5**	**–1.1**	**0.0**	**–**	**30.80%**
		251511	–68	–6.4	–	0.0	30.70%
		251512	6.03	5.1	0.3	–	30.80%
	2517		**–35.7**	**1.2**	**0.0**	**0.0**	**19.50%**
		251741	–39.9	0.8	0.0	0.0	19.80%
	2529		**–32.0**	**–4.0**	**0.2**	**3.2**	**18.50%**

Source: author's calculations from anonymised Customs and COMTRADE data.

The analysis in this chapter shows that the weight gap observed at the chapter level as a whole is largely based on a subsection (250300), the content of which should be further explored. There is also a probable tariff shift between subsections 251511 and 251512, however, this may not be due to deliberate tax evasion as the two positions have similar effective tax rates.

7. Conclusion

This chapter illustrates how mirror analyses can be used as a support for risk management, to some extent for frontline controls but even more for post-clearance audit, and as a support for valuation, highlighting the headings that most frequently experience a reduction in value or those used as 'safe havens' because of a lower customs tariff.

Mirror analyses are *a priori* more suitable for post-clearance audits, as their insights must be investigated by intelligence services before it triggers a control and as there is a time lag between the clearance of declarations and the collection of mirror data. However, the immediate operational implementation of mirror data analyses could prove to be effective for first-line controls for customs administration with no database on the previous controles of the frontline controls. Such analyses indeed do not have any particular IT requirements other than the automated clearance system, which is already present in almost all customs administrations, nor additional data requirements, such as feedback from physical controls. The use of mirror analyses can thus allow to initiate risk-based targeting for frontline control and ensure

that declarations targeted for physical inspection are identified in an objective manner. Finally, mirror analysis serves as a good support to valuation, or headings defined as safe havens because they attract lower customs tariffs.

This aspect of mirror analysis is particularly relevant in the context of the re-appropriation of customs-related powers by a number of customs administrations that had for many years outsourced these tasks to private companies under the Import Verification Program (IVP).

References

Cantens, T. (2015). Mirror analysis and revenue fraud. *WCO research paper No. 35*. Retrieved from http://www.wcoomd.org/en/topics/research/activities-and-programmes/~/media/9F730547EF794600ADB7B2012BB5EE63.ashx

Carrère, C., & Grigoriou, C. (2015). *Can mirror data help to capture informal international trade?* United Nations Conference on Trade and Development (UNCTAD) Blue Series Papers 65. Geneva: UNCTAD.

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

Hummels D., & Lugovskyy, V. (2006). Are matched partner trade statistics a usable measure of transportation costs? *Review of International Economics*, *14*(1), 69–86.

Raballand, G., Cantens, T., & Guillermo, A. (2013). Mirror trade statistics: a tool to help identify customs fraud. In T. Cantens, R. Ireland & G. Raballand (Eds), *Reform by numbers: measurement applied to customs and tax administrations in developing countries,* pp. 103–120. Washington DC: World Bank.

Notes

1 Bilateral data can, beyond COMTRADE, be sourced on a case-by-case basis from countries whose statistical services make their bilateral foreign trade data publicly available. This is the case, for example, of the United States or the European Union. These databases contain up-to-date informaton that may be more recent that those from COMTRADE but they are by definition less exhaustive than COMTRADE.

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