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Abstract

Customs administrations in developing countries increasingly use risk-based techniques relying on data mining and statistical scoring. By demonstrating the value of using data analysis techniques to orient frontline controls so as to facilitate legal trade and combat fraud more effectively, these projects have helped promote a cultural change in these organizations. However, these risk management techniques may prove to be ineffective in assessing fraud risks based only on frauds detected by customs inspectors. In a context of moral hazard and low-performing customs administration, one way to address this weakness is to expand the approach by relying on other sources of information such as discrepancies in bilateral trade statistics. Several studies use these statistical discrepancies (mirror data) to identify fraudulent declarations and estimate their effects. By comparing Gabon's import customs data with discrepancies in its bilateral trade data, this paper stresses the usefulness of simultaneously analyzing customs fraud records and mirror trade statistics data. Such an analysis helps quantifying undetected fraud and therefore constitutes a valuable tool to target ex post audits. Then, based on the combination of these databases, the paper defines indicators to monitor the performance of customs controls.

Keywords

Customs risk analysis, Performance of customs authorities, Customs fraud, Tax evasion, Administrative data, Mirror analysis.

JEL Codes

H26, H83, K42, D73, F13.

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1. Introduction

Over the past several years, the customs administrations of developing countries have become aware of the possibilities to modernize their services by using the data contained in their customs clearance information system. Consequently, long-term projects have been implemented in many African countries to improve the risk analysis and selectivity of controls[1], based on customs offence information. Results are encouraging, especially in terms of trade facilitation, and often exceed the initial objectives[2]. These projects have helped promote a cultural change in administrations concerned by demonstrating the benefit of using statistical and quantitative analysis techniques (Geourjon and Laporte 2005).

One of the main weaknesses of these initiatives is to base fraud risk detection solely on non-compliances detected by customs inspectors. This limits the scope of the exercise and its reliability. On the one hand, outcomes of fraud-based risk analysis depend on customs inspectors' work habits, honesty and skill, in a context of moral hazard. On the other hand, they also depend on the number of past frauds detected, which, in the context of African customs administrations, is often very low, thereby justifying the use of additional sources of information.

Several studies use statistical discrepancies in international trade data (mirror data) to identify fraudulent declarations (classification, quantity, origin or value) and estimate their consequences[3]. The mirror analysis of bilateral trade consists in comparing, for a given product, the exports declared by the exporter country with the imports reported by the importer country, recipient of the product, in order to detect discrepancies in quantity, weight or declared value. Bhagwati (1964) was the first to use this method to study customs fraud. In the context of Turkey, he revealed a substantial undervaluation of imports of oil products,

[1] The International Monetary Fund's Technical Assistance Centres in West and Central Africa (AFRITAC West and AFRITAC Centre) have supported several projects to implement automated risk analysis and management systems. Gabon is one of the beneficiary countries of this technical assistance. More generally, it should be noted that many developing countries now use risk management techniques (more or less summary) to assess the compliance of declarations. For the development of risk analysis and management systems in Latin America and the Caribbean, see Volpe Martincus (2016).

[2] Recent studies have shown that a reduction in inspections and waiting periods favours trade. For example, the reduction in inspections in Albania reduced the transit time at the border and consequently significantly increased imports (Fernandes et al., 2015). Martincus et al., 2015 underline that the waiting times in Uruguay have a negative impact on exports.

[3] Other studies use the mirror data to estimate the missing or not very reliable data (e.g., see Anderson and Van Wincoop, 2003; Anson, Cadot and Olarreaga, 2006). Since the exports were declared free on board (FOB) and the imports were declared cost, insurance and freight (CIF), the "export-import" discrepancies represent, in a context of no fraud, the costs of transport, insurance and freight. Thus the mirror data can be used to estimate the transports costs (e.g., see Yeats, 1978; Baier and Bergstrand, 2001; Limao and Venables, 2001; Hummels and Lugovskyy, 2006).

machines and cars. Raballand *et al* (2013) used the analysis of trade discrepancies to estimate the customs fraud in Cameroon. By combining a mirror analysis with a detailed analysis of declaration behaviors, Chalendard *et al* (2016) identified high-risk products and operators in Madagascar. They revealed substantial value and classification frauds (approximately 30% of the non-oil revenues collected). Many empirical papers studying the determining factors in customs fraud use the mirror discrepancies as a fraud indicator. Some of them have studied the link between customs fraud (undervaluation or tariff slippage) and imports tax rate. By analyzing mirror data on trade between China and Hong Kong, Fisman and Wei (2004) estimate that a 1% increase in taxes is associated with a 3% increase in fraud. This result could partially explain the valuation fraud (undervaluation) and classification fraud (tariff slippage) practices. Such a correlation is also seen in India (Mishra et al., 2008), in North America (Stoyanov 2012), in Central Europe (Javorcik and Narciso, 2008) and in Africa (Worku et al., 2016) especially in Mozambique (Van Dunem and Arndt, 2009, Sequeira, 2016), in Kenya, in Tanzania (Levin and Widell, 2014) or in Tunisia (Rijkers et al., 2015).

The contribution of this paper is threefold. First it confirms that a customs authority can improve the effectiveness of its controls and its overall performances by using external data like mirror data to enhance the analysis of its internal data on detected offences. The benefit for administrations considering other sources of information has been underlined in several studies. Chalendard (2017) in particular indicates that customs should use all available information - whether it is located inside or outside the organization - in order to fight more effectively against fraud. Likewise, according to Han and McGauran (2015), information exchanges with (i) foreign customs administrations and (ii) the national authorities concerned are necessary to fight more effectively against customs fraud. This paper then proposes several instruments that can be used to assess the effectiveness of the customs controls, in particular, a "synoptic view" (graphical) of its overall performance and several "innovative" indicators to measure it. Finally, it puts into perspective how the mirror data can be used as a customs fraud indicator in a context of customs administrations' weakness and, more generally, the weakness of public governance.

Since 2014, the Gabon customs authority has developed, with the support of the International Monetary Fund, a project to implement a system for declaration control targeting, using risk management techniques that exploit customs information system (Geourjon and Laporte, 2012 ; Laporte, 2011). Highly disaggregated and detailed databases for 2013, 2014 and 2015, including the history of imports for home use, were constituted and used to separate declarations with a fraud record from those deemed in compliance. In this

paper, this information on declarations is processed, analyzed and compared with the mirror statistics of Gabon international trade for 2013 and 2014 (since the statistics for 2015 from the United Nations COMTRADE statistics were incomplete at the time of the study).

The next section analyses the fraud detected by the Gabon customs. Section 3 presents the mirror data analysis method and results from its application on Gabon customs, as well as the innovative performance indicators for customs controls. Section 4 concludes on the complementarity of scoring methods and mirror data analysis to improve the overall performance of customs controls in developing countries.

2. Analysis of frauds detected by Gabon customs based on the use of fraud records

Even though descriptive, this section aims to provide researchers and practitioners new information on the effectiveness of customs controls in developing countries. These statistics are usually not public because of their sensitivity. The use of historical Gabon data on import declarations for the period 2013 to 2015 provides us in particular with information on the effectiveness of controls (i) as a whole and (ii) by type of inspection (intrusive physical inspection or documentary control).

2.1. Fraud records are rare and declined between 2013 and 2015

Table 1 presents the frequency of fraud records, namely: those deemed as non-compliant by the customs inspector, expressed (i) as average frequency (number of declarations with a fraud record divided by the total number of declarations) and (ii) as a number. This table provides novel information about the effectiveness of customs controls. It shows that reported frauds in Gabon, as in many other Sub-Saharan African countries, are rare (only 1.14% of declarations were subject to a contra-entry). These figures also confirm that only frontline control channels – documentary (yellow channel) and physical (red channel) inspections – are associated with detected frauds. The type of inspection (documentary or physical) does not seem to affect the probability of a fraud being reported, thus suggesting that trade can be facilitated (i.e., by reducing the intrusive physical inspections without necessarily limiting customs' ability to detect non-compliances). Indeed, the frequency of fraud records for declarations routed to the yellow channel (0.51%) is similar to the frequency of fraud records for declarations routed to the red channel (0.63%). However, given the fact that a major part of declarations are physically inspected (52.6% of declarations representing 76.4% of imported goods), the total number of fraud records for declarations routed to the

red channel is greater than the total number of fraud records for declarations routed to the yellow channel.

Table 1. Annual trends in fraud records

	Number of declarations				Number of declarations deemed as non-compliant				Declarations deemed as non-compliant, in% of total declarations			
Channels	***2013***	***2014***	***2015***	***2013-2015***	***2013***	***2014***	***2015***	***2013-2015***	***2013***	***2014***	***2015***	***2013-2015***
Green	2,576	2,402	2,105	**7,083**	0	0	0	**0**	0	0	0	**0**
Yellow	14,391	10,972	9,608	**34,971**	304	85	61	**450**	0.90	0.29	0.24	**1.29**
Red	16,885	15,998	13,768	**46,651**	266	184	106	**556**	0.78	0.63	0.42	**1.19**
Total	**33,852**	**29,372**	**25,481**	**88,705**	**570**	**269**	**167**	**1,006**	**1.68**	**0.91**	**0.65**	**1.13**

Note: the green channel corresponds to the facilitation channel; the yellow channel corresponds to the documentary control channel and the red channel corresponds to the frontline physical inspection channel.

The number and frequency of fraud records on declarations in yellow and red channels declined over the period 2013-2015, but more drastically on transactions in the yellow channel between 2013 and 2014. This observation results from customs' aim to focus its efforts on declarations slated for the red channel.

2.2. Fraud records yield low tax adjustments (2013- 2015)

The scope of fraud records was limited (see tables 2, 3 and 4). Adjustments made by customs increased (i) the imported value by 0.1% (slightly more than 2 billion CFA francs), (ii) the adjusted amounts by 0.19% (slightly more than 900 million CFA francs) and the customs revenues by 0.17% (slightly more than 800 million CFA francs). For each declaration deemed non-compliant, Gabon customs increased on average and per declaration (i) the declared value by 37.3% and (ii) the adjusted amounts by 47% (see table 4).

Table 2. Adjustments and taxable value (in billions of CFA)

	Taxable value (in billions of CFA)		Variation, in billions of CFA	Variation, in %
	After adjustments	**Before adjustments**		
2013	847	846	1.29	0.15
2014	785	784	0.72	0.09
2015	755	755	0.21	0.03
Total	2,387	2,385	2.23	0.09

Table 3. Adjustments and revenues (in millions of CFA)

	Adjusted amounts	Total taxes paid (CD+VAT+ED)	Adjusted amounts	Total taxes paid
	Variation, in millions of CFA		Variation, in %	
2013	460	**445**	0.26	**0.26**
2014	275	**167**	0.18	**0.11**
2015	162	**164**	0.12	**0.12**
Total	897	**775**	0.19	**0.17**

Table 4. Adjustments per declaration deemed non-compliant (in thousands of CFA)

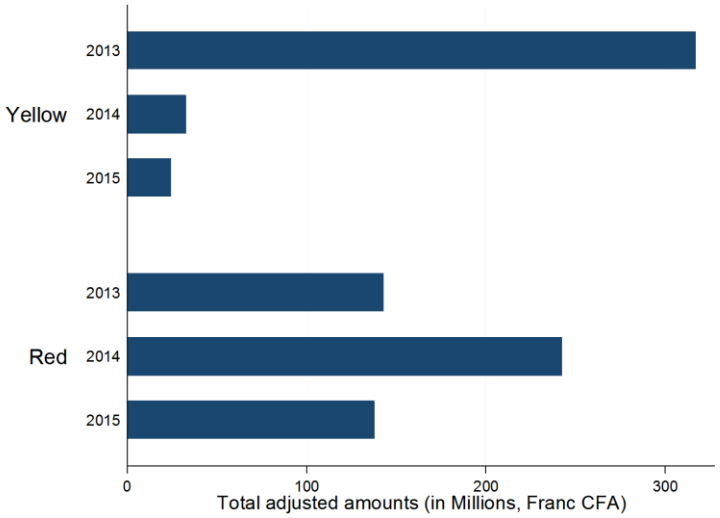
	Average variation in the adjusted amount		Average variation in the taxable value	
	in thousands of CFA	in %	in thousands of CFA	in %
2013	807	64.89	2,260	52.83
2014	1,023	41.57	2,690	31.82
2015	971	35.55	1,275	27.26
2013-2015	934	47.34	2,075	37.30

Graph 1a underlines that the sharp decline in adjustments between 2013 and 2014 is primarily attributable to a decrease in adjustments on declarations routed to the yellow channel. Even though erratic, changes in the customs value after a physical inspection (declarations selected for the red channel) show some stability between 2013 and 2015.

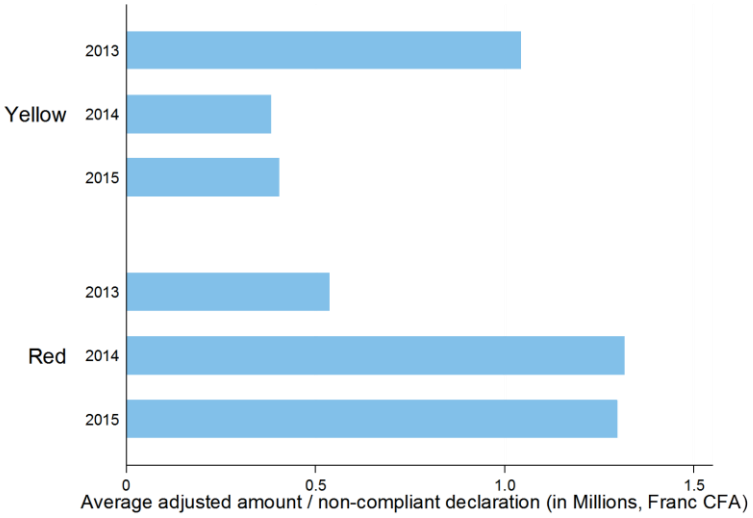
Graph 1b reveals, for the declarations slated for the red channel, a significant increase in the average amount adjusted per declaration between 2013 and 2015. This improvement was nevertheless insufficient to offset the substantial drop in the total number of adjustments.

Graph 1. Annual trend in adjustments, in CFA francs (yellow and red channels)

a) Total adjusted amounts (yellow and red channels)



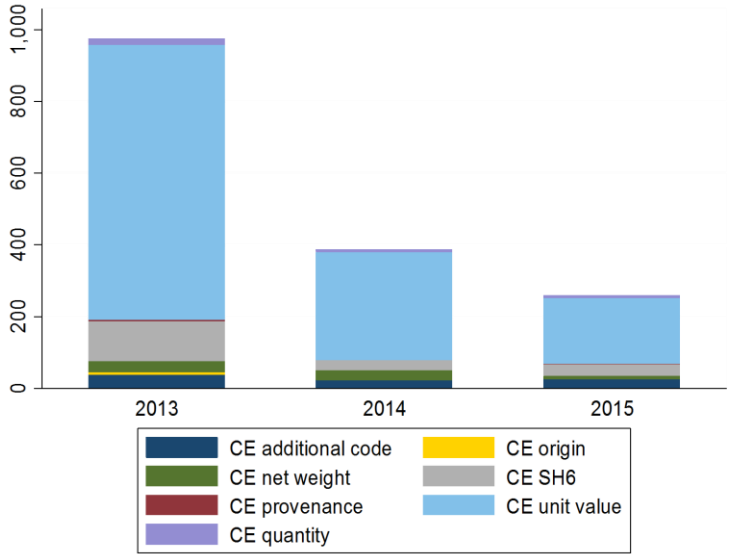
b) Average adjusted amount (yellow and red channels)



2.3. Fraud records are mostly value-oriented

Not surprisingly, fraud records mostly concern changes in unit value (see graph 2). Then, they concern classification (SH6), weight and quantities. Other changes (e.g., origin or additional code) are infrequent.

Graph 2. Annual change in the number of items contra-entered, according to type of offence



2.4. In summary

The analysis of frauds detected by customs during these three years suggests the frontline controls are not very effective, since just 1.13% of the declarations controlled (i.e., routed to the red or yellow channels) were deemed non-compliant. This lack of frontline control performance is accompanied by poor results in terms of facilitation since more than 90% of the declarations were inspected (documentary or physical control).

The project initiated by Gabon customs to develop risk analysis in order to reduce the number of controls and to make them more effective is therefore quite relevant. However, exploiting only fraud records cannot provide the whole picture of frauds at the border, given the low number of detected offences. Consequently, it is necessary to use other sources of information on imports, especially detailed information from export partners included in international trade databases.

Their processing (i) requires following a specific methodology and (ii) opens the possibility of going beyond the mere identification of potential frauds, by making it possible to develop "innovative" performance indicators for customs controls.

3. The benefit for customs of breaking down the data analysis

3.1. The analysis of discrepancies in international trade statistics

3.1.1. The mirror analysis: a tool traditionally used to detect and measure customs fraud

The discrepancy in international trade statistics is the difference, for the same flow of goods, between the declared export value and the declared import value. The difference in value (or respectively weight) is commonly called the *Trade gap* (or respectively the *Weight gap*), and is formalized in equation 1 (or respectively equation 2)[4]. In a perfect context and ignoring transport costs, the declared export value equals the declared import value. Any difference is then attributed to incorrect declaration behavior on the part of the exporter and/or the importer. Since the exporter usually has few incentives to incorrectly declare his goods for export (due to the lack of export taxes), it is then reasonable in many cases to assume that the discrepancy is due to a non-conform declaration on the part of the importer[5]. The corresponding revenue loss is then simply the product of the *Trade gap* times the effective tax rate on imports.

$$Trade\ gap = Declared\ export\ value - Declared\ import\ value \quad (1)$$

$$Weight\ gap = Declared\ export\ weight - Declared\ import\ wieght \quad (2)$$

Traditionally, a fraction of the discrepancies in international trade statistics is attributed to the transit of goods (passage through an intermediary country), to differences in classification between exporter and importer countries, or to flaws in the registration and control of export declarations by the exporting country[6]. Therefore, the *Trade gap* cannot be fully attributed to fraud. To correct this bias in the analysis, Chalendard et al (2016) introduce a 15% margin of error[7] and recommend considering relatively aggregated units of analysis (e.g., (i) section-year, (ii) HS2-year or (iii) HS4-year).

[4] For more details about the basic methodology, see Cantens 2015.

[5]However, one should remember that the exporter can, for diverse reasons (capital flight, imperfections in the VAT reimbursement mechanism, etc.) incorrectly declare the value of its exports. For example, Ferrantino, M. J., X. Liu, and Z. Wang (2012) have revealed that exporters in China have undervalued their exports to avoid paying VAT. In practice, since exports were expressed FOB (free on board) and imports CIF (cost, insurance and freight), the discrepancy between the exported value and the imported value was consequently slightly negative.

[6] Several structural and logistical factors have been advanced in the literature to (partially) explain the discrepancies observed in the mirror data: classification differences between exporting and importing countries (Nitsch, 2012; Gaulier and Zignago, 2010), classification errors (Bhagwati, 1964; Jean and Mitaritonna, 2010), imperfect conversion between currencies (Carrère and Grigoriou 2015), goods' transit time (Bhagwati, 1964, Yeats, 1995), transshipments and re-exports (Hummels and Lugovskyy, 2006; Ferrantino and Wang, 2008), or even the weakness of exporting countries' export declaration control system (Stoyanov, 2012).

[7] Introducing a 15% margin of error means that an imported value between 0.85 ad 1.15 times the exported value will be considered as similar to the exported value.

3.1.2. The mirror analysis: a tool that can be used to identify declarations that should be selected for ex post audits

Since the *Trade gap* is based on the final imported value (i.e., after adjustments made by customs), this indicator represents the "untreated" fraud. The “untreated” fraud comprises the fraud not yet detected by the customs administrations and the fraud detected but voluntarily unreported by the inspectors (due to potential collusion). For these two cases of fraud, the customs investigations service can still intervene since the legislation authorizes the customs administration to carry out ex post audits several years after the customs clearance.

In this context, results of the mirror data analysis can provide useful information to orient *ex post* audits. Due to delays in to getting up-to-date COMTRADE data, mirror data analysis cannot be performed to define a real-time selection system of declarations slated for immediate control channels It is however possible to establish an *ex post* audit program at time *t* concerning the declarations for time*t-2*, based on the results of the mirror data analysis for time *t-2*, carried out as soon as the data are available.

3.2. Contribution of the mirror analysis to customs administrations support: the case of Gabon

3.2.1. The data

Customs usually does not have access to trading partners’ data on their exports to Gabon. However, since a few years, export data is available at a highly disaggregated level (HS6 on the United Nations COMTRADE platform). Countries are indeed required to transmit on an annual basis their international trade statistics to the United Nations Statistics Division[8]. Since export values are expressed in US dollars, the import values expressed in CFA francs in the customs database were therefore converted into US dollars to assess discrepancies in trade statistics.

The analysis covers 2013 and 2014 and concerns the main products cleared by the main Gabon customs office (i.e., port of Owendo-Libreville[9]) — representing 53% of the releases for consumption —, since information on fraud-records was only available for this office.

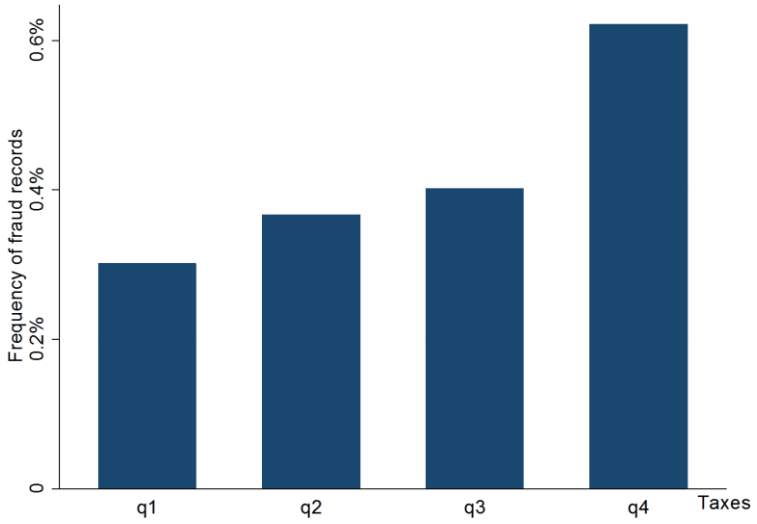
[8] A small number of countries, primarily oil or developing countries, do not transmit data to the platform.

[9]Lacking available data for adjustments made by the other offices, only the imports handled by the Owendo-Libreville office were considered in the analysis. Owendo-Libreville is Gabon's main customs office (more than half of releases for consumption are cleared through it). In order to reduce the impact of not taking the other offices into account, it was decided to only consider the products for which the port of Owendo-Libreville cleared more than two thirds of imports through customs (in value).

3.2.2. The mirror analysis confirms that the most taxed products should be better monitored

Products in the highest taxation quartiles (excl. VAT[10]) are associated with more fraud records (see graph 3). This positive relationship between taxation quartiles and fraud records is moreover linear. Regarding the (average) adjusted amounts, graph 4 indicates that they are considerably higher for heavily taxed products. These results are consistent with the conclusions of the econometric analysis conducted by Stasavage and Daubrée (1988) on the determinants of (detected) customs fraud in Senegal and Mali[11]. Overall, statistics suggest that the most taxed products are the most prone to fraud, in spite of quasi-systematic inspections (see graph 5). Since inspection frequencies were not lower for the lowest taxation quartile, the risk analysis and management system doesn't appear to currently take into consideration this heterogeneity in (detected) frauds. The fact that the "remaining fraud to be processed" (i.e., the *Trade gap*) is positively correlated with the taxation rate (see graph 5) suggests that customs should, to maximize adjustments, *a minima* target *ex post* audits on most-taxed products (especially those in the highest quartile).

Graph 3. Frequency of fraud records according to the import taxation quartile (excl. VAT)

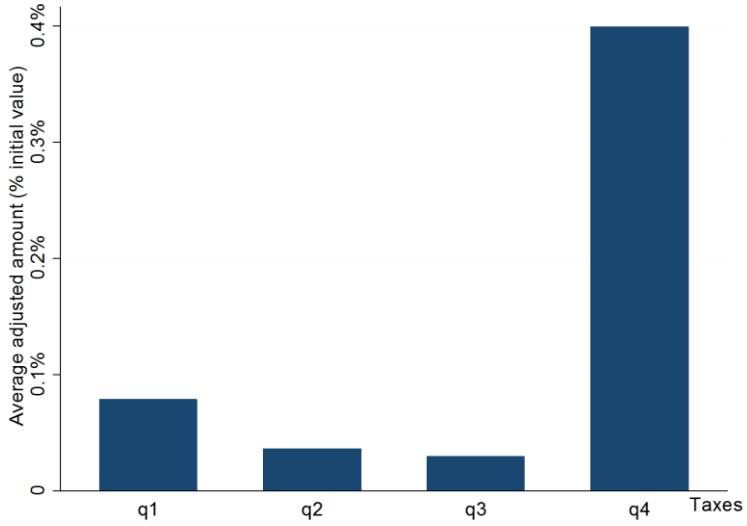


Notes: analysis unit: HS4-yearStudy period: 2013.-2014.

[10] The VAT collected in customs is not considered as a definitive revenue, since it is substantially debited or reimbursed.

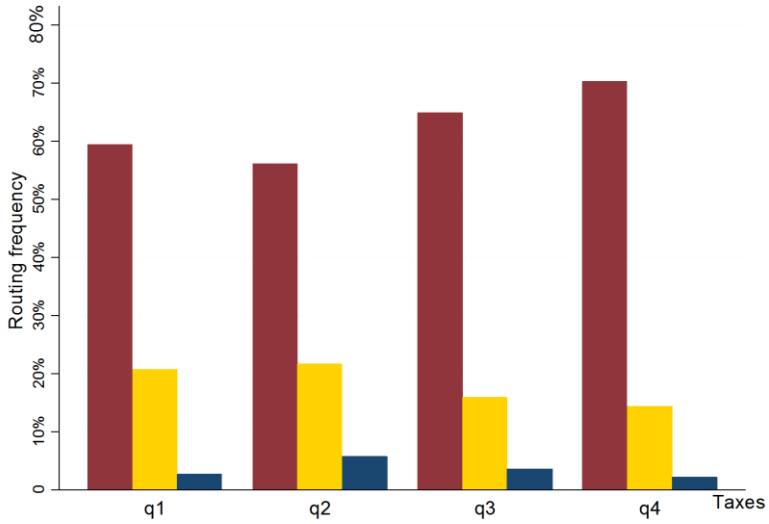
[11] The estimates of Stasavage and Daubrée (1988) reveal that high levels of taxation encourage fraud.

Graph 4. Average adjusted amount based on the import taxation quartile (excl. VAT)



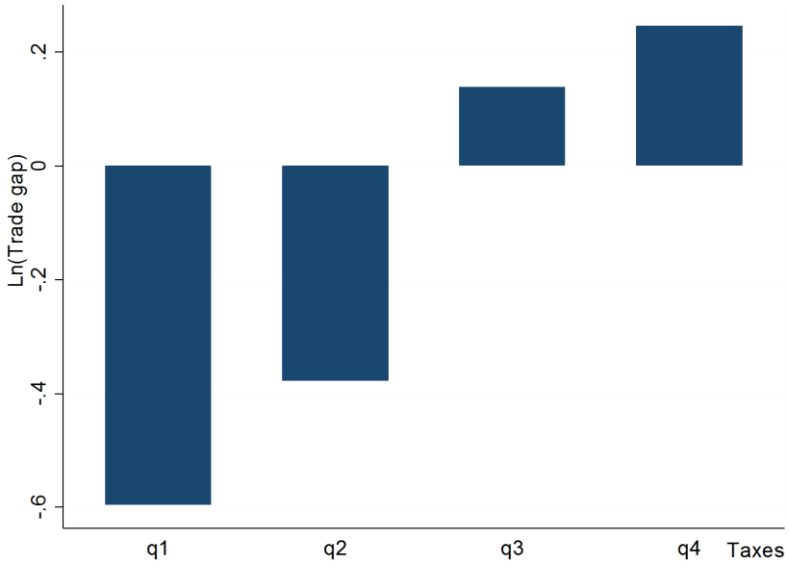
Notes: analysis unit: HS4-yearStudy period: 2013.-2014.

Graph 5. Rate of control based on the import taxation quartile (excl. VAT)



Notes: Analysis unit: HS4-year Study period: 2013.-2014. The frequency of physical control (red channel) is represented in red. The frequency of documentary control (yellow channel) is represented in yellow. The frequency of non-inspection is represented in blue.

Graph 6.*Trade gap* trend based on the import taxation quartile (excl. VAT)



Notes: analysis unit: HS4-year Study period: 2013.-2014. The variable Ln (*Trade gap*) is the logarithm of the difference between the declared export value and the declared import value. Since imports are expressed CIF and exports are expressed FOB, the variable Ln (Tradegap) is therefore, if there is no fraud, negative.

3.2.3. The mirror analysis makes it possible to target relevant products: case studies

Once export data has been obtained, in addition to discrepancy indicators (the *Trade gap* and the *Weight gap*), ratio indicators (value ratio and weight ratio) can also be calculated to target the analysis on products that are relevant for the customs administration (see Chalendard *et al*, 2016).

For illustrative purposes, two case studies deemed especially interesting are presented: (i) imports of fats and oils (chapter HS2: 15) and (ii) imports of beverages (chapter HS2: 22). In these HS2 chapters, nearly all the cargo declared at export seems to have been declared at import, as the ratio between the imported and exported weights (WMdWX) is close to one (see table 5). However, values declared at import are noticeably lower than those declared at export. While they should be greater than one due to the difference of Incoterms[12], the ratio between imported and exported values (MdX) is, in both chapters, less than one. According to discrepancy indicators and the effective rate of taxation, losses related to undervaluation are substantial, amounting to 3.5 million US dollars for fats and oils (chapter HS2: 15) and 7.2 million US dollars for beverages (chapter HS2: 22).

[12] The imports are expressed CIF and the exports are expressed FOB.

Table 5. Estimated discrepancies and losses[13]

HS2 HS4	chapter or product's label	*Trade gap* (millions of US dollars)	MdX	WMd WX	Effective tax rate	Effective tax rate (excl. VAT)	Estimated loss (millions of US dollars)
15	Fats and oils	15.8	0.75	0.91	0.22	0.15	3.48
15.11	Palm oil and its fractions	16.4	0.66	0.83	0.26	0.18	4.26
22	Beverages, alcoholic liquids, etc.	12.8	0.89	1.05	0.56	0.37	7.17
22.04	Fresh grape wines	12.2	0.71	1.20	0.56	0.35	6.83

Palm oil (HS4: 15.11)

Losses related to fat and oil (chapter HS2: 15) imports seem to be primarily attributable to palm oil imports (HS4: 1511)[14] (see table 6). The HS4 code 15.11 "Palm oil and its fractions, whether or not refined, but not chemically modified" covers two HS8 codes, namely crude palm oil (HS8:15.11.10.00) and refined palm oil (HS8: 15.11.90.00). While crude palm oil (HS8: 15.11.10.11) is not taxed, refined palm oil (HS8: 15.11.90.00) is normally taxed at 44.5%[15]. Surprisingly, the average value per kilogram declared for refined oil is substantially lower than that declared for crude oil. Since the refined oil is (heavily) taxed, it is therefore likely that importers undervalue refined oil imports, in spite of the systematic physical and documentary controls. Since the CIF value declared per kilogram for crude oil is slightly greater than that in use in Rotterdam, imports of crude oil do not appear to be undervalued[16].

[13] WMdWX = $\frac{Weightinitiallydeclaredbytheimporter}{Weight(final)reportedby\ the\ exporting\ country's\ customs}$

MdX = $\frac{Valueinitiallydeclaredbytheimporter}{Value(final)reportedby\ the\ exporting\ country's\ customs}$

Estimated loss = *Effective rate of taxation * Trade gap*

[14] Since the imported value, in a case without fraud, is greater than the exported value, the product of the *Trade gap x rate of taxation* is therefore, in a case without fraud, negative. Consequently, the estimated loss for the HS4 product can be greater than the estimated loss in chapter HS2.

[15] Therefore importers have an incentive to undervalue the refined palm oil imports and to declare the refined palm oil as crude oil.

[16] The average price CIF for palm oil destined for Rotterdam was 0.86 USD/kg in 2013 and 0.82 USD/kg in 2014, source: World Bank Commodity Price data.

Table 6. Palm oil import statistics

Palm oil	Year	Declared imported value (millions USD)	Declared imported weight (thousands of metric tons)	Value per kg (USD/kg)	Effective tax rate
Crude	2013	5.47	5.52	0.99	0%
	2014	3.33	3.55	0.94	0%
Refined	2013	11.30	15.40	0.74	41%
	2014	5.76	10.10	0.57	41%

Note: statistics for palm oil imports cleared through customs by the Owendo-Libreville office. All imports were physically inspected (slated for the red channel).

Champagne (HS8: 22 .04.10.10).

Losses related to beverages (chapter HS2: 22) are primarily attributable to imports of fresh grape wine (HS4: 22.04) (see table 5). The *Trade gap* for the HS4 22.04 code represents 95% of the *Trade gap* for chapter 22. Given the variety of prices and the qualities of the wines, the study focuses on a well-known and well-identified wine, namely champagne (HS8: 22.04.10.10). Champagne imports are heavily taxed in Gabon (cumulative rate of 93%), thereby giving a strong incentive to minimize the value. Even though champagne imports are quasi-systematically controlled (by frontline inspections in more than 95% of the cases), table 7 highlights especially low values recorded by customs (approximately 4.5 US dollars per kilogram)[17].

Table 7. Champagne import statistics

Year	Declared imported value (millions USD)	Declared imported weight (thousands of metric tons)	Value per kg (USD/kg)	Rate of non-control (blue channel)
2013	1.73	0.38	4.5	2%
2014	1.57	0.35	4.4	5%

3.3. Synthetic indicators of customs' effectiveness

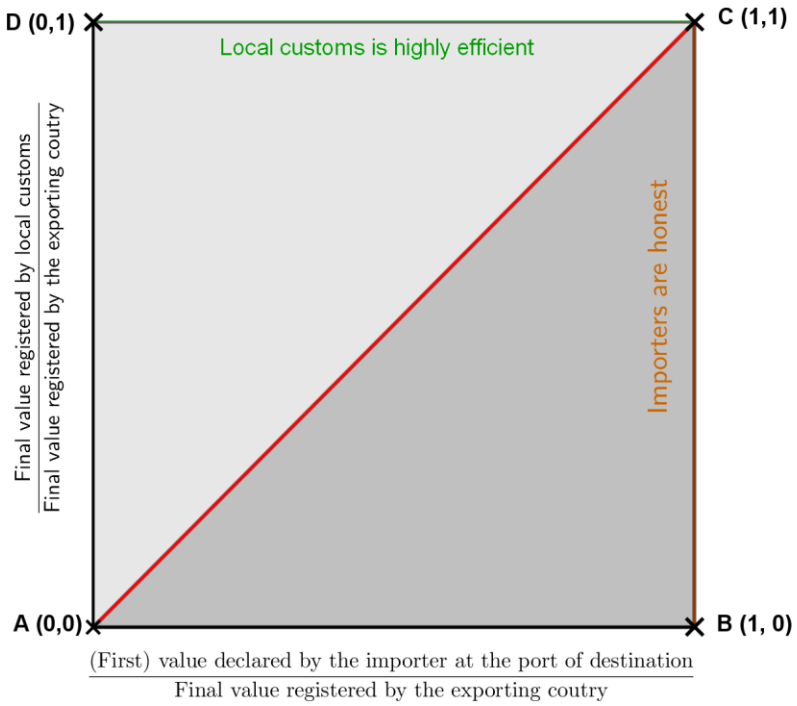
Mirror data can be combined with customs data on adjustments to assess customs' performance in terms of value controls, by comparing the pre-control ratio of import/export values to the post-control ratio. To illustrate the benefits of such an approach, graph 7a

[17]The entire set of declarations of Champagne was deemed compliant.

presents the analytical framework that compares the share of estimated undetected fraud before and after the frontline controls. The abscissa axis represents the initial customs fraud (i.e., valued based just on the importer's declaration) and the ordinate axis represents the customs fraud after controls. Assuming that the value reported by the customs of the exporting country corresponds to the transactional value, the ratio between the import value and the export value provides an estimate of the fraud magnitude. While a ratio close to one suggests an absence of fraud on the value, a ratio close to zero suggests the presence of major frauds. If the customs has, for a given product and a given year, made positive adjustments on value, ordinate axis' values are greater than abscissa axis' values. The point is then located above the 45° diagonal line passing through the origin (the red line, see graph 7a). When the point is located on the 45° diagonal line, this means that the customs has not detected any fraud on the corresponding product. Inspections are all the more effective if the ordinate value is close to one (i.e., close to the green line, see graph 7a). Likewise, importers are all the more honest when the abscissa value is close to one (i.e., close to the red line).

Such a graph can be periodically produced by integrating the results of *ex post* audits carried out on initial year declarations. Following *ex post* audits, more observations should be located above the 45° diagonal line and get closer to the green line. Regular monitoring of this graph would therefore make it possible to track improvements in the effectiveness of customs controls.

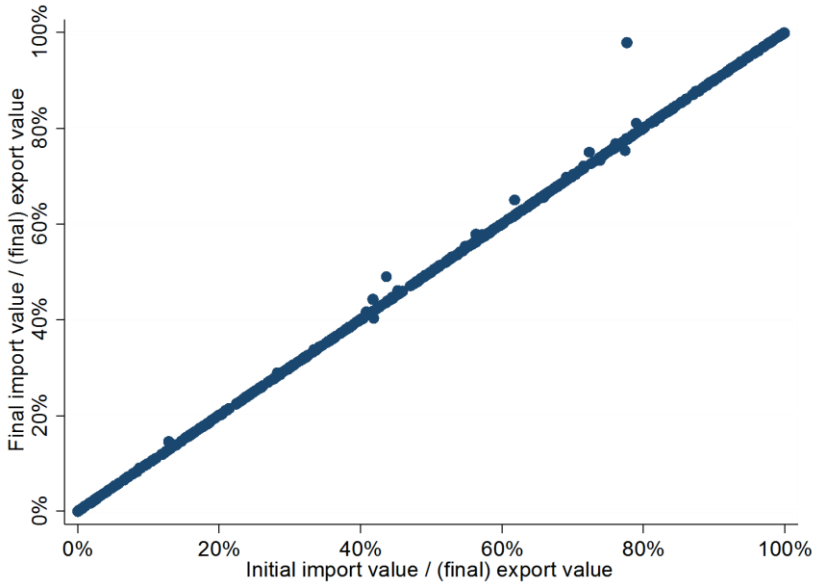
Graph 7a. Synoptic view of the effectiveness of controls of value



By combining the mirror data and information on the adjustments made, graph 7b shows the synoptic view of the effectiveness of Gabon customs. Interpreting this graph gives us a synthetic picture of the Gabon customs' action.

Since the vast majority of the observations are located on the diagonal, the customs' action was unable, for many tariff headings, to increase the value. In spite of this relative ineffectiveness, we nevertheless see that the customs administration was very effective on specific tariff headings, in particular on the imports of wickerwork (HS 46.02). On this product, in 2013 customs was able to increase the customs value by more than 25%, thereby helping to substantially reduce the *Trade gap* corresponding to this heading. By contrast, customs' action also resulted, due to value cuts among other things, in lowering the customs value for some headings. This was especially the case for printed materials, images, engravings and photographs (HS 49.11) imported in 2014. On this HS code, customs' action was totally counter-productive since it increased the Trade gap by 435,000 US dollars (for a revenue loss of 110,000 US dollars).

Graph 7b. Synoptic view: the Gabon case



Notes: analysis unit: HS4-year Study period: 2013.-2014.

3.3.1. Customs effectiveness indicators: calculation principles

The synoptic view of the effectiveness of controls can be usefully supplemented with a synthetic measurement of the effectiveness of customs. This measurement involves, for each HS4 code, relating adjustments observed to those that would have occurred in the case

of maximum inspection effectiveness (i.e., the value reported by the exporting country[18]. In its basic formulation, the customs control effectiveness indicator (CUCOEF) in terms of value appears as follows:

$$\text{CUCOEF}_{base} = \frac{\sum_{HS4=0101}^{9706}\left(Ratio_{vfinal\ value_HS4} - Ratio_{initial\ value_HS4}\right)}{\sum_{HS4=0101}^{9706}\left(1 - Ratio_{final\ value_HS4}\right)} \qquad (3)$$

Where

$$Ratio_{initial\ value_SH4} = \frac{Value\ initially\ declared\ by\ the\ importer_{HS4}}{Value\ (final)\ reported\ by\ the\ exporting\ country's\ customs_{HS4}} \quad (4)$$

$$Ratio_{final\ value_SH4} = \frac{Finale\ value\ retained\ by\ the\ importing\ country's\ customs_{HS4}}{Value\ (final)\ reported\ by\ the\ exporting\ country's\ customs_{HS4}} \quad (5)$$

This indicator is between -1 (maximum direct ineffectiveness) and 1 (maximum direct effectiveness)[19].

In a second step, to better account for undervaluation in customs, the trade gap can be, for each HS code, weighted by the relative import values at export of the corresponding heading. The indicator is then as follows:

$$\text{CUCOEF}_{undervaluation} = 100 \times \frac{\sum_{HS4=0101}^{9706}\left(Ratio_{final\ value_HS4} - Ratio_{initial\ value_HS4}\right)^{\alpha_{HS4}}}{\sum_{HS4=0101}^{9706}\left(1 - Ratio_{final\ value_HS4}\right)^{\alpha_{HS4}}} \quad (6)$$

With

$$\alpha_{HS4} = \frac{Import\ value\ at\ export_{HS4}}{\sum_{HS4=0101}^{9706} Import\ value\ at\ export_{HS4}} \quad (7)$$

In a last step, from the viewpoint of monitoring customs revenue mobilization performance, a third version of the indicator can be calculated. In addition to the relative value of imports, this version of the indicator also takes into account the tariff structure applied to imported products:

$$\text{CUCOEF}_{revenues} = 100 \times \frac{\sum_{HS4=0101}^{9706}\left(Ratio_{final\ value_HS4} - Ratio_{initial\ value_HS4}\right)^{\beta_{HS4}}}{\sum_{HS4=0101}^{9706}\left(1 - Ratio_{final\ value_HS4}\right)^{\beta_{HS4}}} \quad (8)$$

With

$$\beta_{SH4} = \frac{Import\ value\ at\ export_{HS4}}{\sum_{SH4=0101}^{9706} Import\ value\ at\ export_{HS4}} \times \frac{Effective\ rate\ _{HS4}}{Average\ effective\ rate} \quad (9)$$

And

[18] It is assumed that export declarations are compliant.

[19] The use of the term "direct" underlines the fact that this indicator does not take into account the dissuasive component of controls (indirect effect).

$$Average\ effective\ rate = \frac{1}{N_{HS4}} \sum_{HS4=0101}^{9706} t_{HS4} \quad (10)$$

Effective tariff$_{HS4}$ is the average customs tariff corresponding to the HS4 code, *effective tariff*$_{average}$ is the average customs tariff for all imports. N_{HS4}corresponds to the number of HS4 codes associated with imports, t_{HS4}corresponds to the customs tariff for these same headings. The$CUCOEF_{revenues}$ indicator overweights (respectively underweights) and undervalues the HS4 codes for which the revenue losses are substantial (respectively minor).

3.3.2. Customs effectiveness indicators: application to Gabon customs

The three versions of the CUCOEF indicator applied to Gabon customs are shown in table 8. The CUCOEF$_{base}$ indicator shows that the Gabon customs' action on reducing the *Trade gap* was almost nil for 2013 and 2014. By contrast, when trade gaps are weighted by the relative value of imports, the assessment of the customs' effectiveness slightly improves, with a CUCOEF$_{undervaluation}$ score between 0.10 and 0.13, in 2013 and 2014 respectively. Therefore, this indicator reveals that adjustments, even though rather rare, are targeted on HS codes representing a substantial portion of the value of imports.

Finally, when trade gaps are weighted in view of monitoring customs revenue mobilization performance (i.e., by taking into account the relative value of imports and the tariff structure), the CUCOEF$_{revenues}$ indicator is around 0.17, suggesting that the Gabon customs tend to target their controls on imports with high revenue mobilization potential.

Table 8. Effectiveness of Gabon customs

	2013	2014	2013-2014
CUCOEF base	0.0015	-0.0002	0.0006
CUCOEF undervaluation	0.1381	0.1056	0.1218
CUCOEF revenues	0.1857	0.1568	0.1712

3.4. *Limitation of the analysis: the problem of value abatements in Gabon customs*

In Gabon, as in other countries on the African continent, value abatements are sometimes granted to certain categories of importers or to those who request such abatements. This practice aims to the tax burden without modifying the tax rate, by reducing the tax base. These advantages are mostly granted following a specific request: they are exceptional or *ad*

hoc partial exemptions[20]. The resulting value registered in customs is less than the transactional value: there is an undervaluation, which implies a *Trade gap*, but this is officially approved by the authorities. It corresponds to a lawful tax benefit granted, i.e. a tax expense, not a fraudulent behavior by the importer requiring a reassessment on the part of the customs authority. The benefits of the mirror analysis to improve the effectiveness of value controls (i.e., to carry out the necessary adjustments) are therefore challenged.

In Gabon customs administration, no coding is provided to identify these abatements, which precludes any traceability[21]. For example, it is impossible to know whether the low values registered by customs for champagne is due to a fraudulent value cut, or to an abatement in value officially granted to a specific operator. Therefore the practice of value abatement significantly limits the scope of the mirror analysis.

The contribution of the mirror analysis to customs administrations depends on the reliability of the data, especially the data from the customs information system. In particular, the problem of value abatements should encourage them to review certain procedures in order to improve the quality of their database. At the same time, the authorities should gradually abandon such practices, incompatible with effective domestic revenues mobilization and administration.

4. Conclusion

The customs administrations of developing countries increasingly use data analysis, especially to develop risk-based management systems. In addition to presenting new stylized facts on the effectiveness of controls, this paper stresses that customs should diversify their sources of information in order to improve (i) the fight against fraud and (ii) the monitoring of their performances.

The use of customs data (e.g., fraud records, tax adjustments) for routing declaration in inspection channels reaches limits in terms of "revenue" effectiveness because the *scoring* techniques used only aim to "do as well" as what customs has done yet so far, by controlling less.

Thus several benefits are withdrawn from using external sources of information such as mirror trade statistics. The mirror data analysis is an efficient tool to target *ex post* audits towards high-risk transactions that escaped the frontline controls. The illustration based on

[20] In Benin, this practice was used more systematically with the application of so-called "consensual" values to favor imports to Nigeria.

[21] For example, in Cameroon, specific additional codes (A05 - A60) are used in the information system to monitor these kinds of benefits.

the case of Gabon is enlightening because it demonstrates the complementarity of the two successive risk analysis and selectivity approaches; the first based primarily on the customs data, aimed at targeting frontline controls, and the second based on discrepancies in trade statistics, to target *ex post* audits.

The combination of mirror trade statistics and data on customs adjustments is also useful for constructing indicators aiming to measure and monitor the performance of customs controls (frontline and *ex post*). The introduction of such tools should favor the implementation of objective and transparent methods of assessing results, thereby helping to promote more virtuous behaviors.

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