WPS7625

Policy Research Working Paper 7625

The Use of Detailed Statistical Data in Customs Reform

The Case of Madagascar

Cyril Chalendard
Gaël Raballand
Antsa Rakotoarisoa

WORLD BANK GROUP
Governance Global Practice Group
April 2016

Policy Research Working Paper 7625

Abstract

To carry out their various missions (collecting revenue, facilitating trade, and ensuring security), many customs administrations have established a risk management unit. In developing countries, however, because of the lack of dedicated human and material resources, intelligence and risk analysis remain insufficiently developed. In view of the lack of resources, this paper proposes a simple methodology aiming at detecting risky import operations. The mirror analysis first helps to identify and target products or sectors with the greatest risk. Based on the examination of customs declarations patterns (data mining), it is possible to identify and target higher risk economic operators (importers and customs brokers). When implemented in Madagascar, this method has helped to reveal probable fraud cases in the present context of customs reform. Estimates suggest that, in 2014, customs fraud reduced non-oil customs revenues (duties and import value-added tax) by at least 30 percent.

This paper is a product of the Governance Global Practice Group. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at graballand@worldbank.org.

The Use of Detailed Statistical Data in Customs Reform

The Case of Madagascar

Cyril Chalendard

Gaël Raballand

Antsa Rakotoarisoa[1]

JEL code: F14, D73, H26, K42.

Keywords: customs fraud, mirror statistics, Madagascar, customs reform, tax evasion.

[1] Cyril Chalendard, PhD candidate in Development Economics, CERDI, University of Auvergne, Gaël Raballand, Senior Public Sector Specialist, World Bank, graballand@worldbank.org (corresponding author), Antsa Rakotoarisoa, Director of Statistics at the Directorate General of Customs of Madagascar. The authors would like to thank Coralie Gevers, Keiko Kubota, Mark Lundell and Bertrand Laporte for comments and suggestions and the participants at the presentation done at Customs headquarters in Antanarivo in January 2016.

I. Introduction

With a per capita gross domestic product (GDP) of US$449 (2014), Madagascar is one of the five poorest countries in the world. To finance the country's development, there must be a significant increase in the state budget. With this end in view, the tax revenue ratio, which is one of the lowest in Africa (around 10% of GDP), should increase.

In order to increase domestic revenue mobilization, Madagascar revenue collection authorities (i.e., tax and customs administrations) should notably combat fraud more effectively. The fight against tax evasion involves that revenue collection authorities should detect more to deter more. To this end, the analysis of discrepancies in international statistics may be very helpful. Zucman (2013) uses the differences between international assets and liabilities to evaluate the degree of tax evasion by households. Based on Bhagwati (1964), Raballand et al. (2012) use discrepancies in trade statistics to identify and assess customs frauds. In a perfect scenario,[2] any statistical anomaly—that is, any difference between the declared export value (price, volume, weight) and the declared import value for the same trade flow, is suspect. When exports are not taxed, the exporting company has no incentive to make a non-compliant declaration. In such a situation, assuming that the gap is due to the importer is therefore a reasonable assumption.

Using original customs data, this paper aims to identify, in Madagascar, some high-risk products and high-risk operators (importers and brokers). The proposed method is complementary to risk analysis methods based on compliance (see e.g. Geourjon and Laporte (2012)). A two-step procedure is adopted. Based on discrepancies in trade statistics (mirror statistics), the paper presents products or sectors in which customs fraud is deemed to be significant. A quantification exercise of customs losses is provided. Then, through the use of highly disaggregated customs data, high-risk operators (importers and brokers) are identified.

Despite the fact the methodology is straightforward, to our knowledge there is hardly any paper using this approach (at the importer/broker level) due to the fact that it is usually difficult to get access to such information. The paper demonstrates how useful such detailed customs data can be and should convince the Head of Customs and/or Ministers of Finance to give access to them to researchers, since they can be used for an operational use. For researchers, it enables to identify some fraud techniques and collusive practices.

The use of export data provided by exporting countries allows us to compute for each sector/product the mirror gap. The mirror gap is, for each product/sector, defined as the difference between export X to Madagascar reported by the exporting country and import M from the exporting country as reported by Madagascar customs. Export data are downloaded

[2] This means that the same nomenclature is used between the exporting and the importing country, both declarations are made in the same currency, and the same incoterm is used.

via the United Nations platform COMTRADE. Notice that, in view of the time lag in uploads to COMTRADE, by the national institutes of statistics, a wait period of a few months should be observed before downloading the most recent annual bilateral trade data.[3] Due to this time lag, the mirror analysis cannot identify new trends in customs fraud in Madagascar.

Based on mirror gaps, we are then able to identify some sectors/products for which non-compliance seems common. Estimates suggest that undervaluation and misclassification[4] in 2014 accounted for a loss of revenue of US$53.7 and US$42.4 million, respectively.[5]

Total estimated losses (96 million of US$ or MGA 232 billion) represented 30 percent of total non-oil revenues collected by customs. The analysis indicates that clothing (textile, footwear and leather goods) and high tech products (telephones, digital cameras) seemed to be substantially undervalued in 2014. Undervaluation of clothing products and telephones (and digital cameras) are, respectively, estimated at US$25.4 million and US$13.6 million.

Regarding misclassification, the paper highlights that, in Madagascar, some customs tariff headings not subject to duties and value-added tax (VAT) were probably used, in 2014, for tax evasion purposes. Considering that abnormal statistics (e.g. inconsistent unit values) are indicative of fraud, there is reasonable evidence that some high-taxed goods were declared as zero-taxed products, notably fertilizers and rice. The declared unit value of imports of rice and fertilizers (products exempt from duties and VAT) largely exceeded corresponding world prices. Based on discrepancies in trade statistics, we estimate losses in VAT revenues at US$12 million.[6] Despite the fact that rice imports were almost systematically physically inspected, *i.e.,* directed through the red channel, very few infractions had been reported. This figure suggests that there were probably collusion agreements between some economic operators and some customs agents. As the number of reported cases of fraud sharply increased in 2015, such bad practices seem to have declined.

The remainder of the paper proceeds as follows. Following a brief overview of the context of Madagascar customs (section II), the third section presents the mirror analysis methodology. Estimates of loss of revenue are presented in section IV. Section V provides some suggestive evidence of fraud. Some high-risk operators are then identified.[7] Initial lessons learned are detailed in section VI.

---

[3] Due to the fact that a large number of oil-exporting countries do not share their statistics with the UN Statistics Division, imports of oil products are excluded from the analysis (HS2 chapter: 27).

[4] Misclassifying means that an economic operator declares product A to customs as product B. Committing a misclassification that is, declaring product A as product B, induces an increase in imports of product B. The bigger the fraud, the bigger the increase in imports.

[5] Estimates are based on the main positive and negative gaps per chapter (*i.e.,* at the HS-2 digit level), Since a non-negligible part of import operations were, in 2014, not subject to the common law regime (9.2 per cent). we have decided to base our estimates on the rate of effective taxation on imports. This latter is smaller than the *de jure* rate. Regarding the specific estimation of losses due to misclassification, notice that only VAT losses are considered as the real tariff are unknown. Our estimates therefore constitute a lower bound.

[6] The "M-X" discrepancy is US$15 million for fertilizers and US$43 million for rice.

[7] Importer names are anonymized.

II. The Customs Administration in Madagascar: Context

Customs plays a very important role in revenue collection in Madagascar. The size of the customs administration is limited in terms of the number of customs officers (in comparison to other countries with similar characteristics). Customs controls are still largely ineffective.

In 2014, imports accounted for 31 percent of GDP (US$3.29 billion).[8] Accounting for 22 percent of imports, the European Union is the biggest supplier of non-oil goods (cf. Table 11, appendix A). Due to large tax rates, taxes on petroleum products are the main source of revenues collected by customs (26 percent).

A. The Importance of Revenues Collected by Customs

As for many other African countries, revenues collected at the border from trade remain significant in Madagascar (see *i.e.,* Keen (2003), Zake (2011), Montagnat-Rentier and Parent (2012)). Customs collected 45 percent of total tax revenues in 2014 (see Figure 1). Due to the decline in tariff protection and the rise of indirect taxation, value-added tax now represents 72 percent of revenues collected by customs (see Figure 2). As duties on petroleum products account for 30 percent of revenues collected at the border, revenues from customs are consequently heavily dependent on oil prices.

A comparison of the data on revenue collected by Madagascar customs with that of other African countries (especially low-income countries), yields the following results (see Table 1):

- There is potential to improve the level of effective taxation.
- The customs administration of Madagascar is plagued by a lack of human resources, with around 15 percent lower resources than the administrations of countries in a similar category. This explains why the level of revenues collected by each customs officer is higher than the median.

Table 1: International Comparison with Madagascar Customs

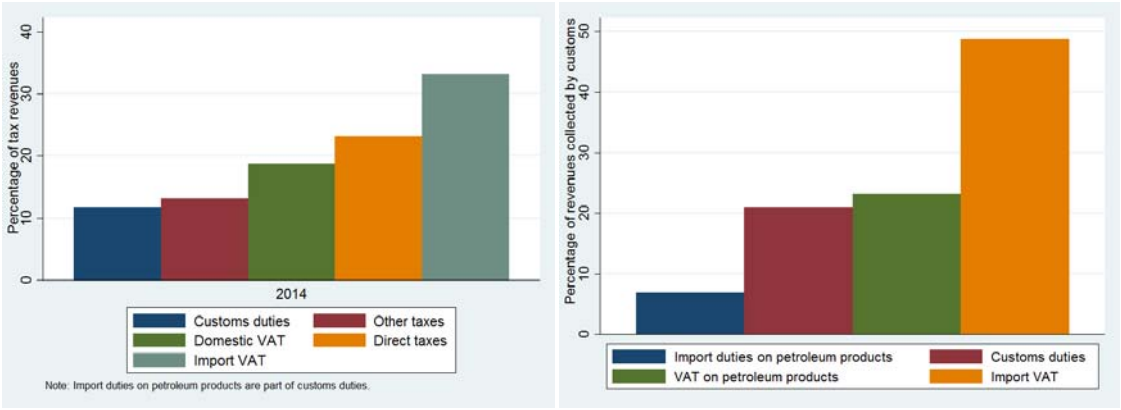
	Customs revenue/per capita (US$)	Customs revenue/per customs agent (US$)	Number of employees
Madagascar	22.7	416,600	1,182
Median for Africa	28.5	282,900	1,393

Note: Data for 31 African countries provided by World Development Indicators. Data on number of agents provided by the World Customs Organization, 2012 figures.

Figure 1: Structure of Tax Revenues by Major Type of Taxes

Figure 2: Structure of Customs Revenues

[8] The structure of Madagascar's economy leads to a sizeable balance of trade deficit. In 2014, the trade deficit was 10.5 percent of GDP. Unless otherwise indicated, all statistics in the rest of this document pertain to the year 2014.



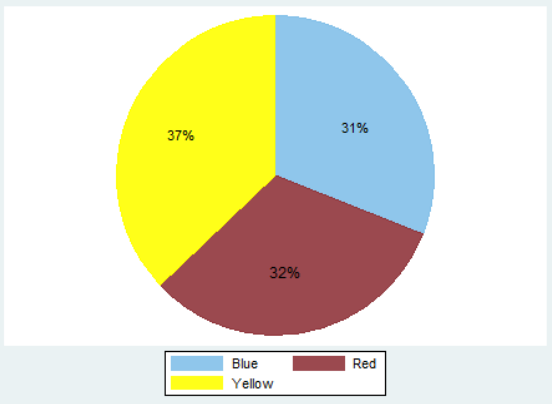
B. The Performance of Customs Controls

Since the import verification program ended in 2006 (see Montagnat-Rentier and Parent (2012)), the customs administration is fully responsible for customs clearance. As methods of risk analysis are traditional, that is, controls are mainly based on qualitative and sometimes subjective criteria, inspections are carried out on a significant proportion of all imports, with only 31 percent of declarations sent through the blue channel, the channel with no controls (cf. graph 3). Although customs inspections are widespread, reported fraud is infrequent. For instance, in the country's main customs office (Tamatave 1), only 5 percent of declarations sent through the red channel have been reported as non-compliant (source: World Bank (2015)). Customs controls seem therefore to be poorly efficient.

Numerous and repeated inspections are a major obstacle to the development of trade (see *i.e.*, Djankov et al. (2010), Hornok and Koren (2015), Martincus et al. (2015) and Fernandes et al. (2015)). In Madagascar, customs controls increase the time needed for customs clearance by around two days. According to Widdowson and Holloway (2011) and Widdowson (2005), the adoption of risk-based compliance management would improve targeting, and would therefore lead to a reduction of cross-border costs.[9]

[9] Note that trade facilitation, security, and revenue collection are usually the main functions of the customs administration (De Wulf et Sokol (2005)).

Figure 3: Orientation of Customs Declarations by Channel



III. The Mirror Analysis Methodology

A. Basic Methodology

The mirror trade statistics analysis is a computation of the differences between exports X to Madagascar reported by other countries and imports M reported by Madagascar for the same commodity flows.[10] Export data are typically downloaded from the United Nations COMTRADE platform. The analysis cannot go beyond the HS6 disaggregated level, as the platform does not provide statistics at the HS8 level of disaggregation.

The "X-M" gap (or mirror gap) may be caused by factors other than customs fraud. Since exports are expressed free on board (*f.o.b*), and imports are expressed cost insurance freight (*c.i.f*), the "X-M" discrepancy is negative. The difference represents the cost of transport, insurance, and freight. Discrepancies in international trade statistics may also be attributed to the transit of goods (transit through a third country),[11] differences in classification between the exporting and importing countries (Nitsch (2012)), inaccuracies in conversion between the local currency and the US dollar[12] (Carrère and Grigoriou (2014)), or the relatively lax control of customs declarations by the exporting country (Stoyanov (2012)). That is why the more detailed the unit of analysis (HS6 level-exporting country-year, HS6 level-year, HS4 level-exporting country-year, for example), the higher the probability that the resulting "mirror gap" value is not solely attributable to fraud.

[10] The basic methodology is detailed in Cantens (2015).
[11] In order to reduce the "Rotterdam effect" (see Herrigan et al. (2005)), member countries of the European Union are considered one single country. Differences arising from transit trade are thus drastically reduced.
[12] Conversion to US $ is made on the basis of an average monthly MGA/US$ exchange rate provided by the Central Bank of Madagascar, source: http://www.banque-centrale.mg/index.php?id=m5_1_1

B. Indicators of Fraud

By analyzing and matching export data (obtained from UN COMTRADE) and import data (provided by customs), we are able to compute (i) gap indicators (value, quantity, weight) and (ii) ratio indicators (value, quantity, weight, unit value). While the first group aims to provide a quantitative estimate of fraud, the second group intends to provide a relative estimate of the phenomenon. Combining the two types of indicators, one can identify goods for which the risk of fraud and the estimated loss of revenue are estimated to be high. Gap indicators—(1) and (2)—and ratio indicators—(3), (4) and (5)—are defined below:

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

$$Weight\ gap\ =\ Reported\ export\ weight\ (kg) - \ Reported\ import\ weight\ (kg) \quad (2)$$

$$MdX\ = \frac{Reported\ import\ value\ (USD)}{Reported\ export\ value\ (USD)} \quad (3)$$

$$WMdWX\ = \frac{Reported\ import\ weight\ (kg)}{Reported\ export\ weight\ (kg)} \quad (4)$$

$$Rvd = \frac{MdX}{WMdWX} \quad (5)$$

Associated with a variable rate of effective taxation of imports, ratio indicators (MdX, WMdWX, and Rvd) taken together can reveal potential misclassification, undervaluation or smuggling.[13] For example, the ratio of weights (WMdWX) close to unity, together with a low ratio of values (MdX), indicates a probable undervaluation. A ratio of density values (Rvd) close to unity, combined with a ratio of weights (WMdWX) and a ratio of values (MdX) lower than unity suggest a misclassification (*i.e.,* the product has not been declared under the appropriate tariff heading) or a possible case of smuggling. Table 18 in appendix C lists types of fraud according to the value of ratio indicators. Gap indicators (trade gap, weight gap) provide a quantitative estimate of the phenomenon. Specifically, they make it possible to estimate losses and therefore facilitate prioritization. Based on mirror gaps calculated at the HS2 or at the HS4 level, section IV presents sectors/products in which customs fraud is estimated to be important.[14]

[13] Because of their complex nature, each type of fraud has to be dealt with separately.
[14] For the sake of brevity, only products/sectors with large estimated losses are presented.

IV. Products with the Largest Estimated Losses

Once the mirror gap (trade gap, indicator 1) is calculated and the effective import tax rate[15] has been determined, estimates of revenue losses may be computed. For the sake of brevity, only the main positive and negative gaps by HS2 chapter are presented. Whereas a positive "X-M" gap suggests an undervaluation, a negative gap is indicative of misclassification. Overall losses are estimated at around US$96 million, or 30 percent of non-oil revenues collected.[16] Estimates indicate that valuation fraud (undervaluation) and tariff misclassification accounted, in 2014, for a loss of revenue of US$53.7 million and US$42.4 million, respectively.

A. Undervaluation

Table 2 lists the sectors with the largest estimated losses. Considering only the five sectors with the highest mirror gap, the "X-M" discrepancy is US$242 million (*cf* Table 2).

Table 2: Undervaluation: Estimated Losses of Revenue by Sector

Sector	Estimated losses (US$ millions)	Estimated losses (% of non-oil revenues)
Textiles, footwear, and leather goods	25.4	7.6
Machinery, electrical appliances, and equipment	11.1	3.3
Furniture and furnishings	7.6	2.3
Animals or vegetable fats and oils	5.2	1.6
Glass and glassware	4.4	1.3

Since it is extremely difficult to assess the value of textile goods,[17] it is not surprising that our estimates outline that imports of textiles, footwear, or leather goods are mis-declared. Two products—clothing for women and girls (HS4 digit code: 6104) and footwear (HS4 digit code: 6402)—are the source of more than two-thirds of losses (67 percent). Table 12, appendix A presents the main positive gaps (and associated losses) by HS4 digit.

As indicator 5 (the ratio of density values) is very low for electrical appliances and furniture, it suggests that undervaluation is, in this sector, widespread. Undervaluation is estimated at

[15] The effective import taxation rate is calculated on the basis of the tax value (customs duties and VAT) paid at the border. Since Madagascar customs did not collect all levied taxes at the border (notably, excise duties up to 2015) we are currently unable to accurately calculate the effective taxation rate. This is one of the factors limiting the estimation of losses of tax revenue and hampering measures to correct misclassifications. Furthermore, the estimates are a lower-bound.

[16] As the main oil producing countries (United Arab Emirates, Bahrain, and Saudi Arabia) do not submit their export figures to the UN Division of Statistics, oil exports (HS2 chapter 27) are not included in the study.

[17] Rauch classification (1999) has listed clothing under "differentiated products." Assessing the value accurately is thus an extremely difficult task.

US$13.6 million and seems to be common for telephones and digital cameras (HS4 digit codes: 8517 and 8525).[18] Losses due to mis-valuation of telephones and digital cameras account for 35 percent of total losses of the electrical appliances sector (losses are estimated at US$ 3.9 million, see Table 14, appendix A). It would also appear that glass imports are subject to widespread undervaluation. Regarding oils and fats, note that the gap is largely attributable to imports of palm oil.[19] For palm oil, the ratio indicators notably suggest potential smuggling.[20]

B. Misclassification

Unscrupulous operators have an incentive to (illegally) make use of the low level of taxation on low-taxed products to evade taxes. In Madagascar, fertilizers, books and a large part of cereals are not taxed (*i.e.,* exempt from tariff and VAT). Not surprisingly, the import value significantly exceeds the export value for these products, the "import minus export" gap for the five main sectors is US$212 million, see Table 3. This suggests a loss of VAT of US$42.4 million. As the tariff applicable to "misclassified" products cannot be determined, only VAT losses may be estimated. Estimates are based on the normal VAT rate (20 percent). VAT losses could be higher, as the real value of the imported product is not known. This is therefore a lower-bound estimate.

Table 3: Misclassification: Estimated Loss of Revenue by Sector

Sector	Estimated losses of VAT (US$ millions)	Estimated losses (% non-oil revenues)
Cereals, vegetable meal	15.7	4.7
Cement, plasters and sulfur	13.0	3.9
Chemical products	8.1	2.4
Fertilizers	3.0	0.9
Products of the printing industry, newspaper	2.6	0.8

The main losses at the HS4 level are presented in Table 13, appendix A. The import values for rice (HS4 digit code: 1006) and fertilizers (HS2 chapter 31) are significantly higher than the export values. The "M-X" discrepancy is US$43 million for rice and US$15 million for fertilizers. Revenue losses on VAT alone on these products is estimated at US$12 million. Although taxed, cement constitutes an attractive tariff heading because of its very low unit

[18] As the volume ratio is close to one, it suggests that the trade gap is attributable to an undervaluation of imports.
[19] Palm oil (HS4 digit code: 1511) is the source of 80 percent of gaps and 94 percent of losses.
[20] The estimated gap for palm oil is US$30 million. Whereas the ratio of density values is close to unity, imports are less than exports by approximately 40,000 metric tons (the ratio of weights is 0.44).

price. Note that 42 percent of the cement gap[21] is attributable to imports of hydraulic cement (HS4 digit code: 2523).

V. Comparison of Import Prices with International Prices

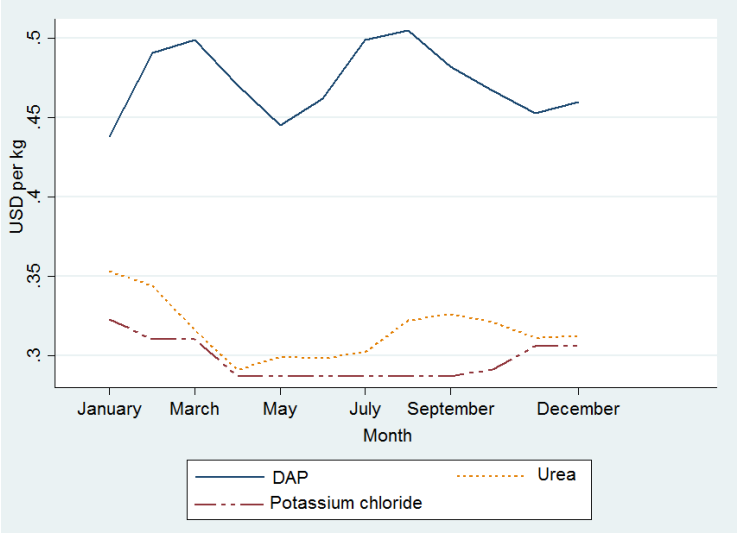
A. Evidence of Misclassification

1. The case of fertilizers

As the importation of fertilizers is exempt from taxes,[22] economic operators have an incentive to list heavily taxed goods as fertilizers. With a negative gap of US$15.1 million, the mirror analysis suggests frequent misclassifications.[23] Since a large variety of fertilizers exists, for the sake of brevity, we limit our analysis to urea (HS6 digit code: 310210).

Widely used, urea is particularly rich in nitrogen. In Madagascar, imports of urea account for almost one third[24] of total fertilizer imports (see Table 15, appendix B). A simple comparison of the declared value with world prices of urea highlights significant inconsistencies. Whereas the world price did not exceed US$0.35 per kg for the year 2014 (see Figure 4), the average price declared at Madagascar customs was much higher (US$0.54 per kg). Such abnormal declared import values are also found for potassium chloride (HS6 digit code: 310210) and diammonium phosphate (abbreviated DAP, HS6 digit code: 310530), see appendix B.

Figure 4: Export Prices for some Fertilizers



Source: World Bank Commodity Price Data. Prices are f.o.b. 2014 figures.

[21] Or US$27.5 million, a gap of 42 percent for the sector.
[22] Fertilizers are totally exempt from tariffs and VAT.
[23] The M/X ratio of values is higher than 2.2.
[24] In value.

As export prices are expressed f.o.b, a part of the difference arises from the fact that insurance and freight costs are included in the import declared value.[25] In order to correct this inaccuracy, a CIF-FOB correction is applied. We have chosen to retain a particularly cautious CIF-FOB correction rate (30 percent). With this rate, only an operator using an average unit value at least 30 percent higher than the world price is considered suspect.

Tables 5 and 6 list importers and brokers identified as risky, *i.e.,* operators whose the declared unit value of urea is at least 30 percent higher than the world price. [26] These operators share some common characteristics. Lists are mainly formed by new operators or operators whose imports of urea spiked in the year 2014. For example, urea imports of the main importer increased 740 percent between 2013 and 2014. The low dispersion of unit values (low standard deviation) suggests that misclassification is, for urea, widespread. Regarding potassium chloride and diammonium phosphate, Tables 16 and 17 in Appendix B list the high-risk operators.

Table 5: Characteristics of importers identified as risky — urea

Tax identification number[27]	Declared value (US$)		Declared price per kg		No. of import operations
	2014	2013	Average	Standard deviation	
0000000001	2,896,009	345,097	0.73	0.02	12
0000000002	896,048	0	0.72	0.01	4
0000000003	675,731	0	0.74		1
0000000004	613,180	145,464	0.53	0.01	3
0000000005	603,807	0	0.73	0.00	2

Note: Only importers who (i) have declared a value per kg at least 30 percent higher than the maximum monthly export price and (ii) have declared an import value of more than US$25,000 are presented.

Table 6: Characteristics of brokers identified as risky — urea

Broker identification number	Declared value (US$)		Declared price per kg		No. of import operations
	2014	2013	Average	Standard deviation	
001-AAA	4,215,745	345,097	0.73	0.02	15
002-AAA	837,593	648,542	0.50	0.13	7
003-AAA	342,515	0	0.73	0.01	2

[25] Whereas the world price is expressed as f.o.b., the import price is c.i.f.
[26] High-risk operators are those having declared an abnormally high unit value (more than 30 percent higher than the maximum monthly world price for the year 2014).
[27] For this and the following tables, the tax identification and customs brokers identification numbers are fictitious in order to maintain anonymity.

004-AAA	339,708	664,606	0.72		1
005-AAA	173,628	0	0.74		1

Note: Only brokers who (i) have declared a value per kg at least 30 percent higher than the maximum monthly export price and (ii) have declared a value higher than US$100,000.

2. The case of rice

Due to the sharp rise in international prices of rice in the mid-2000s, the Government of Madagascar decided in 2008 to make rice VAT exempt. Without customs duties charged on this cereal, there is no longer taxes imposed on rice. As is the case for fertilizers, rice constitutes a highly attractive customs tariff position. Unscrupulous importers seeking to avoid paying import taxes and duties therefore have an incentive to declare their cargo as a rice shipment.

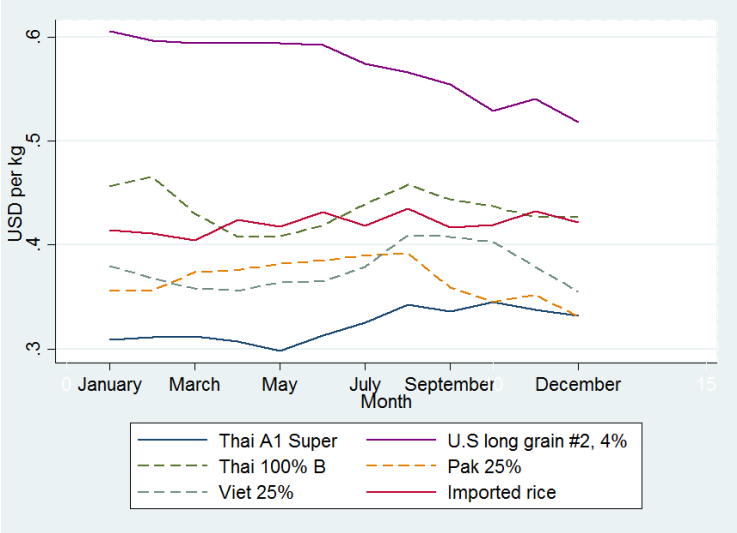
Not surprisingly, the trade gap suggests considerable misclassification. The import value is higher than the export value by US$43 million. This discrepancy is mainly due to imports from India and Pakistan. In addition to the direct revenue losses caused by tax exemptions, the measure has therefore induced important indirect losses due to tariff misclassification. Based on the trade gap, a back-of-the-envelope calculation stresses that misclassification induced losses in VAT of US$8.6 million. As declarations are almost systematically routed to the red channel,[28] fraud is the result of an enforcement problem rather than of weaknesses in the risk analysis system.

Abnormal import prices

The price of rice is relatively well known. It is therefore easy to detect price anomalies (e.g., see Mishra et al. (2008), Javorcik and Narciso (2008)). Figure 5 indicates that in 2014, the export price ranged between US$0.30 and US$0.60 per kg. The declared import value should therefore be within the range of US$0.30 -US$0.60 in 2014. Given Madagascar's poverty rate (75 percent of the population lives below the national poverty line), the rice imported is probably of poor quality. The expected import value should therefore be closer to the US$0.30 value threshold. Yet, the declared import unit value is closer to the top value of US$0.58 per kg (*cf.* Table 7). It is noteworthy that there is an unexpectedly marked fragmentation of declared import values. The standard deviation is US$1.14/kg. As the standard deviation is larger than the top international price US$0.58 per kg, this suggests that some goods declared as "rice imports" are in fact goods whose value per kg is vastly greater than that of rice. This inconsistency provides additional evidence of misclassification.

[28] Of all declarations, 95.92 percent are routed through the red channel.

Figure 5: Variations in Export and Import Prices of Rice, 2014.



Note: Data on world prices are from the Food and Agriculture Organization (FAO)

Table 7: Main Rice Import Statistics

Value density (US$/kg)						
Average	Median	Standard deviation	p25	p75	Minimum	Maximum
0.58	0.42	1.14	0.39	0.44	0.00	31.62

Note: p25 indicates the 25th percentile distribution of values, p75 shows the 75th percentile distribution of values. 2014 figures.

Poorly performing controls

Despite the fact that almost all declarations are inspected,[29] few infractions have been reported.[30] In fact, customs controls have detected 4.6 percent of estimated fraud.[31]

One may observe a very marked difference in performance between customs offices. Indeed, the third largest customs office for the clearance of rice imports reported 80 percent of the infractions,[32] while the other cases of non-compliance were reported in the main office. The second largest entry point therefore did not report infractions. As stressed by Sequeira and Djankov (2014), such differences in enforcement encourage non-compliant importers to import through the less efficient customs office.

[29] More than 95 percent of declarations (for rice) are routed to the red channel (i.e., for inspection).
[30] Only 1.7 percent of declarations for rice have been find to be non-compliant.
[31] Although the estimated trade gap is US$43 million, customs officers have reported US$1.96 million in false classifications of rice.
[32] It may be noted that in 2013, this office did not report a single infraction for rice imports.

Inspections appear to be more efficient for very small importers. In fact, more than 50 percent of instances of fraud detected involved operators who had imported rice fewer than three times for the year 2014. Declarations found to be non-compliant refer to minor import operations. Adjustments seem justified since all declared import unit values exceed the ceiling world price of US$0.60/kg.

Having shown examples of classification fraud and the inefficiency of inspections, we will now attempt to identify those economic operators (importers and brokers) involved in such practices.[33]

Identifying high-risk economic operators

Detecting an economic operator involved in fraudulent activities *a posteriori* is complex. However, based on a detailed study of declaration patterns, as well as the characteristics of the operators, high-risk economic operators may be identified. Let us first discuss tax evasion techniques.

Misclassification techniques

Misclassifying means that an economic operator declares product A to customs as product B. Detecting such a non-compliant declaration *ex post* is particularly difficult. Apart from an *ex post* audit, an in-depth analysis of the information provided on the declaration can shed light on abnormal behaviors or inconsistencies. For instance, an abnormally high/low unit value suggests a non-compliant behavior.

Committing a misclassification, that is, declaring product A as product B, induces an increase in imports of product B. The bigger the fraud, the bigger the increase in imports. A marked increase in declared imports of product B is therefore indicative of a misclassification fraud.

In order to reduce the detection probability, an importer may (i) truthfully declare a part of the imports or (ii) may mix compliance and non-compliance within the same declaration (*i.e.,* some imports are declared truthfully, some imports are not declared truthfully). Adopting such a strategy implies that the import operation or the declaration is non-homogenous, that is, it contains multiple products or headings.

Generally speaking, "abnormal" statistics are indicative of fraudulent practices. Regarding misclassification, it has been stressed that declaring an inconsistent or abnormal unit value in parallel with a sharp increase in imports of the low-tax product and the non-homogeneity of imports suggests tariff misclassification.

[33] Part of the fraud seems to have been confirmed since in 2015, rice imports fell significantly back to 2009 levels.

Methods to limit customs controls: Many customs authorities take into consideration the specific importer risk in their risk analysis. Typically, the greater the past compliance of the importer, the fewer customs controls are imposed. In effect, this means that an economic operator with a poor record will be subject to very frequent controls. In order to get around this system, unscrupulous economic operators may create a new import company, thereby causing the poor record to be expunged. Another way to get around the system of controls is to separate compliant import operations from fraudulent ones by establishing a company dedicated to the perpetration of customs fraud. In this way, new operators and/or operators heavily specialized in the importation of a particular product may be considered risky.

Identification of high-risk operators

We have seen where the features or patterns of declaration by economic operators (importers and brokers) may indicate some fraudulent practices. Based on the foregoing, we consider new operators and economic operators heavily specialized in the importation of rice as risky, in addition to importers with a sharp increase in rice importation, those declaring several different products or headings in a single declaration,[34] and those declaring inconsistent and unusual unit values.

Targeting High-Risk Operators

Given the extent of the estimated mirror gap for rice, it is not surprising that numerous economic operators fit at least one of the selection criteria mentioned above. More than 80 percent of importers and 63 percent of brokers satisfy at least one of the criteria for fraudulent practices. By virtue of the type or pattern of their declarations, all of the operators that were sanctioned satisfy at least one of the criteria. In order to identify the riskiest operators, only those satisfying at least two of the criteria will be singled out for more in-depth analysis. A large part of rice importers meet at least two criteria (64 out of 186 importers). For the sake of brevity, we present, in Table 8, only the 10 largest importers. Since brokers are less specialized in the importation of a particular good, only 5% of brokers met the criterion "operator specialization". This explains why only a small number of brokers (4 out of 67) are identified as risky, see Table 9. Although rice is a non-perishable good, it is observed that a large number of importers make on average more than one declaration every two weeks (*i.e.* more than 26 transactions per year).

Table 8: Characteristics of Importers identified as risky — rice

Tax identification number	Declared value (US$)	Declared price per kg	Growth rate	Share of rice imports	Non-homogeneity	No. of import operations
0000000006	5,366,882	0.44		100%	0%	24
0000000007	4,991,451	0.42	133%	98%	0%	94
0000000008	4,388,958	0.38	6,201%	97%	0%	46

[34] Since the homogeneity of import operations is the responsibility of the importer, this criterion will therefore not be taken into account when targeting high-risk brokers.

0000000009	3,854,101	0.39	309%	99%	2%	49
0000000010	3,356,433	0.45	415%	100%	0%	26
0000000011	2,919,223	0.45		94%	0%	34
0000000012	2,344,306	0.41	51%	91%	0%	25
0000000013	2,227,170	0.42	690%	71%	0%	10
0000000014	2,197,989	0.37		100%	0%	19
0000000015	2,161,430	0.42	102%	92%	0%	19

Note: Where the growth rate is not mentioned, it means that the importer is new.

Table 9: Characteristics of brokers identified as risky — rice

Declarant number	Declared value (US$)	Declared price per kg	Growth rate	Share of rice imports	No. of import operations
006-AAA	5,817,736	0.42	441%	74%	43
007-AAA	599,298	5.30		4%	2
008-AAA	110,093	0.42		100%	1
009-AAA	66,204	0.61	44%	3%	5

Note: Where the growth rate is not mentioned, this means that the broker is new.

B. Evidence of Undervaluation: The Case of Suits[35]

As previously mentioned, the trade gap related to clothing (HS2 chapters: 61 and 62) is huge (US$83.17 million), and estimated losses are significant (US$15.75 million). Since the ratio of weights is nearly equivalent to unity (1.02), imports, in volume, seem to be truthfully declared. The very low ratio of values[36] suggests a widespread undervaluation.

In practice, it is difficult to accurately assess the value of clothing because of differences in manufacturing quality, *inter alia*. However, as indicated below, discrepancies can come to light when the scale of undervaluation is very significant.

For suits, the analysis of import declarations[37] suggests a sizeable undervaluation. The average value declared is US$0.94 per suit. A simple calculation shows that customs collects only US$0.41 per imported suit. Table 10 below lists the importers whose declared unit value is particularly low.

[35] HS6 digit codes: 610310, 620311, 620312 and 620319.
[36] It should be borne in mind that there may be errors in the number of units declared, which would therefore distort the figures for certain importers.
[37] Declarations where the weight and quantity imported are identical have not been taken into account.

Table 10: Characteristics of importers identified as risky — suits

Tax identification number	Declared value (US$)	Unit value (US$)	Taxes (duties and VAT) paid per unit imported (US$)
0000000016	43,120	0.64	0.28
0000000017	12,083	0.78	0.34
0000000018	6,126	0.58	0.26
0000000019	5,754	0.56	0.25
0000000020	5,629	1.84	0.81
0000000021	2,735	0.76	0.33
0000000022	2,112	2.31	1.01
0000000023	1,917	0.64	0.28
0000000024	1,565	0.59	0.25
0000000025	1,506	0.72	0.32

VI. First Lessons and Customs Reforms

To supplement the risk analysis based on compliance, this study has identified some risky import operations and some risky economic operators. Although we are not yet able to determine what extent we have effectively identified non-compliant operators, we are already in a position to present certain findings:

First, by reducing information asymmetry, mirror analysis seems to be a powerful intelligence and investigative tool. While gap indicators aim to provide an estimate of tax losses, ratio indicators aim to identify the type of fraud.

Second, combining mirror analysis with an analysis of declaration patterns is useful to identify and target some high-risk economic operators.

Third, in order to assess the compliance of a declaration, investigators should use all sources of available information, whether internal or external.[38] Abnormal statistics (inconsistent unit values, etc.) suggest fraud. The use of the internal information, that is, using declaration patterns of "competing importers", can help identify non-compliance. Similarly, the use of external sources of information, such as information gleaned from sources other than customs databases, can also reveal bad practices. For instance, based on a comparison of declared unit values with international market prices, we have highlighted probable misclassifications for fertilizers.

Fourth, only effective inspections have a deterrence effect. As highlighted for rice imports, non-compliance may be frequent despite an inspection rate close to 100 percent.

[38] See Chalendard (2015).

Fifth, misclassification of goods may create huge revenue losses. Low-tax headings should therefore be closely monitored.

Against this backdrop, a new multipronged strategy is being implemented in Madagascar, with the aim not only of curtailing fraud, but also of facilitating legal trade. A reform strategy for the 2015–2018 period was adopted in September 2014.

Several significant reform measures have recently been adopted or are in the process of being adopted:

- A system has been instituted whereby the performance of each customs office will be monitored based on monthly indicators. This should enable better scrutiny of the Customs Authority and make monitoring more effective, thus facilitating trade.
- The post-clearance audit unit has been reinforced with the recruitment of additional auditors, and several major importers have since been audited and have been found to have committed fraud.
- A new circular has been signed by the Minister of Finance revising the criteria under which companies are eligible for fast-track customs clearance.
- Moreover, in the context of the "quick results" approach adopted, the Customs Authority is making every effort to scale back physical inspections, given their negligible impact.
- Finally, the risk analysis and statistics departments have been reinforced to provide more targeted monitoring.

VII. Concluding Remarks

This paper proposes a simple methodology aiming to identify some risky import operations. The mirror analysis first helps to identify and target products or sectors with the greatest risk. Analysis of declaration patterns (that is, mining of customs data) is then performed to identify and target the most high-risk companies. In the specific case of Madagascar, and within the current context of customs reform, this paper suggests that there was sizeable fraud in the areas of customs valuation and tariff classification in 2014.

Recent studies (Yang (2008), Carrillo et al. (2014)) have highlighted that many tax evaders respond to the implementation of corrective measures (such as increased monitoring, establishment of cross-checking systems, etc.) not by changing their behavior, but by changing their tax evasion method. Therefore, if the authorities are to succeed in reducing fraud, they must make every effort to anticipate how fraudulent actors are likely to adapt their behavior.

References

Bhagwati, J., 1964. On the underinvoicing of imports. Bull. Oxf. Univ. Inst. Econ. Stat. 27, 389–397.

Cantens, T., 2015. Mirror Analysis: Customs Risk Analysis and Fraud Detection. Glob. Trade Cust. J. 10, 207–216.

Carrère, C., Grigoriou, C., 2014. Can mirror data help to capture informal international trade? Trade Commod. Res. Study Ser. Geneva U. N. Conf. Trade Dev.

Carrillo, P., Pomeranz, D., Singhal, M., 2014. Dodging the taxman: Firm misreporting and limits to tax enforcement. Harv. Bus. Sch. Work. Pap. Boston Harv. Univ.

Chalendard, C., 2015. Use of internal information, external information acquisition and customs underreporting, in: Etudes et Documents. CERDI.

Djankov, S., Freund, C., Pham, C.S., 2010. Trading on time. Rev. Econ. Stat. 92, 166–173

De Wulf, L., Sokol, J.B., 2005. Customs modernization handbook. World Bank Publications.

Fernandes, A.M., Hillberry, R., Mendoza Alcántara, A., 2015. Trade Effects of Customs Reform. World Bank Policy Res. Work. Pap. 7210.

Geourjon, A.-M., Laporte, B., 2012. Risk management in customs: Initial lessons from experiences in some African countries. Rev. Déconomie Dév. 20, 67–82.

Herrigan, M., Kochen, A., Williams, T., 2005. Analysis of asymmetries in intra-community trade statistics with particular regard to the impact of the Rotterdam and Antwerp effects. Statistics and Analysis of Trade Unit, HM Revenue & Customs,United Kingdom.

Hornok, C., Koren, M., 2015. Administrative barriers to trade. J. Int. Econ. 96, S110–S122.

Javorcik, B.S., Narciso, G., 2008. Differentiated products and evasion of import tariffs. J. Int. Econ. 76, 208–222.

Keen, M., 2003. Changing customs: Challenges and strategies for the reform of customs administration. International Monetary Fund.

Martincus, C.V., Carballo, J., Graziano, A., 2015. Customs. J. Int. Econ.

Mishra, P., Subramanian, A., Topalova, P., 2008. Tariffs, enforcement, and customs evasion: Evidence from India. J. Public Econ. 92, 1907–1925.

Montagnat-Rentier, G., Parent, G., 2012. Customs administration reform and modernization in Francophone Sub-Saharan Africa, 1995–2010. Washington: International Monetary Fund.

Nitsch, V., 2012. Trade mispricing and illicit flows, in: Draining Development? Controlling Flows of Illicit Funds from Developing Countries. Reuter, Peter, Washington.

Raballand, G., Cantens, T., Arenas, G., 2012. Mirror Trade Statistics: A Tool to Help Identify Customs Fraud, in: Reform by Numbers Measurement Applied to Customs and Tax Administrations in Developing Countries. Cantens, Thomas, Ireland Robert, Raballand Gaël, p. 103.

Rauch, J.E., 1999. Networks versus markets in international trade. J. Int. Econ. 48, 7–35.

Sequeira, S., Djankov, S., 2014. Corruption and firm behavior: Evidence from African ports. J. Int. Econ. 94, 277–294.

Stoyanov, A., 2012. Tariff evasion and rules of origin violations under the Canada-US Free Trade Agreement. Can. J. Econ. Can. Déconomique 45, 879–902.

The World Bank, 2015. Madagascar – Public Sector Performance Project : Pre-evaluation mission report – July 12 to 24, 2015 : Madagascar. The World Bank, Washington.

Widdowson, D., 2005. Managing risk in the customs context, in: Customs Modernization Handbook. De Wulf, Luc and Sokol, José B., Washington, pp. 91–99.

Widdowson, D., Holloway, S., 2011. Core border management disciplines: risk based compliance management, in: Border Management Modernization. McLinden, Gerard ; Fanta Enrique ; Widdowson David ; Doyle Tom, Washington, p. 95.

World Trade Organization, 2015. Examen des politiques commerciales. Madagascar. World Trade Organization, Geneve.

Zake, J.O., 2011. Customs Administration Reform and Modernization in Anglophone Africa-Early 1990s to Mid-2010. IMF Work. Pap. 1–45.

Zucman, G., 2013. The Missing Wealth of Nations: Are Europe and the US net Debtors or net Creditors? Q. J. Econ. 128, 1321–1364.

Appendix A: Supplementary Tables

Table 11: Main Exporting Countries

Country code	Country name	Imports (US$ millions)	Share of imports (%)	Share of revenue (%)
EUU	European Union	735	22	20
ARE	United Arab Emirates	581	17	25
CHN	China	536	16	15
IND	India	207	6	4
ZAF	South Africa	152	5	3
PAK	Pakistan	135	4	2
BHR	Bahrain	124	4	6
MUS	Mauritius	111	3	1
USA	United States	107	3	2
QAT	Qatar	74	2	0
THA	Thailand	63	2	3
TUR	Turkey	62	2	3
MYS	Malaysia	57	2	2
JPN	Japan	49	1	3
EGY	Egypt	46	1	2

Table 12: Main Positive Gaps, HS4 level [39]

HS4 digit code	Product description	Trade gap (US$ millions)	Estimated losses (US$ millions)	Estimated losses (% revenues minus oil)
6104	Women's or girls' suits, knit	19.21	9.16	2.76
6402	Foot wear	16.75	7.68	2.31
4202	Travel goods, handbags	16.10	7.16	2.16
8506	Primary cells and batteries	14.46	6.35	1.91
7004	Drawn and blown glass	13.20	5.10	1.53
1511	Palm oil	30.40	4.87	1.47
6204	Women's or girls' suits, not knit	17.97	4.83	1.45
9405	Lamps and lighting fittings	14.51	4.51	1.36
6301	Blankets and traveling	7.20	3.59	1.08

[39] Those chapters where the estimated gap is not considered reliable are excluded: oil (HS2 chapter: 27), used cars (HS2 chapter: 87), and production inputs for the textile industry (HS2 chapters: 50-59).

	rugs			
8517	Telephony	10.54	3.11	0.94

Table 13: Main Negative Gaps, HS4 level [40]

HS4 digit code	Product description	Trade gap (US$ millions)	Estimated losses (US$ millions)	Estimated losses (% revenues minus oil)
1006	Rice	-43.40	8.68	2.61
2523	Cement	-27.51	5.50	1.66
2521	Limestone flux	-21.71	4.34	1.31
1101	Wheat or meslin flour	-20.57	4.11	1.24
6006	Knitted or crocheted fabrics	-19.00	3.80	1.14
2814	Ammonia	-18.53	3.71	1.12
2503	Sulfur	-13.71	2.74	0.83
4907	Unused postage, check forms, banknotes, stock …	-13.47	2.69	0.81
1701	Cane or beet sugar	-11.22	2.24	0.68
0303	Fish, frozen	-11.09	2.22	0.67

Table 14: Main HS4 with a Ratio of Weights Close to unity, HS4 level

HS4 digit code	Product description	Trade gap (US$ millions)	Estimated losses (US$ millions)	Estimated losses (% revenue minus oil revenue)
8517	Telephony	10.54	3.11	0.94
8302	Miscellaneous articles of base metal	5.06	1.53	0.46
7013	Glassware for table, kitchen, toilet	3.06	1.38	0.42
8301	Padlocks, locks & keys	3.93	1.25	0.38
7323	Household articles and parts	2.64	1.16	0.35
8708	Parts and access for motor vehicles	3.97	1.14	0.34
8525	Tv cameras cordless telephones …	3.11	0.83	0.25
7306	Tubes, pipes and	2.46	0.59	0.18

[40]Those chapters where the estimated gap is not considered reliable are excluded: oil (HS2 chapter: 27), used cars (HS2 chapter: 87), and production inputs for the textile industry (HS2 chapters: 50-59).

	hollow profiles, iron and steel			
7219	Flat-roll stainless steel products	2.05	0.33	0.10
3926	Articles of plastics	2.12	0.31	0.09

Appendix B: Misclassification: The Case of Potassium Chloride and Diammonium phosphate

Table 15: Statistics for some Fertilizers

Nomenclature (HS6 digit code)	Urea (310210)	Potassium (310420)	Diammonium phosphate (310530)
Share of fertilizer imports	32.8%	2.1%	1.8%
Average export price (US$/kg)	0.32	0.30	0.47
Maximum export price(US$/kg)	0.35	0.32	0.51
Average declared import value	0.54	0.54	0.63
Declared import value (US$)	9,183, 320	585,562	504,990
M-X gap (US$)	2,569,561	149,728	132,145

Potassium chloride

In 2014, imports of potassium chloride (HS6 digit code: 310420) reached US$585,562. While the maximum monthly price on the world market during that period was US$0.32 per kg, the average price declared by importers was 70% higher (US$0.54 per kg). If one takes only those importers whose average unit value is abnormal (that is, at least 30 percent higher than the maximum world market price), the two largest importers turn out to be high risk (*cf.* Table 15). It should be noted that the largest importer (with a market share of 95 percent) is a new entrant.

Table 16: Characteristics of Importers identified as risky—Potassium Chloride

Tax identification number	Declared value (US$)		Price per kg		No. of import operations
	2014	2013	Average	Standard deviation	
0000000021	558,779	0	0.54	0.01	3
0000000022	26,050	86,168	0.52		1

Note: Only importers whose declared value per kg was at least 30 percent higher than the maximum monthly export prices and who declared a value higher than US$25,000 are presented.

Diammonium phosphate (DAP)

Imports of DAP (HS6 digit code: 310530) amounted to US$504,990. Although a comparison with the world market price and the average import price does not suggest anomalies,[41] it is noteworthy that the declaration pattern of one importer (the smallest) is quite inconsistent. Since his imports grew by 270 percent between 2013 and 2014, it suggests that the company is competitive in the DAP market. Yet, the importer declared an average unit value 43 percent higher than the maximum monthly world price (*cf*. Table 17).

Table 17: Characteristics of Importers identified as risky—DAP

Tax identification number	Declared value in US$		Price per kg		No. of import operations
	2014	2013	Average	Standard deviation	
0000000023	78,809	20,073	0.73	0.02	4

Note: Only importers whose declared value per kg was at least 30 percent higher than the maximum monthly export prices and who declared a value higher than US$25,000 are presented.

Appendix C: Suspected Types of Fraud according to the Value of Ratio Indicators

Table 18 presents the main possibilities of fraud for each combination of indicators (MdX, WMdWK, Rvd). Table 19 defines the abbreviations used. Due to differences in incoterm (imports are expressed *c.i.f* while exports are expressed as *f.o.b*), or potential losses during storage and transportation, etc., import and export values may be slightly different. In order to take into account these various small inconsistencies, we introduce a margin of error of 15 percent. It means that if the ratio of weights is in the range of 0.85 to 1.15, export and import weights are considered to be similar.

Table 18: Suspected Types of Fraud according to the Value of Ratio Indicators

M/X WM/WX	<1	=1	>1	Rvd
<1	M-, S & U			<1
=1	U			
>1	M+ , U	M+	M+, SO & U	
<1	S, M-			=1
=1		E		
>1			M+, SO	
<1				>1
=1			O	
>1			M+, SO & O	

Note: Commas are used as separators in this table.

[41] The declared unit value is 23 percent higher than the maximum monthly world market price.

Table 19: Description of Abbreviations Used

Abbreviation	Description
	Impossible
	Inconsistent
E	Expected
M-	Misclassification: the product is declared under another (hence, incorrect) heading
M+	Misclassification: under this heading, some products are misclassified
O	Overvaluation
S	Smuggling into country of import
SO	Smuggling into country of origin/export
U	Undervaluation