

How helpful are mirror statistics for Customs reform? Lessons from a decade of operational use

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Abstract

From a tool for trade economists, mirror data, which consist of comparing export and import data reporting by exporting and importing countries, have been increasingly used to detect potential fraud in developing countries. This dramatic change can be explained by the simplicity and low cost of using open worldwide databases. Even though mirror data discrepancies do not guarantee fraud records, this approach contributes to improved risk analysis (on origins and tariff lines, as well as brokers/importers, locations and inspectors), estimates of potential revenue losses, and new dialogue between customs administrations, importers, brokers and, sometimes, political authorities. The use of mirror statistics in developing countries is, therefore, promising and should be used increasingly for customs reforms. However, this statistical tool is even more efficient with other reforms, such as human resources reforms.

1. Introduction

Over the last decade, customs administrations have increasingly been using mirror statistics. This involves comparing export and import data reporting by exporting and importing countries.¹ While such analysis began in the mid-1960s, its use was limited to solving statistical issues in the field of trade economists for more than forty years. The dramatic expansion of its use can be attributed to mirror analysis contributing to the literature on governance and the discovery that it is an excellent operational tool for customs administration all over the world.

This paper demonstrates how mirror statistics can be helpful and operationalised almost immediately by customs administrations, especially in developing countries, to help improve risk analysis and fraud detection. It shows how powerful it can be and how it has been used by customs administrations in the last decade.

The use of mirror statistics began with trade economists in the 1960s. They have increasingly used mirror data to overcome the issue of missing values and insufficient quality in the reported data, increasing both the size and the quality of their samples. Mirror data were used for statistical purposes, for example exports from country *j* to country *i* would henceforth be used as substitutes for the reported data of imports of country *i* from country *j*, either because the data reported by trading partners are considered as more reliable or to deal with countries that do not report their data at all.² This was pioneered by Bhagwati (1964). Import data³ reported by country *i* from country *j* are usually considered as more reliable than the symmetrical exporting flow from country *j* to county *i*. Indeed, customs clearance processes, mostly occurring on the importing side, constrain the importers to a detailed declaration of the goods, including details such as their value, classification and weight.

After being used to increase database observations, mirror data have been used by trade economists as a common way to proxy trade costs, particularly transportation costs. Imports are traditionally reported CIF (cost insurance freight) while exports are registered FOB (free on board). Then, in a perfect world, the discrepancy between the two registered trade flows of the same good k (M_{ijk}/X_{jik}) should be trade costs. The ratio (M_{ij}/X_{ji}) is often reported as the CIF/FOB ratio in the literature. Yeats (1978), Rose (1991), Baier and Bergstrand (2001) and Hummels and Lugovskyy (2006) illustrate this frequent use of the mirror data.

However, while the use of the ratio (M_{ij}/X_{ji}) to proxy the trade costs makes common sense, empirical analysis from these authors evidenced that if a part of the (M_{ij}/X_{ji}) ratio was mechanically measuring trade costs (CIF vs FOB), the ratio clearly captures ‘something else’, as in many cases observed gaps appeared to be erratically driven. While one would expect a ratio in a range of values between 1.06 to 1.20, reflecting trade costs between 6 per cent and 20 per cent of the goods value⁴, ratio could be in a high number of cases either smaller than 1, suggesting negative trade costs (!), or conversely, higher than 2 or 3, suggesting trade costs way high to be credible. Hummels and Lugovskyy (2006) exhibit from a sample of 17,790 country pairs of 1997 that hardly 50 per cent of the total bilateral trade flows have magnitude orders that could be considered as ‘reasonable’, while ratios computed from their sample often happened to be lower than 1.

This highlighted the fact that ‘something else’ other than just the transportation costs were captured by this ratio.⁵ Some authors argue it was pure noise, suggesting that country pairs exhibiting ‘abnormal’ ratios be removed from empirical analysis. However, more disaggregated data has shown that such ‘abnormal’ ratios are usually focused on some country origins and for a limited number of products or tariff lines and most tariff lines and origins do not exhibit such problems.⁶

New literature in the last two decades has demonstrated the importance of poor governance on mirror statistics discrepancies, enabling its use to go beyond this ‘something else’ and to dramatically expand the field of use of such data.

The remaining sections present the wide variety of mirror statistics used to capture governance problems, demonstrate the most operationally relevant use for customs administrations and shows some possible way forward on how to make the use of mirror statistics even more efficient.

2. Mirror data – a reliable instrument to capture governance problems

Customs fraud may be in the form of under/overvaluation, misclassification, smuggling or fraud at origin. These are the main avenues through which unscrupulous traders undertake international trade-based money laundering and illicit financial flows (IFFs). Spanjers and Salomon (2017) estimate that 87 per cent of the IFFs in the developing countries from 2005 to 2014 were through trade mis-invoicing. This is why it is critical for Customs to detect potential under/over valuation and misclassification to prevent tax evasion, money laundering and IFFs. A large body of literature has demonstrated empirically the correlation between the mirror statistic discrepancies (for a limited number of products) and corruption or taxation, both at the global level and the country level.

Poor governance at land borders or ports, reflecting both a lack of capacity or skills and/or corrupted customs officers in collusion with fraudulent importers, may result in undervaluation or misclassification in customs declarations. Substantial undervaluation in imported goods by fraudulent importers willing to evade taxes will result in lowered M_{ij}/X_{ji} ratio. Mirror data are henceforth used here to compute the M_{ij}/X_{ji} ratio in order to capture poor governance issues at the border, trying to identify any pattern

and relationship between the ratio and governance or macroeconomics variables through econometric models. Misreporting can be on the values, on the quantities or on the goods classification to evade taxes by declaring a tariff line from a lower tax band.

Recent papers mostly consider ‘abnormal’ ratios (e.g. too high (over 50%) or smaller than 1), reflecting governance issues related to customs clearance. Empirically, worldwide or country analysis points again and again to poor governance, such as the level of corruption or tariff evasion to escape the high level of taxation faced by certain goods.

2.1 At the global level

Part of the literature has over the last decade focused its attention on the correlation between mirror statistics discrepancies and macroeconomic variables regarding governance and public sector integrity indicators, such as corruption level, tariff level and the complexity of its structure.

Carrere and Grigoriou (2014) use a gravity equation over a worldwide panel at the HS6 level (3.5 million observations) to highlight a robust relationship between the M_{ij}/X_{ji} ratio and macroeconomic variables like the average tariffs, but also foreign direct investment, suggesting profit shifting, and the implementation of regional trade agreements. They furthermore run a probit estimate over 7 million observations to predict ‘orphan imports’, which are imports reported by importing countries without the equivalent flow reported by the exporting country. Up to 68 per cent of the misclassification cases are accurately predicted by the set of macroeconomic variables previously mentioned. Carrere and Grigoriou conclude that discrepancies from the mirror data are not erratically driven, part of the ratio being predicted by macroeconomic variables, suggesting a relationship between misreported trade flows and fraud opportunities to evade tariffs and taxes and/or poor governance.

Javorcik (2017) uses the M_{ij}/X_{ji} ratio to test the impact of World Trade Organization (WTO) accession on tariff evasion. Indeed, countries accessing WTO are committing to World Customs Organization (WCO) valuation agreements, implying an increased level of transparency from customs officials, (expectedly) resulting in lowered corruption and undervaluation (increased ratio M_{ij}/X_{ji}). From the sample of 15 countries having joined the WTO between 1996 and 2008, they find that tariff evasion through underreported values decreased after the accession, even though it is substituted by underreporting of the quantities where the tariff rate has been increased after the accession.

2.2 At the country level

Fisman (2004) demonstrates that, in the context of the bilateral trade between China and Hong Kong, there is a significant relationship between the ‘evasion gap’ and the tax rates: the higher the tariff and tax rates, the lower the M_{ij}/X_{ji} gap (i.e. the higher the undervaluation of imports). Fisman’s findings suggest that this tax evasion is processed not only through undervaluation but also through misclassification.

Javorcik (2008) demonstrated similar findings over German bilateral trade, highlighting a strong correlation between the discrepancy and the tariff level, which appeared to be even stronger for differentiated products. Javorcik concludes that, in the German context, the discrepancies largely reflect poor reporting.

Rijkers (2015), looking at Tunisian bilateral trade, showed that the correlation between the discrepancy and the tariffs is not homogeneously distributed but is strongly correlated to the proximity of the importer with the political power (i.e. the discrepancy is stronger when the importer is close to the government). In the same country, Tunisia, Ayadi, Benjamin, Bensassi and Raballand (2013) assessed that at the disaggregated level of trade data, for common reported flows between Tunisia and Libya and Algeria, underreporting of imports by Tunisia Customs was, on average, around a factor of 3. The potential large undervaluation by two-thirds of the export price value was confirmed by surveys at borders and it was estimated that informal trade with Algeria was higher than the official trade.

Many other applications of the use of mirror statistics have been performed over almost all regions of the world to detect statistic discrepancies and map sectors and goods with the highest observed discrepancies, which can only be explained by fraud practices or smuggling. To name some, Kaminski and Raballand (2009) could be quoted on Central Asia; Raballand and Mjekiqi (2010) on Nigeria; Bensassi, Brockmeyer, Pellerin and Raballand (2015) on Mali; and Hamanaka (2011) on Cambodia.

Finally, Anson, Cadot and Olarreaga (2006) use the M_{ij}/X_{ji} ratio to assess improvements in governance at the border in the context of pre-shipment inspection program (PSI), considering most of the poor governance is explained by undervaluation by importers, in collusion or not with customs officers. They henceforth regress the M_{ij}/X_{ji} ratio on a set of explanatory variables, including a variable to capture the potential impact of PSIs, trying to measure their ability to decrease the fraud and, consequently, increase the collected taxes at the border. Empirical analysis relying on bilateral trade data for Philippines, Indonesia and Argentina reveal mixed evidence of the impact of PSIs on undervaluation.

3. Mirror data to identify fraud channels and the operational use for customs administrations

Another wave of studies identifies fraud channels and quantify possible revenue losses at a macroeconomic level. It started with a detailed analysis done in Cameroon (Raballand, Cantens, & Guillermo; 2012), then in Tunisia (Ayadi et al., 2013), in Mali (Bensassi et al., 2015) and in Madagascar (Chalendard et al., 2016). In the meantime, WCO published a research paper to explain how to use this method operationally for customs administrations (Cantens, 2015). Other similar studies were carried out in some Sub-Saharan African (SSA) countries even though not published.

All these studies have in common that they were carried out at a disaggregated level (HS6⁷), in countries facing smuggling and widespread fraud practices, high levels of corruption and relatively complex tariff structures (although slightly less relevant for Madagascar).

These studies, while carried out in different sub-regions, have interestingly led to some invariant findings:

1. A strong correlation between tariff peaks (and tariff complexity) and statistics gaps.
2. Gaps are limited to less than 10 products BUT in all countries, statistics gaps are for the same types of products (which are usually considered at risk by customs administrations).
3. The main gaps concern some food products (vegetable oil, sugar, rice), clothes and footwear, some manufactured products (motorcycles, phones), construction materials (including cement), fuel, low-selling price density (such as fertilizers) or products exempted from duties/VAT in some countries (like rice).
4. In terms of estimates of revenue losses, even though they are minimal estimates, at least 20 per cent to 30 per cent of total customs revenues can be identified through mirror statistics largest discrepancies.

The increasing operational use of mirror statistics by customs administrations can be explained by the following reasons:

- it is easy to use to initiate or rapidly improve risk analysis
- it generates numbers that can contribute to change dialogue with importers and brokers.⁸

Mirror trade statistics is an easy tool to use and comes at near zero cost. The skills requirements of mirror analysis are readily available for customs officers with basic analytical skills and already used to working with statistical or database management software. The data collection from both the local

systems and the United Nation's COMTRADE, as well as the training to acquire the ability to manage mirror trade statistics analysis only require a gentle learning curve (see Cantens (2015) for a step-by-step guide on computing trade gaps, interpreting various typologies and assessing potential revenue losses).

Mirror trade statistics is also important for risk management. Customs administrations have computer systems with selectivity modules that are based on fraud or risk profiles. But the objective (i.e. non-arbitrary) definition of these risk profiles requires a sound historical database from the results of the previous physical inspections, which is an issue when it comes to initiating a risk management strategy for a given customs administration. Moreover, risk management mostly must cope with situations where corruption is rampant, making the achievement of such sound historical databases on the feedback from previous controls difficult, eventually preventing the objective identification of new fraud patterns (Cantens, 2015). Mirror trade statistics indeed complements such risk analysis approaches by suggesting (additional) potential fraudulent trade flows patterns, relying on the use of external data instead of poorly reported internal data.

Moreover, sectoral studies are also being produced using mirror statistics to focus the controls on the riskiest operators and goods. Chalendard et al. (2016) used mirror trade statistics to identify and target products and sectors that were deemed risky in Madagascar, enabling the targeting of non-compliant customs operators.

Mirror trade statistics can be used for both frontline customs officers and investigation services. Mirror trade statistics may also be useful for post-clearance audits (PCAs) because it can be used as an objective way of flagging anomalies like tariff slippage, under or over valuation and origin fraud. Moreover, the average declared price for a commodity and declaration can easily be established and then compared with international prices or with any other information internally collected by tax administration. Such fraudulent flows may then be targeted during the PCA, where investigation teams have more time to deeply review the declared values and thereby enhance the effectiveness of audits.

As indicated by Cantens (2015), mirror trade statistics can initiate experimental fraud control systems, especially on major identified cases at both national and international level. Thus, mirror trade statistics can be conducted and lead to formation of some hypotheses on the suspected fraudulent trade flows and importer behaviour. Then, this can be cross-checked with experiences or observations of frontline customs officers on the ground. Eventually, this generates powerful and detailed leads to fraudulent trade flows to be targeted for audits and further investigations.

This approach was followed in Cameroon. As reported in Raballand et al. (2012), Cameroon Customs had closely monitored the trend in statistics gaps after having focused controls in some identified sectors and demonstrated that the strengthened control of some goods had led to decreased mirror statistics gaps.⁹

With a similar approach, Kalizinje (2018) employed mirror trade statistics in order to identify, classify and approximate customs revenue fraud in Malawi's 2015 trade data. The identified fraud was in the form of smuggling, misclassification, undervaluation and overvaluation. The analysis revealed plausible fraud cases in various products and this informed customs policies in risk analysis, enforcement and PCAs. A fraud control plan to help stop the identified customs revenue leakages was proposed.

Furthermore, in developed countries and according to WCO (2015), the Italian Customs and Monopolies Agency also employed mirror trade statistics to identify undervaluation of imported textiles from the Far East through the port of Naples. Through mirror trade statistics they were able to establish high-risk transactions, perform price analysis on international markets and use tools like technical analysis to identify threshold values and consider further examination. Since 2004, the Italian Customs and Monopolies Agency has realised an increase in the average declared values per kilogram. For instance, between 2003 and 2012 the average import value of textiles and related products increased by nearly four-fold.

Revelations on the possible quantitative assessments of customs fraud reinforces the enforcement strategy of customs administrations and helps in initiating a dialogue with economic operators and other relevant stakeholders like importers. By quantifying the extent of possible fraud and identifying the most likely sectors to fraud, it contributes to change dialogue with importers/brokers. After having identified possible fraudulent trade flows, customs administrations can engage relevant stakeholders.

4. A way forward?

Despite its usefulness, mirror statistics still suffer from some limitations that should be tackled in the future to make this approach even more effective. Four areas need to be kept in mind when Customs use mirror statistics for an operational purpose:

1. The use of mirror statistics is even more powerful when coordinated with other public agencies and private agents (e.g. tax department, company registry, social security institutions, banks, security forces, anti-corruption agencies). A coordinated inter-agency approach helps Customs to fight fraud more efficiently.
2. As explained by Raballand et al. (2009), mirror statistics are more useful when complemented with surveys and other methods of investigations. It is important to cross-check and investigate thoroughly with other sources of information to confirm fraud in a country.
3. It remains almost impossible to carry out mirror statistics analysis on a real-time basis due to reporting lags of exporters. Some real-time mechanisms of automatic exchange of information, like implemented in tax administrations in the world, should be replicated in Customs, probably with impetus from the WCO.
4. Mirror statistics use will be more powerful if packaged with a set of reforms regarding governance at the border, including human resource reforms that include better staff monitoring at the team and individual level (as was consequently implemented in Cameroon and Madagascar).

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Notes

- 1 Bilateral comparisons of two basic measures of a trade flow. It is a traditional tool for detecting the causes of asymmetries in statistics. For further details and explanations, see EUROSTAT (1998).
- 2 Papers using worldwide bilateral trade data at the highest level of internationally harmonised disaggregation (hs6) to model trade patterns from gravity equation have been typically using mirror data for their empirical estimates (e.g. Anderson & Van Wincoop, 2003; Carrère, 2006; Anson, Cadot & Olarreaga, 2006). Another well-known example of use of mirror data for solving such statistical issue is the database BACI provided by the CEPII (Gaulier, 2010), reconciling both flows in a single one.
- 3 The accuracy of the declaration is critical for the importing country as declared value of imported goods is the tax base for the calculation of duties and taxes. Documentary or physical controls of the declaration might be consequently done by customs officers to verify its accuracy. On the other hand, exported goods are rarely taxed or controlled, which explains why the declarations of export might usually be considered less accurately filled.
- 4 This ratio can even reach 25 per cent for some landlocked countries but this is exceptional.
- 5 There are some valid explanations of statistics discrepancies, such as reporting period at the end of the year, some exchange rate conversion issues. However, Raballand et al. (2012) demonstrate how the possible explanations may not explain ratios of 100–200 per cent discrepancies or even more that were captured for some tariff lines in some countries worldwide.
- 6 Mirror statistics are easier to use for trade between developed and developing countries and is more difficult to use for neighbouring developing countries that share land borders because smuggling is the easiest between neighbouring developing countries (confirmed by Bensassi et al., 2016 in Mali and in Raballand et al., 2010 in Nigeria).
- 7 Harmonized system. The UN trade classification system.
- 8 Indirectly, mirror statistics may also contribute to data quality. The Common Market for East and Southern Africa (COMESA) pursues a statistics strategy that aims to ensure the availability of quality, timely and harmonised statistics in the regional bloc and, for instance in 2017, spearheaded a bilateral mirror merchandise trade statistics reconciliation workshop between Malawi and Zambia. The exercise was attended by representatives from national statistical offices and revenue authorities. In this task, mirror trade statistics was used to identify, process, explain and assess the causes of trade gaps between the two trading countries.
- 9 A similar trend was recorded in Madagascar with rice following the publication and dissemination of the paper written by Chalendar et al. (2016).

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