



Use of Mirror Analysis for Supporting Essential Data Elements for Exchange Information, in order to Mitigate Risk of Trade Mis-invoicing and to Reduce the Illicit Financial Flow

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United Nations Network of Experts for Paperless Trade and Transport in Asia and the Pacific

Working Paper

No. 2 | 2023

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Please cite this paper as:

Davaa, T., Gurjav, E. and Khuderchuluun, M. (2023). “Use of Mirror Analysis for Supporting Essential Data Elements for Exchange Information, in order to Mitigate Risk of Trade Mis-invoicing and to Reduce the Illicit Financial Flow”, **UNNEXT Working Paper Series** No. 2, September 2023, Bangkok, ESCAP.

Available at <https://unnex.unescap.org/>

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Abstract

The main purpose of this paper is to examine how to use mirror analysis⁴ for mitigating the risks of trade mis-invoicing and reducing Illicit Financial Flows (IFFs), and affirm it by using mirror analysis in the bilateral trade of four countries.

The term IFFs came into the being in the 1990s, and trade mis-invoicing is the main channel of IFFs (Choi and McGauran, 2018). Combatting cross-border illegal movement activities are not only the responsibility of customs administrations, but also many other law enforcement agencies, including intelligence, police, tax and other authorities that need to cooperate in fighting against IFFs. Therefore, close cooperation among these agencies is required on both the strategic and operational levels.

Clear essential data elements are the best solution for maintaining, developing and strengthening frameworks for exchanging information among the contracting parties. The methodology used in this paper relied on data available at the international level from the World Customs Organization (WCO), United Nations policy documents and the World Trade Organization's (WTO) International Trade Centre database. One of the solutions for identifying trade mis-invoicing is to conduct a mirror analysis on bilateral trade. Mirror analysis could guide its users on how to filter specific high-risk goods involved in trade mis-invoicing. In addition, it is a useful tool for analysing primary data. However, it must be followed up by action in order to eliminate IFFs. For example, Memoranda of Understanding (MoU) between trading countries should be established to conduct mirror analyses and exchange information about high-risk goods in real time. Such action improves the quality of risk profiling and supports facilitating legitimate trade movements.

This paper comprises five sections. Section 1 presents the introduction and the methodological framework of this study. Section 2 provides the conceptual framework for conducting a mirror analysis and introduces the mode of trade mis-invoicing, which is a main channel of IFFs. Section 3 begins with an overview of the international trade (trade in goods) of China, the Republic of Korea, Japan and Mongolia. It then summarizes an overview of the international trade environments of those selected countries.

In section 4, the mirror analysis estimates bilateral trade among China, the Republic of Korea, Japan and Mongolia in the Asia-Pacific region (goods classified under the HS⁵ 2-digit, 4-digit and 6-digit levels). To undertake a mirror analysis, data provided by INTRACEN and United Nations Comtrade were used. A mirror analysis was made on bilateral trade between Mongolia and China using customs clearance data base.

⁴ The mirror analysis involves comparing mirror imports (or exports) of a country with exports (or imports) reported to this country by its partner countries in order to detect gaps in terms of quantities, weight or value that may unveil fraudulent flows or practices (Cantens, 2015).

⁵ The Harmonized Commodity Description and Coding System, which is generally referred to as the "Harmonized System" or simply "HS", is a multipurpose international product nomenclature developed by the WCO. It comprises about 5,000 commodity groups; each identified by a six-digit code, arranged in a legal and logical structure and is supported by well-defined rules to achieve uniform classification. The system is used by more than 200 countries and economies as a basis for their customs tariffs and for the collection of international trade statistics.

Section 5 provides the main findings of the study and presents further recommendations.

Keywords: international trade, trade mis-invoicing, illicit financial flows, mirror analysis

JEL Codes: F14, H26, K42

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Acronyms and Abbreviations

CIF	Cost, Insurance and Freight
CN	People Republic of China
EPA	Economic Partnership Agreement
EX	Export
FOB	Free on Board
FTA	Free Trade Agreement
GATT	General Agreements on Tariff and Trade
GFI	Global Financial Integrity
HS	The Harmonized Commodity Description and Coding System
HS 2-DIGIT	Harmonized System Chapter
HS 4-DIGIT	Harmonized System Heading
HS 6-DIGIT	Harmonized System Sub Heading
HS 8-DIGIT	Harmonized System National Subheading
IFFs	Illicit Financial Flows
IM	Import
INTRACEN	International Trade Centre
ISO	International Organization for Standardization
JP	Japan
KR	Republic of Korea
MN	Mongolia
MOU	Memorandum of Understanding
RKC	Revised Kyoto Convention
SAFE	Secure and Facilitate Global Trade (Framework of Standards)
TFA	Trade Facilitation Agreement
UN	United Nations
UNCOMTRADE	United Nations Commercial Trade Data
UNCTAD	The United Nations Conference on Trade and Development
UNESCAP	United Nations Economic and Social Commission for Asia
VAT	Value Added Tax
WB	World Bank
WCO	World Customs Organization
WTO	World Trade Organization

1. Introduction

Customs administrations around the world are highly focused on eliminating the cross-border illegal movement of goods, as it mainly leads to revenue losses for them. Recently, many customs administrations have not only acted alone in combatting cross-border illegal movement of goods, but also closely cooperated with other law enforcement agencies, including police, intelligence agencies and others, both on the national and the international levels.

Trade mis-invoicing is closely related to the study of IFFs, the combatting of which has been explicitly included as part of the 2030 Development Agenda as the target 16.4 (Kravchenko, 2018). Several documents and standards encourage exchanging information among trading partners including the Revised Kyoto Convention (WCO, 1999), WCO SAFE Framework of Standards (WCO, 2005), WCO data model, the WTO Agreement on Trade Facilitation,⁶ the United Nations Economic and Social Commission Framework Agreement on Facilitation of Cross-Border Paperless Trade in Asia and the Pacific (ESCAP, 2016), among others. In addition, various studies and guidelines related to IFFs have been produced by international organizations, researchers, practitioners and others.

Without suitable and efficient data analysis it is difficult to mitigate trade mis-invoicing and eliminate IFFs. Consequently, this study attempts to identify appropriate data elements used in mirror analysis for exchanging information between trading partners. There are a number of recommendations for mitigating trade mis-invoicing and reducing IFFs, guides on conducting mirror analysis with the appropriate risk profiling, and future activities. The scope of such an analysis is as follows:

- An empirical analysis based on five years of international trade statistics (see <http://www.intracen.org/>) from China, the Republic of Korea, Japan and Mongolia;
- Tools and instruments in the area of customs issues and international trade, which have been adopted by the United Nations, WCO, WTO, ESCAP, Global Financial Integrity (GFI) and others; and
- Reports and studies by WTO, WCO, GFI, the World Bank, World Integrated Trade Solution Software, the United Nations Conference on Trade and Development (UNCTAD) and others.

This study uses both quantitative and qualitative methods as follows:

- Mirror analysis for assessing risks of cross-border trade;
- Institutional theory and public theory; and

⁶ Article 8.2: 'each Member shall, to the extent possible and practicable, cooperate on mutually agreed terms with other Members with whom it shares a common border, with a view to coordinating procedures at border crossings to facilitate cross-border trade; and Article 12.2: Exchange information etc (WTO17).

- The common methods of econometric and social-business as well as comparisons, which are used to identify essential data for exchange between trading countries.

Data analysis in the study was carried out using Microsoft Excel and E-views software.

2. Literature review on trade mis-invoicing and mirror analysis

2.1 Trade mis-invoicing

International trade plays an important role in the economic development of countries. In fact, it can be said that it is an engine of economic growth. International trade supply chains involve more than 25 stakeholders, including importers, exporters, banks, customs administrations, port authorities, customs brokers, freight forwarders, transport service suppliers, and logistics companies, both in exporting and importing countries. The effectiveness and efficiency of international trade requires close cooperation among stakeholders.

In exercising customs controls, customs administrations interact with different stakeholders and deal with different risk areas, such as national security, revenue and economic prosperity. The traditional customs procedures, such as examining documents and undertaking physical border controls aimed at detecting illegal trade, is a costly and time-consuming process. Customs administrations need to focus on the cost efficiency of their own activities. Risk-based customs controls can produce effective and efficient results both for customs and traders. Therefore, targeting high-risk selections is a more useful method than the random check selection method.

The WCO has adopted tools and instruments⁷ for its member customs administrations. Article VIII of the WTO General Agreement on Tariffs and Trade (GATT) recognizes the need to minimize “the incidence and complexity of import and export formalities...[by] decreasing and simplifying import and export documentation requirements” (WTO, 1994).

Article 7.4 of the WTO Trade Facilitation Agreement also includes measures for risk management⁸ in customs (WTO, 2014). Other international organizations are focusing

⁷ The International Convention on the Simplification and Harmonization of Customs Procedures, 1999; Guidelines on Customs Control, 1999; Risk Management Guidelines, 2004; SAFE Framework of Standards to Secure and Facilitate Global Trade (WCO, 2005); The Global Information and Intelligence Strategy (WCO, 2005); Customs in the 21st Century (WCO, 2008); Risk Management Compendium (2011); Guidelines for Post Clearance Audit (WCO, 2012); Implementation Guidance on Post Clearance Audit (2016); Commercial Fraud Manual (2004-2016);

⁸ 4.1. Each Member shall, to the extent possible, adopt or maintain a risk management system for customs control; 4.2. Each Member shall design and apply risk management ... 4.3. Each Member shall concentrate on customs control and on high-risk consignments, and expedite the release of low-risk consignments. 4.4. ...risk management on an assessment of risk through appropriate selectivity criteria (WTO, Agreement on Trade Facilitation).

on improving the facilitation of trade, including the World Bank through its *Doing Business (Trading Across Borders)* report. This report includes the best practices of countries in the area of trade facilitation.

Global Financial Integrity⁹ has suggested that more than 80% of IFFs are accompanied by trade mis-invoicing (Choi and McGauran, 2018). The importance of the role of customs in combatting IFFs as well as the findings of studies and research papers are highlighted with initiatives that are being implemented successfully by some customs administrations.

Table 1 lists definitions of trade mis-invoicing from different sources. The meanings of the definitions are similar (it is illegal) based on the calculation of imports and exports and that the main purposes are IFFs, but the explanations are slightly different.

Table 1: Definitions of trade mis-invoicing

Definitions	Sources
Trade mis-invoicing is a method for moving money illicitly across borders that involves the deliberate falsification of the value, volume and/or type of commodity in an international commercial transaction of goods or services by at least one party to the transaction.	Global Financial Integrity (2020).
Trade mis-invoicing occurs if the true value of exports or imports deviates from the amount of exports or imports that businesses report to the authorities.	Buehn and Eichler (2011).
Trade mis-invoicing involves misreporting in the invoices of imported and exported commodities for various malign purposes.	Qureshi and Mahmood, (2015).
Trade mis-invoicing, or simply mis-invoicing, refers to a means of illegally moving large amounts of money across national borders via misreporting or misrepresenting the total value of a given commercial transaction exchange.	Herold financial dictionary (2014-2020).
Trade mis-invoicing is a form of customs and/or tax fraud involving exporters and importers deliberately misreporting the value, quantity or nature of goods or services in a commercial transaction.	Illicit Financial Flows, Trade Misinvoicing, and Multinational Tax Avoidance: The Same or Different? (Forstater, 2018)
Trade mis-invoicing occurs when the value of an export or import transaction is different from the arm's length ¹⁰ value of such transaction.	Tackling illicit financial flows to unleash funds for development, UNCTAD, 2020.

There are four main standard types of trade mis-invoicing – import over-invoicing, export under-invoicing, import under-invoicing and export over-invoicing – as shown in

⁹ Global Financial Integrity (GFI) (2020) is a Washington, D.C.-based think tank that produces high-calibre analyses of [illicit financial flows](#), advises developing country Governments on effective policy solutions and promotes pragmatic transparency measures in the international financial system as a means of global development and security.

¹⁰ The arm's length principle requires that the conditions (prices, profit margins etc.) in transactions between related parties should be the same as those that would have prevailed between two independent parties in a similar transaction under similar conditions (WCO Guide to Customs Valuation and Transfer Pricing, 2018)..

figure 1. These include two ways of illicitly sending funds into other countries (IFF inflows) and two ways of illicitly sending funds out of a country (IFF outflows). In each case, either method could be used by manipulating invoices for either imports or exports (GFI, 2017).

Figure 1: The four main types of trade mis-invoicing and their common purpose

IFF OUTFLOWS	IFF INFLOWS
<p>Import over-invoicing to:</p> <ul style="list-style-type: none"> • Send money abroad (evading capital controls, moving wealth into a hard currency etc.); • Overstate the cost of imported inputs to reduce income tax liability; • Avoid anti-dumping duties. <p>Export under-invoicing to:</p> <ul style="list-style-type: none"> • Move wealth into a hard currency etc.); • Evade income taxes (lowering taxable income levels); • Evade export taxes. 	<p>Import under-invoicing to:</p> <ul style="list-style-type: none"> • Evade customs duties or VAT taxes; • Avoid regulatory requirements for imports over a certain value. <p>Export over-invoicing to:</p> <ul style="list-style-type: none"> • Exploit subsidies for exports; • Exploit drawbacks (rebates) on exports.

Source: Value Gap Trade Mis-invoicing Methodology (GFI, 2017).

Figure 1 describes the main types of trade mis-invoicing, and their common purposes. In general, trade mis-invoicing cases¹¹ are frequently under- and over-valuation fraud as well as mis-description, mis-classification etc.

One of the methods for identifying trade mis-invoicing cases is to compare mirror statistics from trading partners. That is, to compare the exports from one country with the imports of another. For example, if Mongolia exports goods valued at US\$ 5.1 million to China, but China reports a different amount – for example, US\$ 6.1 million – of imports from Mongolia, a potential case of trade mis-invoicing can be flagged.

2.2 Mirror analysis

The word “mirror” can be defined as a reflecting surface, which was originally of polished metal but is now usually made of glass with a silvery, metallic or amalgam backing. Mirror analysis refers to a system where exportation by country “X” is matched with country “Y” importation, like a mirror. Mirror analysis is a useful tool for developing risk profiles and targeting either high- or low-risk shipments.

There are a number of mirror analysis definitions: (1) mirror data are bilateral data where each quantity is reported twice (Cate, 2017); (2) bilateral comparisons of two basic measures of trade flow; and (3) a traditional tool for detecting the causes of asymmetries in statistics (Eurostat, 1998). Mirror analysis involves comparing mirror

¹¹ Causes of import over-invoicing in illicit outflows of funds from a country. Export under-invoicing can also be used for moving money abroad, while import under-invoicing is often used for the purpose of customs and other types of duty evasion, and export over-invoicing also results in illicit inflows of funds into a country.

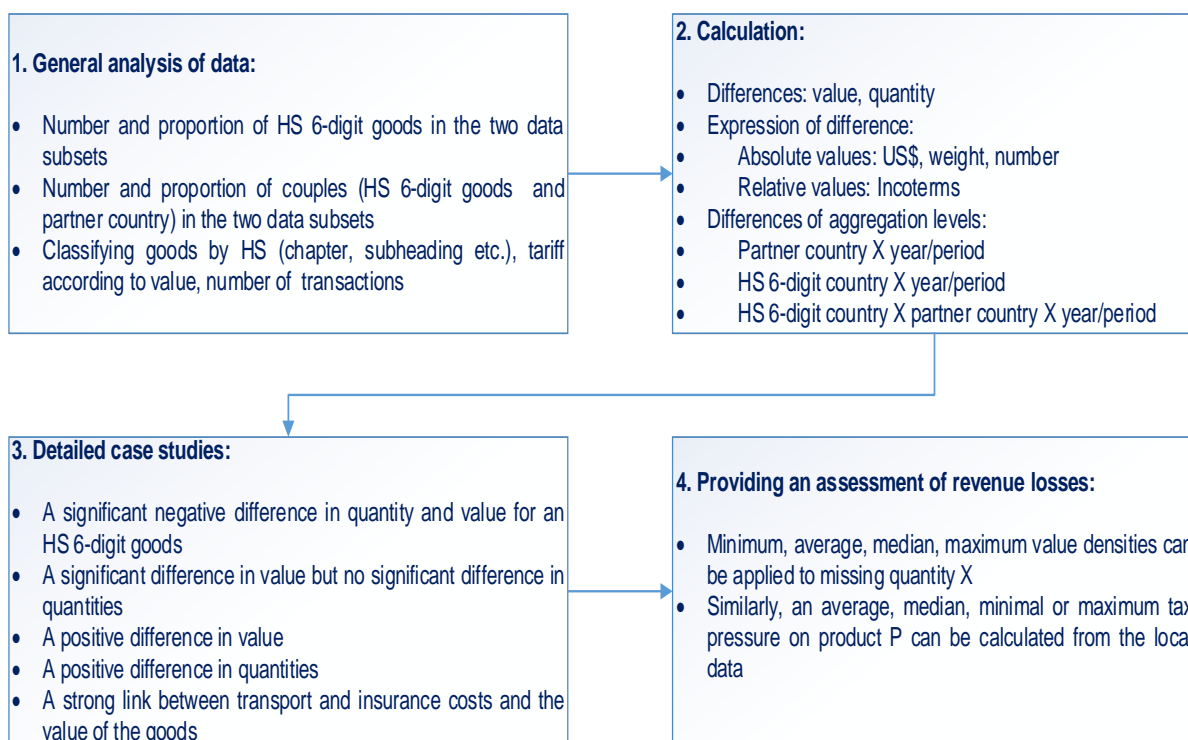
imports (or exports) of a country with exports (or imports) reported to this country by its partner countries in order to detect gaps in terms of quantities, weight or value that may unveil fraudulent flows or practices (Cantens, 2015).

Mirror analysis is guided by big data to filter high-risk transactions in order to detect commercial fraud risk. There are various categories of commercial fraud, and it is a useful methodology for assessing the risk of trade mis-invoicing. According to the *Commercial Fraud Manual for Senior Customs Officials* (WCO, 2006), commercial fraud can be categorised as “revenue, non-revenue or both”. False declarations of quality or quantity, misdescriptions and misclassification frauds are related to both revenue fraud and non-revenue risks, while valuation fraud is related only to revenue-loss risks.

A number of Customs Unions and Regional Communities use an integrated clearance database with specific criteria so that they can identify high-risk shipments by details such as transport number, HS code, shipping line, exporter, and importer name and country of origin. The benefit of mirror analysis is that it makes it easier for customs administrations to identify commercial fraud risks.

WCO Research Paper No. 35, *Mirror analysis and revenue fraud* (Cantens, 2015) explains the theoretical aspects of mirror analysis and the associated methodological debate. Figure 2 outlines a number of options for conducting mirror analysis.

Figure 2: Possible stages of mirror analysis



Source: *Mirror Analysis and Revenue Fraud*. Cantens, 2015, pp. 11-14.

The main component of mirror analysis is the processing of big data, using econometric models. Eurostat has defined the formula to apply when mirror analysis is used for identifying possible deviations, which are expressed in percentages, between the values of the country initiating the mirror analysis and the value of the partner country (Eurostat, 1998) and asymmetries that occur when the declaration of the importer in country A is not consistent with the declaration of the exporter in country B (Eurostat, 1998; Montenegro, 2011). For example:

$$\text{Asymmetry} = OF_{AB} - mIF_{AB} \quad (\text{Formula 1});$$

$$\text{Deviation } A_B = \text{ABS} \frac{OF_{AB} - mIF_{AB}}{(OF_{AB} + mIF_{AB})/2} \quad (\text{Formula 2});$$

DA_B : The difference expressed in percentage after the calculation;

OF_{AB} : Outbound flow going from country A to country B;

mIF_{AB} : Mirror inbound flow;

ABS represents the absolute value. Asymmetry represents the difference between mirror values.

Deviation percentage is ranged between 0 and 200. If there is no deviation, it means that there is no difference in the data between two countries which is a very rare occurrence, if the deviation percentage is 200 it implies that one of countries has not

reported the external trade (Montenegro, 2011). In accordance with the defined rules of mirror analysis, three levels of deviation exist, as set out in table 2.

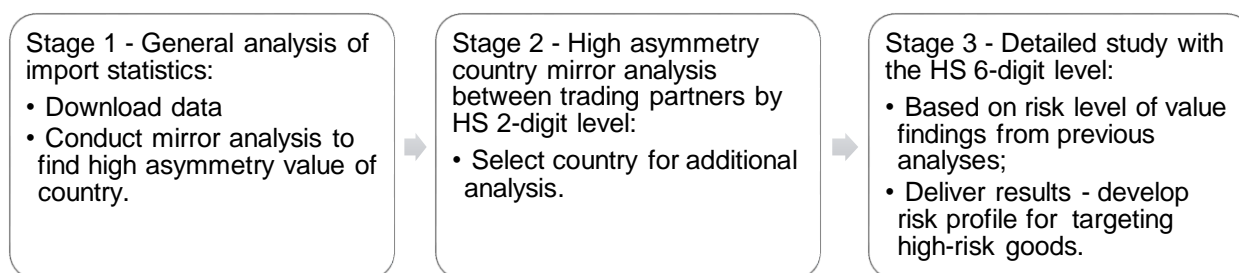
Table 2: Risk level rate of deviation

Range of percentage	Rate of deviation	Measurement
0–15	Low	Mirror analysis requires both value and quantity calculation at the HS 6-digit level.
15–50	Medium	Over 30% needs additional deviation analysis
More than 50	High	Indicating irregularities or very serious imbalances in the external trade

Source: *Mirror Analysis of External Trade of Montenegro (Montenegro, 2011)*.

Deviation can be used to estimate whether a country is declaring a higher or lower level of flows compared with the mirror flows declared by its partner countries. This study uses three stages of mirror analysis which are presented in figure 3.

Figure 3: Stages for conducting mirror statistical analysis



Source: *Authors*

As mentioned above, conducting a mirror analysis comprises several stages, depending on the data available for analysis. The estimates presented are based on the HS 6-digit level trades from internationally accepted open sources (International Trade Centre and United Nations Comtrade).

Aggregation is likely to add significant bias to the estimates as some outflows within a 6-digit aggregation may cancel out inflows. Moreover, aggregation masks deliberate product-level mis categorizations to take advantage of lower tariffs/bypass no-tariff measures. Ideally, detailed bilateral transaction level data would be used to conduct such analysis (Kravchenko, Trade, Investment and Innovation Working Paper Series № 01, April 2018). In Section 4 of this paper, a mirror analysis of bilateral trade between Mongolia and China is made by using a customs clearance database (so it is Stage 4 of mirror analysis).

First, it is necessary to identify high asymmetry of import partners from big trade data. Although administrations know their main import partner countries, customs need to

analyse a respective import database from different time periods in order to assess high-risk shipments. Conducting a mirror analysis needs to identify factors related to:

- Time lag;¹²
- Customs valuation (FOB for exports and CIF for imports);
- Trade threshold (*di-minimis*);¹³
- Classifications of goods;
- Simplified procedures (goods and partners);
- Trade system;¹⁴
- Currency exchange rates; and
- Customs territories.

These factors are dependent on the national policies for international trade as well as the policies of neighbouring countries and key trading partners.

2.3 CIF/FOB ratio

International trade practices lead to imports being reported at the CIF level and exports being reported at the Free on Board (or Freight on Board) level. To understand the FOB pricing, it is necessary to first define the meaning of FOB. The acronym FOB translates to sellers including the cost of the goods being delivered to the nearest port in the purchase price.¹⁵ Cost, Insurance and Freight (CIF) is a legal Incoterms (International Commercial Terms) rule that is used in international shipping for the delivery of goods to a port. In this case, the seller must pay for the export and delivery of goods, including insurance, and is responsible for the goods right up until they are loaded on a ship (ICC, 2017).

The “matched partner” CIF/FOB ratio technique consists of comparing the valuation of the same flow reported by both the importer and the exporter (Carrere and Grigoriou, 2014). This study used the Carrere and Grigoriou theoretical definition of the CIF/FOB ratio. According to their study, the so-called CIF/FOB ratio of a trade flow for product k imported by country i from country j could be defined as:

$$R_{ijkt}^{CIF/FOB} = \frac{P_{ijk}^M Q_{ijk}^M}{P_{ijk}^X Q_{ijk}^X} \quad (\text{Formula 3})$$

¹² Time lag: Landlocked countries have higher trade and timing than other countries. The average import time for Mongolia is approximately 47 days (World Bank, 2014; 2017). Therefore, exports from October to December will be registered in Mongolia’s import data for the next financial year (January-February).

¹³ Trade threshold (low-value transactions): Trade threshold is one of the factors explained by mirror asymmetries. A number of customs administrations introduced *de minimis* thresholds for customs clearance. A majority of customs administrations indicated that a simplified declaration and clearance process was provided for goods below the *de minimis* thresholds (WCO, 2017).

¹⁴ The applied trade system (special or general trade system) represents an additional reason for existing deviations in the mirrored data. Depending on which trade system (general or special) is used in the external trade data processing, this is one of the possible reasons for deviations in the data between two countries due to differences in coverage of the two systems (Montenegro, 2011).

¹⁵ However, the buyer is liable to pay for the shipping costs from that port as well as any other fees associated with transporting the goods to their destination.

- P - price;
- Q – quantity;
- $P_{ijk}^M Q_{ijk}^M$ – value of the import flows of product k from country j to country i , as reported by the importing country i ;
- $P_{ijk}^X Q_{ijk}^X$ – value of the import flows of product k from country j to country i , as reported by the exporting country j .

Again, in this study, the data were taken from internationally available open sources; therefore, it was not possible to calculate the unit price of goods. However, at the national level, customs can use bilateral agreements to assess the CIF/FOB ratios for a specific product.

3. Overview of international trade: China, Japan, the Republic of Korea and Mongolia

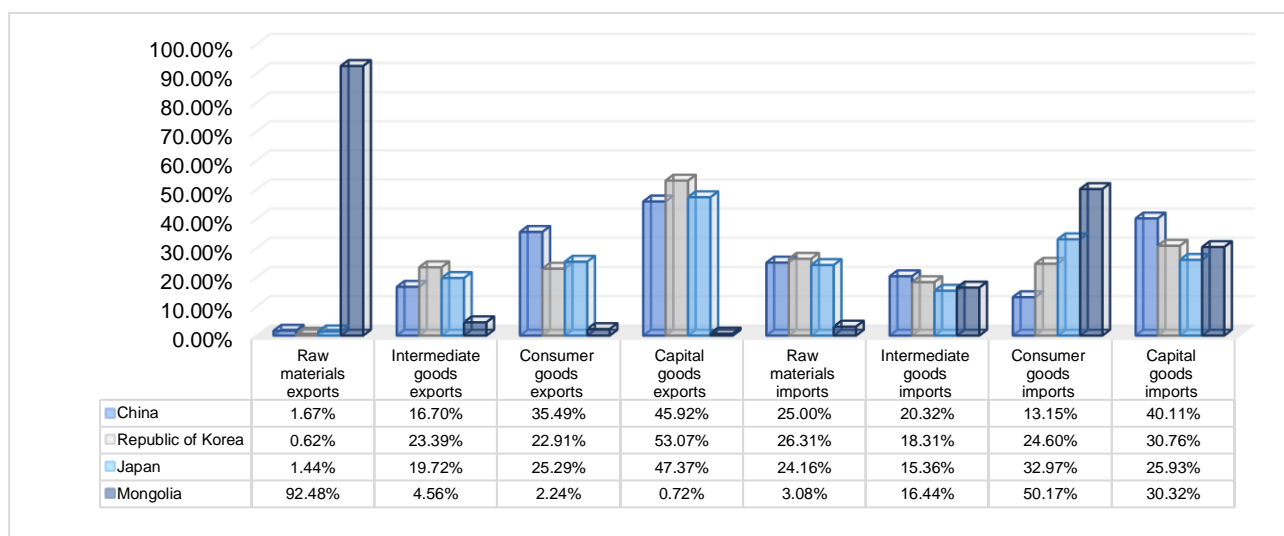
In 2020, China (GDP – US\$ 15.54 trillion) is ranked as the second-largest economy in the world, while Japan (GDP – US\$ 5.36 trillion) is ranked as the third-largest economy in the world, and the Republic of Korea (GDP – US\$ 1.63 trillion) is ranked at 13 (United States Census Bureau, 2020). It shows that the economic development rates of China, the Republic of Korea and Japan are not only the highest in the Asia-Pacific region, but also the rest the world. The purpose of this study is to identify trade mis-invoicing by analysing mirror data bilateral trade in goods among the selected countries. Many reports suggest that IFFs usually appear through international trade, so it is common in both developing and developed economies.

There are a number of reasons for selecting China, Mongolia, Japan and the Republic of Korea in this study. First, they are located in the same geographical region. Second, China is not only the main trading partner country of Mongolia, the Republic of Korea and Japan, but also a trading partner with many other countries around the world, and a member of the United Nations, ESCAP, WTO and WCO. Thus, they can work together in facilitating legitimate trade and targeting high-risk shipments.

Annex 1 presents the international trade statistics of China, the Republic of Korea, Japan and Mongolia, while Annex 2 presents the bilateral trade shares between China, the Republic of Korea, Japan and Mongolia (from 2014 to 2018, by percentage). According to the selected period, all three partners shared a percentage of trade with China, the largest trading partner for both exports and imports of the other three countries. Although the Republic of Korea and Japan play the second and third trading partners of China. China, the Republic of Korea and Japan account for 47.4% of Mongolia's imports, while Mongolia's exports to China account for 92.8% of the former country's total exports.

Figure 4 describes the structure of exported and imported goods in 2018 by stages of processing and its share.

Figure 4: Product groups in 2018 and its share (China, the Republic of Korea, Japan and Mongolia)



Source: World Integrated Trade Solution software (Software, 2020).

The trade balance of China, the Republic of Korea, Japan and Mongolia is assessed as trade surplus. Raw material exports by China, the Republic of Korea and Japan are extremely low, while Mongolia shares a high percentage (92.48%) of such exports. Even though the Mongolian trade balance is reported as a trade surplus, from an economic perspective the structure of exported goods does not look good.

The main duty of customs administrations around the world is to compile international trade statistics and trend analyses, collect revenue and control the flow of goods crossing customs frontiers. Customs administrations are highly focused on the quality of trade statistics and implement appropriate tariff policies on exporting and importing goods.

Table 3: Comparison of tariff information on international trade in China, the Republic of Korea, Japan and Mongolia, 2018

Tariff rates and duty-free imports	China	Republic of Korea	Japan	Mongolia
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The maximum tariff rate, in percentage, on any product (%)	695.50	887.40	2,322.36	40.00
The simple average tariff across all products (%)	7.56	5.23	3.77	5.04
The trade-weighted average tariff (%)	3.39	4.83	2.45	5.26
Total duty-free imports (US\$ million)	777,099.92	234,335.05	576,238.72	225.91
Duty-free tariff line items (%)	25.84	68.57	56.30	4.30

Source: World Integrated Trade Solution software (Software, 2020).

In 2018, the maximum rate of tariffs by percentage on any goods for China was 695.5%, while for the Republic of Korea it was 887.4%, for Japan it was 2,322.3% and for Mongolia it was 40%. The maximum rate of tariffs imposed by Japan shows the highest percentage while Mongolia shows the lowest percentage compared with other three countries. The average tariff across all products of the four countries range from 3.7% to 7.5%. Regarding trade, weighted by average tariffs, all four countries reported between 2.4% and 5.2%. China, the Republic of Korea, Japan and Mongolia are members of WTO, thus each WTO member treats all the other members equally as “most-favoured” trading partners. If a country improves the benefits that it gives to one trading partner, it has to give the same “best” treatment to all the other WTO members so that they all remain “most-favoured” (WTO, 2020).

However, the WTO members prefer to establish Free Trade Agreements (FTA) for reducing “most-favoured tariffs” for trade in goods and to allow “preferential tariffs” for selected trade in goods. As of 17 January 2020, 303 Regional Trade Agreements (RTAs) were in force. These correspond to 483 notifications from WTO members, counting goods, services and accessions separately.

Currently, China have signed 16 FTAs and has 8 Agreements under negotiation; Japan has signed 18 EPA/FTAs and has 4 Agreements under negotiation; the Republic of Korea has signed 15 FTAs; and Mongolia has 2 EPA/FTAs (Regional trade agreements and the WTO, 2020)

The WCO develops an annual report with its members’ profiles. Table 4 presents the percentage of revenue collection by customs administrations of the selected four countries. In 2018, the State budget revenue collected by Mongolia, the Republic of Korea, China and Japan 33.3%, 23.5%, 23.1% and 13.8%, respectively.

Table 4: Revenue collected by Customs in 2018 (China, the Republic Korea, Japan and Mongolia)

Type of taxes	China	Republic of Korea	Japan	Mongolia
Customs duties in tax revenue (%)	3.3	3.3	1.6	8.3

Revenue collected by customs in tax revenue (%)	23.1	23.5	13.8	33.3
Customs duties (%)	14.4	14.0	11.9	25.00
General consumption taxes (%)	0.0	71.1	72.0	54.7
Special consumption taxes (%)	85.5	14.9	15.8	19.5
Taxes on exported goods (%)	0.1	0.0	0.0	0.8
Other tax (%)	0.0	0.0	0.3	0.0

Source: WCO Annual Report 2018-2019 (WCO, 2019).

Revenue collection is one of the main duties of customs administrations and is clearly linked to international trade. False or wrong international trade statistics will lead to decreased revenue collection and appears through trade mis-invoicing. As stated at the beginning of this study, trade mis-invoicing is a main channel for IFFs (approximately 70%).

4. Mirror analysis

One of the solutions for identifying trade mis-invoicing is to conduct mirror analyses on bilateral trade. In other words, comparing the exports from one country with the imports of another, known as the Partner Country Method. This section describes several limitations to the methodology used for mirror analysis on bilateral trade among the selected countries from 2014 to 2018. However, a number of researchers and practitioners are conducting mirror analyses based on trade data from the United Nations Comtrade database at <https://comtrade.un.org/>. This study utilizes trade data from the WTO International Trade Centre. There is little difference between the data from these two data bases, primarily different methodologies and downloading procedures.

The first stage of mirror analysis is asymmetry calculation utilizing Formula 1, which is presented in the previous section of this study, and the estimations are shown in Annex 3. It describes only general calculations; trade mis-invoicing between all of the trading partners were found. There is significant asymmetry with China's imports from Japan and the Republic of Korea. Further analysis will be conducted to identify high-risk transactions and for this purpose, it is necessary to calculate the deviation percentage, using the risk matrix, as well as the CIF/FOB ratio with the risk level. For the selected bilateral trading partner countries, there was both positive and negative asymmetry in each year. In the case of Mongolia, the trade statistics were lower than those of the other selected countries.

A comparison of asymmetries, deviation and CIF/FOB ratio: Bilateral trade among China, the Republic of Korea, Japan and Mongolia (using Formula 1, 2 and 3 of this study) is given in Annex 4.

Table 5 provides deviation estimates based on mirror analysis of bilateral trade among the selected four countries, utilizing Formula 2 of this paper. The risk level of deviation for three of them are assessed as high (the Republic of Korea's exports to Mongolia in 2014 and Japan's exports to Mongolia 2015 and 2017), 26 of them are assessed as medium, and 31 are assessed as low. In further analysis, bilateral trade that is assessed as a high- and medium-risk level of deviation will be selected.

Thus, the asymmetries of trade statistics are still large, as shown in figure 5. For example, the asymmetries of China's exports to the Republic of Korea ranged from US\$ 2.5 billion to US\$ 11.04 billion, while the asymmetries of Japan's exports to the Republic of Korea ranged from US\$ 1.2 billion to US\$ 2.2 billion. The above-mentioned deviation percentages are generalized. According to the methodology of mirror analysis, the CIF/FOB ratio needs to be calculated.

Table 5: Deviation and risk level matrix of bilateral trade among China, the Republic of Korea, Japan and Mongolia, 2018¹⁶

Trading partner countries ¹⁷	2018	
	D (%)	Risk level
<i>Im_{CN} and Ex_{MN}</i>	2.55	L
<i>Im_{CN} and Ex_{JP}</i>	22.45	M
<i>Im_{CN} and Ex_{KR}</i>	23.13	M
<i>Im_{KR} and Ex_{CN}</i>	2.37	L
<i>Im_{KR} and Ex_{JP}</i>	3.92	L
<i>Im_{KR} and Ex_{MN}</i>	23.72	M
<i>Im_{JP} and Ex_{CN}</i>	16.40	M
<i>Im_{JP} and Ex_{KR}</i>	4.98	L
<i>Im_{JP} and Ex_{MN}</i>	19.33	M
<i>Im_{MN} and Ex_{CN}</i>	17.82	M
<i>Im_{MN} and Ex_{KR}</i>	15.92	M
<i>Im_{MN} and Ex_{JP}</i>	8.05	L

Source: Calculation (Formula 2) based on trading partner countries' imports and exports in 2018 (WTO, International Trade Centre, 2020). Country abbreviations based on ISO 3166.

International Financial Statistics data¹⁸ are unreliable, as the International Monetary Fund (IMF) relies heavily on a 10% imputation rule (David Hummels; Volodymyr Lugovskyy, 2003). Therefore, from zero to 10% is assessed as being at the low-risk level. If the CIF/FOB ratio is above 10%, it should be assessed as being at the medium- or high-risk level. If the CIF/FOB ratio exceeds the accepted level of percentage, then customs need to do additional analysis on the national customs clearance data base.

¹⁶ See Annex 5 – Deviation and risk level matrix of bilateral trade among China, the Republic of Korea, Japan and Mongolia (2014 to 2018).

¹⁷ *Im_{CN}* and *Ex_{MN}* (China's imports from Mongolia and Mongolia's exports to China).

¹⁸ IFS contain trade data that are aggregated over all commodities and partners for a particular importer.

The following table illustrates the calculation of CIF/FOB ratios among the selected four countries from 2014 to 2018.

Table 6: The CIF/FOB ratio and risk level matrix of bilateral trade among China, the Republic of Korea, Japan and Mongolia, 2018¹⁹*

Trading partners	2018	
	Ratio	Risk level*
<i>Im_{CN} and Ex_{MN}</i>	0.97	L
<i>Im_{CN} and Ex_{JP}</i>	1.25	M
<i>Im_{CN} and Ex_{KR}</i>	1.26	M
<i>Im_{KR} and Ex_{CN}</i>	0.98	L
<i>Im_{KR} and Ex_{JP}</i>	1.04	L
<i>Im_{KR} and Ex_{MN}</i>	1.27	M
<i>Im_{JP} and Ex_{CN}</i>	1.18	M
<i>Im_{JP} and Ex_{KR}</i>	1.05	L
<i>Im_{JP} and Ex_{MN}</i>	1.21	M
<i>Im_{MN} and Ex_{CN}</i>	1.20	M
<i>Im_{MN} and Ex_{KR}</i>	0.85	M
<i>Im_{MN} and Ex_{JP}</i>	1.08	L

* Low risk (0 to 10%); medium risk (11% to 30%); high risk (>30%).

Source: Author's calculation (Formula 3) based on trading partner countries' imports and exports between 2014 and 2018 (WTO, International Trade Centre, 2020). Country abbreviations based on ISO 3166.

The mirror analysis shows that in 2014 China's imports: (a) from Mongolia were at the low-risk level; (b) from Japan were at the medium-risk level; and (c) from the Republic of Korea were at the high risk-level. The remainder of the bilateral trade among the selected countries was assessed as being at the medium-risk level.

The Republic of Korea's imports from China and Japan were assessed as being at the low- risk level, while imports from Mongolia – which were small – were assessed as being at the high-risk level between 2014 and 2015, and at the medium-risk level between 2016 and 2018. According to the theory of mirror analysis, it is possible to have a time lag in bilateral trade between Mongolia and the Republic of Korea. A further detailed analysis of the national customs clearance databases of these two countries needs to be done.

¹⁹ See Annex 6 – The CIF/FOB ratio and risk level* matrix bilateral trade among China, the Republic of Korea, Japan and Mongolia (2014 to 2018).

Japan’s imports from the Republic of Korea were assessed as being at the low-risk level, while imports from China were at the medium-risk level. Imports from Mongolia between 2015 and 2017 were assessed as being at the high-risk level, and in 2014, 2016 and 2018 at the medium-risk level.

General calculation results of mirror analysis of bilateral trade among the selected four countries shows that there were almost no changes between 2014 and 2018. However, it covers only a few years of trade in goods that were assessed as being at the high-risk level; the rest of years trade were assessed as being at the medium-risk and low-risk level. Therefore, for this study the latest international trade data of bilateral trade among selected four countries were selected. Moreover, during stages 2 and 3 of the mirror analyses, the latest trade statistics for 2018 were used.

Stage 1 of the mirror analysis shows that there is trade mis-invoicing in both outflow and inflow. This is the general finding of the mirror analysis of bilateral trade in goods among the four countries. Data on further analysis are listed in the following table.

Table 7: Comparison of asymmetry, deviation and CIF/FOB ratio of bilateral trade among China, the Republic of Korea, Japan and Mongolia, 2018

Trading partners	Asymmetries (US\$ million)	Deviation	CIF/FOB ratio
China's imports from the Republic of Korea	-42,408.86	23.13	1.26
The Republic of Korea's imports from China	2,549.75	2.37	0.98
Japan's imports from China	-26,302.39	16.40	1.18
Mongolia's imports from China	-322.09	17.82	1.20

Source: Authors’ calculation based on trading partner countries’ imports and exports in 2018 (WTO, International Trade Centre, 2020).

Data used in this study are based on internationally available data. Therefore, it is limited to calculating unit price analysis, time lag, *de minimis* price, customs clearance procedures for specific transactions, international trade transactions, simplified customs procedures, e-clearances and authorized economic operators’ customs procedures.

As mentioned above, among the customs administrations of the four countries cooperation is highly developed in terms of exchanging information on imports and exports, administrative and criminal offence data, conducting joint customs control and joint statistical analysis.²⁰

The reasons for trade gaps are the time lags between trading partner countries, freight costs, customs valuations, policies on international trade and customs clearance and *de minimis* prices. The main goal of mirror analysis is to identify trade mis-invoicing

²⁰ For example, the customs administrations of Mongolia and China signed bilateral agreements in 2010 for conducting an annual joint statistical analysis. Through this cooperation they targeted high-risk shipments step by step, and the result of these initiatives is an enhanced compliance level among traders as well as reduced IFFs.

and to reduce IFFs. Thus, mirror analysis covers the risk level of deviations at the HS 2-, 4- and 6-digit levels.

Table 8: Deviation and risk level matrix of bilateral trade among China, the Republic of Korea, Japan and Mongolia, 2018

Deviation percentage	<i>EX_{KR}</i> & <i>IM_{CN}</i>		<i>EX_{CN}</i> & <i>IM_{KR}</i>		<i>EX_{CN}</i> & <i>IM_{JP}</i>		<i>EX_{CN}</i> & <i>IM_{MN}</i>	
	N*	Percentage	N*	Percentage	N*	Percentage	N*	Percentage
HS 2-digit level (HS Chapter)								
0-15	32	33.68	25	26.31	52	53.61	23	24.21
16-50	31	32.63	29	30.52	30	30.93	30	31.58
<50	32	33.68	41	43.15	15	15.46	42	44.21
Total	95	100.00	97	100.00	97	100.00	95	100.00
HS 4-digit level								
0-15	N**	Percentage	N**	Percentage	N**	Percentage	N**	Percentage
0-15	278	25.53	418	36.54	442	39.05	155	17.03
16-50	267	24.52	316	27.62	313	27.65	175	19.23
<50	544	49.95	410	35.84	377	33.30	580	63.74
Total	1,089	100.00	1,144	100.00	1,132	100.00	910	100.00
HS 4-digit level								
0-15	N***	Percentage	N***	Percentage	N***	Percentage	N***	Percentage
0-15	682	17.07	1,128	25.07	1,137	25.89	303	10.18
16-50	793	19.84	1,153	25.62	1,089	24.80	474	15.92
<50	2,521	63.09	2,219	49.31	2,166	49.32	2,200	73.90
Total	3,996	100.00	4,500	100.00	4,392	100.00	2,977	100.00

* N = number of the HS Chapters.

** N = number of goods classified at the HS 4-digit level.

*** N = number of goods classified at the HS 6-digit level.

Source: Authors' calculation based on trading partner countries' imports and exports in 2018 (WTO, International Trade Centre, 2020).

Mirror analysis on the deviation of trading partners' risk levels presents different results at the HS 2-, 4- and 6-digit levels, as shown in table 8. However, a comparison of deviation percentages at the HS 2-, 4- and 6-digit levels shows that the deviation percentage at the high-risk level of HS 6-digit level goods is higher than the HS 2- and 4-digit levels. Also, deviation percentages at the low-risk level of HS 2-digit level are lower than at the HS 4- and 6-digit levels and there is only a small difference in the deviation percentages presented at the medium-risk level.

Conducting mirror analysis starts from the HS 2-digit level to HS national subheading. In general, HS national subheadings are composed of 8-10 digits and depend on national legislation. For example, since 1 August 2018, the China Customs Commodity

HS Code has been changed from the original 10-digit HS code to the new 13-digit HS code; the first 8 digits are the Commodity HS code of "Import and Export Tariff of the People's Republic of China"; the HS 9 to 10 digits are customs supervisory additional numbers, and HS 11 to 13 digits are additional numbers for inspection and quarantine (TransCustoms, 2020).

The estimation of mirror analyses is intended to identify trade mis-invoicing on goods at the HS 6-digit level among the trading countries.

4.1 Mirror analysis: The Republic of Korea's exports to China, and China's imports from the Republic of Korea, 2018

In 2018, China's imports from Republic of Korea were reported as US\$ 204.56 billion and the Republic of Korea's exports to China were reported as US\$ 162.15 billion. The asymmetry is US\$ 42.4 billion and both deviation and CIF/FOB ratio were assessed at the medium-risk level.

Table 9: Mirror analysis: The Republic of Korea's exports to China, and China's imports from the Republic of Korea, by HS Chapters, 2018 (US dollars million)

Deviation risk level	Asymmetry (US\$ million)		Asymmetry (HS Chapters)	
	(-)*	(+)**	(-)*	(+)**
High risk	0.8-1,484.01	0.002-191.7	HS (13) Chapters: 24; 35; 41; 46; 67; 70; 76; 80; 89; 91; 92; 97; 99.	HS (19) Chapters: 02; 03; 06; 07; 12; 14; 21; 26; 31; 44; 45; 62; 64; 65; 66; 69; 81; 93; 94.
Medium risk	0.6-33,866.0	0.02-179.8	HS (16) Chapters: 20; 25; 42; 43; 47; 49; 50; 52; 53; 58; 59; 63; 68; 74; 79; 85.	HS (15) Chapters: 05; 09; 10; 11; 16; 18; 30; 32; 37; 61; 71; 75; 83; 86; 95.
Low risk		0.5-22,851.5		HS (32) Chapters: 01; 04; 08; 13; 15; 17; 19; 22; 23; 27; 28; 29; 33; 34; 38; 39; 48; 51; 54; 55; 56; 57; 60; 72; 73; 78; 82; 84; 87; 88; 90; 96.

Source: Calculation based on Republic of Korea exports to China and China's imports from the Republic of Korea in 2018 (WTO17).

* IM_{CN} from $KR > EX_{KR}$ to CN (29 HS Chapters). ** EX_{KR} to $CN > IM_{CN}$ from KR (66 HS Chapters).

The second stage of the mirror analysis of China's imports from the Republic of Korea covering 95 HS Chapters was conducted. According to the methodology of mirror analysis, the risk level of each HS Chapter was categorized. There are both large and low value asymmetries in the high, medium and low-risk levels. Annex 7 presents a one-way tabulation of asymmetries based on China's imports from the Republic of Korea as well as the Republic of Korea's exports to China based on the HS 2-digit level. Following this categorization, goods are related to 23 HS Chapters²¹ China's imports from the Republic of Korea were higher than the Republic of Korea's exports to China (ranging from US\$ 30 million to US\$ 33,860 million) and goods are related to

²¹ HS Chapters: 85; 84; 90; 70; 27; 39; 76; 29; 74; 33; 35; 99; 41; 89; 79; 59; 72; 28; 68; 25; 20; 48; 54.

20 HS Chapters.²² The Republic of Korea's exports to China were higher than China's imports from Republic of Korea (ranging from US\$ 10 million to US\$ 200 million); thus, both of these cases require further analysis. Other HS Chapters are assessed as low risk, but at the national level customs administrations need to establish risk profiles for mitigating the risks of those transactions. A number of goods at the HS 6-digit level presented no difference in the data between exporting and importing countries (perfect matches). The next step of mirror analysis in this subsection covers goods at the HS 6-digit level. Small and large values of asymmetries are still identified. One-way tabulation (HS 6-digit level) is presented in Annex 8.

For the goods classified at the HS code: 9999.99²³ the Republic of Korea's exports to China were reported as US\$ 5.6 million and China's imports from Republic of Korea under this subheading were reported as US\$ 160.62 million in 2018. Such types of large asymmetry depend on many factors, including a different trade system methodology, or classification fraud. In addition, customs administrations of trading partner countries need to conduct detailed analyses with the customs clearance database, as it is one of the best solutions for aggregate random errors.

A total of 450 goods at the HS 6-digit level in the Republic of Korea's exports to China were reported as US\$ 491.21 million in 2018, but which are not reported in China's imports from the Republic of Korea. It shows that there are "lost" imports.²⁴ Likewise, 290 goods at the HS 6-digit level in China's imports from Republic of Korea were reported as US\$365.21 million, but which were not reported in the Republic of Korea's exports to China.

For the third stage of mirror analysis of the Republic of Korea's exports to China in 2018, the top 10 goods identified as having large values of asymmetries based on the findings of mirror analysis, calculated deviation and CIF/FOB ratio were selected, as listed in table 10.

Table 10: Top 10 goods asymmetries by value – the Republic of Korea's exports to China, and China's imports from the Republic of Korea, 2018 (US dollars thousand)

HS code	EX_{KR} to CN	IM_{CN} from KR	Asymmetry	D%*	CIF/FOB ratio	Customs tariff
8542.32	39,996,349.0	63,695,331.0	(23,698,982.0)	46	1.59	PT** (APTA) 1.4%
8542.31	5,666,246.0	11,364,048.0	(5,697,802.0)	67	2.01	MFN duties 0%
8529.90	3,247,283.0	2,006,871.0	1,240,412.0	42	0.62	MFN duties 0%
8517.70	1,991,250.0	4,061,036.0	(2,069,786.0)	47	2.04	MFN duties 0%
8523.51	698,471.0	62,186.0	636,285.0	68	0.09	MFN duties 0%
8542.39	575,699.0	5,076,939.0	(4,501,240.0)	167	8.82	PT** (APTA) 1.4%

²² HS Chapters: 16; 19; 31; 61; 95; 12; 30; 38; 81; 69; 71; 83; 62; 64; 21; 26; 37; 03; 32; 94.

²³ Commodities elsewhere not specified goods (HS code 9999.99).

²⁴ During the mirror analysis "lost" imports reported to the INTRACEN database in 2018 were all bilateral trading among the selected four countries.

8548.90	2,578,672.0	92,595.0	2,486,077.0	159	0.04	MFN duties 8%
8542.33	9,042.00	2,006,977.0	(1,997,935.0)	186	221.96	PT** (APTA) 1.4%
2707.99	671.00	3,305,644.0	(3,304,973.0)	198	4,926.44	PT** for the Republic of Korea 0%
2710.19	6,354,414.00	4,136,091.0	2,218,323.0	200	0.65	PT** for the Republic of Korea 0%

Source: *Market Access Map, Market Access Condition (Centre, 2020)*.

* Deviation percentage. ** PA Preferential tariff.

China's imported goods from the Republic of Korea classified under HS Chapter 85 were higher than the Republic of Korea's exported goods to China. A total of 247 goods at the HS 6-digit level were traded between the Republic of Korea and China. Among them, the largest asymmetry was assessed as HS code 8542.32. For the goods classified at the HS codes 2707.99 and 2710.19, preferential tariffs for the Republic of Korea are zero per cent. There are 10 and 74 different measures, respectively, for these goods in import requirements. The goods classified under the HS codes 2710.19; 8529.90; 8523.51 and 8548.90 could be considered as "lost" imports.

In this subsection, the mirror analysis at the HS 6-digit level identified a large high-risk level volume based on CIF/FOB ratios and asymmetries. One of the main reasons for trade mis-invoicing is duty evasion by submitting forged documents declaring false HS codes in order to pay lower tariffs to customs. In 2015, the Government of the People's Republic of China²⁵ and the Government of the Republic of Korea signed the Free Trade Agreement, which started in 2004 (China, 2020). Under this agreement, customs tariffs for two goods at the preferential tariff level for the Republic of Korea were set at zero per cent. In addition, a trade remedy for the **top 10 high asymmetry goods** is not applied in China.

4.2 Mirror analysis: China's exports to the Republic of Korea, and the Republic of Korea's imports from China, 2018

In 2018, imports by the Republic of Korea from China were reported as US\$ 106.47 billion while China's exports to Republic of Korea were reported as US\$ 109.02 billion. There are deviations and the CIF/FOB ratio was assessed as being at the low-risk level with asymmetry at US\$2.54 billion.

Table 11: Mirror analysis: China's exports to Republic of Korea and Republic of Korea's imports from China, by HS Chapters, 2018 (US dollars million)

Deviation risk level	Asymmetry (US\$ million)		Asymmetry (HS Chapters)	
	(-)*	(+)**	(-)*	(+)**
High risk	0.01 - 133.59	14.03 - 1,570.51	HS (9) Chapters: 01; 02; 71; 78; 79; 80; 91; 93; 97.	HS (14) Chapters: 04; 09; 13; 20; 24; 26; 27; 30; 46; 53; 61; 65; 86; 99.

²⁵ Currently, China has 24 FTAs under construction, among which 16 Agreements have been signed.

Medium risk	0.53-650.8	1.38 - 431.48	HS (14) Chapters: 17; 32; 33; 34; 38; 45; 47; 49; 70; 73; 81; 88; 92.	HS (15) Chapters: 03; 05; 06; 14; 16; 18; 37; 50; 52; 60; 66; 67; 68; 82; 94.
Low risk	0.35 - 2,130.09	0.11 - 2,333.48	HS (25) Chapters: 15; 23; 25; 28; 29; 31; 36; 39; 40; 41; 42; 44; 48; 51; 56; 58; 64; 72; 74; 76; 83; 84; 90; 95; 96.	HS (20) Chapters: 07; 10; 11; 12; 19; 21; 22; 35; 43; 54; 55; 57; 59; 62; 63; 69; 75; 85; 87; 89.

Source: Calculation based on China's exports to Republic of Korea and Republic of Korea's imports from China in 2018 (WTO, International Trade Centre, 2020).

* IM_{KR} from CN > EX_{CN} to KR (48 HS Chapters);

** EX_{CN} to KR > IM_{KR} from CN (49 HS Chapters).

The second stage of the mirror analysis on the imports by the Republic of Korea from China covered 97 HS Chapters. There is a trade gap in the HS Chapters, as shown in Annex 9. This was followed by HS 2-digit level categorization – a goods deal with 17 HS Chapters,²⁶ showing that imports by the Republic of Korea from China were higher than China's exports to the Republic of Korea (ranging from US\$ 50 million to US\$ 2,100 million), and a goods deal with 21 HS Chapters²⁷ showing that China's exports to Republic of Korea were higher than the Republic of Korea's imports from China (ranged from US\$ 50 million to US\$ 2.350 million). Therefore, both cases require further analysis.

The next step of the mirror analysis in this subsection covers goods at the HS 6-digit level. Small and large values of asymmetries are still identified. The one-way tabulation is presented in Annex 10.

Goods classified at HS code 9999.99 show that China's exports to the Republic of Korea were reported as US\$ 88.06 million while imports by the Republic of Korea from China show zero value ("lost" imports) in 2018.

In 2018, 121 goods at the HS 6-digit level were exported from China to the Republic of Korea, for which the value was reported as US\$ 404.17 million, but which was not reported in the Republic of Korea's imports from China. It shows that there are "lost" imports. Also, 345 goods at the HS 6-digit level imported by the Republic of Korea from China in 2018 were valued at US\$ 175.38 million, but were not reported in China's exports to the Republic of Korea.

In the next stage of the mirror analysis in this subsection, the top 10 goods with a large value of asymmetries, calculated deviation and CIF/FOB ratio, are listed in table 12.

Table 12: Top 10 goods asymmetries by value – China's exports to the Republic of Korea, and the Republic of Korea's imports from China, 2018 (US dollars thousand)

²⁶ HS Chapters: "84; 73; 38; 29; 90; 72; 81; 39; 95; 70; 91; 28; 64; 71; 32; 44; 48".

²⁷ HS Chapters: "52; 63; 07; 65; 99; 82; 87; 26; 86; 69; 16; 53; 30; 03; 62; 68; 94; 20; 61; 27; 85".

Product code	EX _{CN} to KR	IM _{KR} from CN	Asymmetry	D%*	CIF/FOB	Customs tariff
8523.51	35,114.0	468,022.00	(432,908.0)	172.08	13.33	PT** for China 0%
8471.80	63,366.0	461,140.0	(397,774.0)	151.68	7.28	MFN duties (Applied) 0%
8542.31	544,336.0	1,178,444.0	(634,108.0)	73.61	2.16	Preferential tariff for China 0%
8517.62	597,420.0	1,047,197.0	(449,777.0)	54.70	1.75	Preferential tariff for China 0%
8473.30	1,575,251.0	2,323,922.0	(748,671.0)	38.40	1.48	MFN duties (Applied) 0%
2710.19	1,585,626.0	167,529.0	1,418,097.0	161.78	0.11	Preferential tariff for China 1%
8471.30	1,655,576.0	2,085,423.0	(429,847.0)	22.98	1.26	MFN duties (Applied) 0%
8517.70	3,576,501.0	1,425,377.0	2,151,124.0	86.01	0.40	PT** for China 0%
8517.12	8,381,990.0	3,263,786.0	5,118,204.0	87.90	0.39	MFN duties (Applied) 0%
8542.32	10,853,104.0	10,211,436.0	641,668.0	6.09	0.94	PT** for China 0%

Source: Market Access Map, Market Access Condition (WTO, International Trade Centre, 2020).

* Deviation percentage. ** Preferential tariff.

A detailed mirror analysis at the HS 6-digit level identified a high-risk level of the CIF/FOB ratio and asymmetries in larger values. It shows that trade mis-invoicing appears in existing trade between the Republic of Korea and China.

Goods classified under HS code 2710.19 preferential tariff in China are “1%”, and customs tariffs on nine other goods are zero per cent. However, a large number of asymmetries are found in the mirror analysis. The goods classified under HS code 2710.19, 8517.70 and 8517.12 could be considered as “lost” imports.

The mirror analysis shows that one of the solutions for assessing trade mis-invoicing and for creating risk profiles with the appropriate risk mitigation measures at the national level.

4.3 Mirror analysis: China’s exports to Japan and Japanese imports from China in 2018

Japan’s imports from China in 2018 were valued at US\$ 173.53 billion while China’s exports to Japan were valued at US\$ 147.23 billion. There is deviation and the CIF/FOB ratio was assessed as being at the medium-risk level with asymmetry of US\$ 26.3 billion.

Table 13: Mirror analysis: China’s exports to Japan and Japan’s imports from China, by HS Chapters, 2018 (US dollars million)

Deviation risk level	Asymmetry (US\$ million)		Asymmetry (HS Chapters)	
	(-)*	(+)**	(-)*	(+)**
High risk	10.01-1,512.15	1.8 - 608.28	HS (10) Chapters: 02; 24; 41; 45; 49; 71; 79; 91; 97; 99.	HS (5) Chapters: 13; 26; 86; 88; 93.
Medium risk	0.94-12,872.98	- 13.41-847.16	HS (22) Chapters: 01; 09; 11; 12; 14; 17; 30; 32; 33; 38; 42; 58; 64; 65; 68; 70; 74; 83; 84; 85; 92; 95.	HS (8) Chapters: 03; 20; 22; 27; 37; 53; 69; 89.
Low risk	2.45 - 942.16	0.3 - 342.80	HS (33) Chapters: 05; 06; 07; 15; 25; 28; 29; 31; 36; 39; 40; 43; 44; 48; 50; 52; 54; 55; 57;	HS (19) Chapters: 04; 08; 10; 16; 18; 19; 21;

59; 61; 62; 63; 66; 67; 72; 73; 23; 34; 35; 46; 47; 51;
81; 82; 87; 90; 94; 96. 56; 60; 75; 76; 78; 80.

Source: Calculation based on China's exports to Japan and Japan's imports from China in 2018 (WTO, International Trade Centre, 2020).

* IM_{JP} from $CN > EX_{CN}$ to JP (65 HS Chapters); ** EX_{CN} to $JP > IM_{JP}$ from CN (32 HS Chapters).

The second stage of the mirror analysis of Japan's imports from China covered 97 HS Chapters. Table 1 shows similar findings to those in the previous subsection. In trade between Japan and China the CIF/FOB ratio was assessed as low, while the value of asymmetry compared with the China's imports from the Republic of Korea was not so large. Yet, there is still a trade gap in the HS Chapters, as listed in Annex 11. Analysis using the goods categorization related to 36 HS Chapters²⁸ shows that Japan's imports from China were higher than China's exports to Japan (US\$ 50 million compared with US\$ 12,900 million), while 8 HS Chapters²⁹ show that the value of China's exports to Japan were higher than Japan's imports from China (US\$ 50 million compared with US\$ 850 million). Therefore, both these cases require further analysis.

At the HS 6-digit level, exports of 225 goods by China to Japan were valued at US\$ 101.63 million in 2018, but were not reported in Japan's imports from China. It shows that there were "lost" imports. At the same time, 223 goods at the HS 6-digit level that were exported by China to Japan were valued at US\$ 365.21 million, but were not reported in Japan's imports from China. All of those missing trades are listed in Annex 12 using a one-way tabulation form. Under HS Chapter 99, China's exports to Japan were valued at US\$ 332.06 million and Japan's imports from China were valued at US\$ 1,842.51 million – the value of imports was more than 5.5 times higher than the exported value.

Table 14 lists the top 10 goods identified as large-value asymmetries using the mirror analysis.

Table 14: Top 10 goods asymmetries by value – China's exports to Japan and Japan's imports from China, 2018 (US dollars thousand)

Product code	EX_{CN} to JP	IM_{JP} from CN	Asymmetry	D*%	CIF/FOB	Customs tariff
4202.92	357,847.0	1,589,848.0	(1,232,001.0)	126.51	4.44	MFN duties (Applied) 8%
8529.90	501,335.0	1,463,138.0	(961,803.0)	97.92	2.91	MFN duties (Applied) 0%
4202.22	593,164.0	98,741.0	494,423.0	142.92	0.17	MFN duties (Applied) 16%
2601.11	606,499.0	5,712.0	600,787.0	196.27	0.01	MFN duties (Applied) 0%
8473.30	876,965.0	1,886,909.0	(1,009,944.0)	73.08	2.15	MFN duties (Applied) 0%

²⁸ HS Chapters: "85; 84; 95; 99; 62; 39; 42; 73; 91; 61; 64; 38; 90; 29; 68; 70; 71; 44; 30; 28; 74; 12; 83; 63; 07; 25; 33; 49; 65; 32; 40; 96; 97; 82; 81; 72".

²⁹ HS Chapters: "69; 13; 86; 20; 16; 26; 27; 03".

9013.80	949,723.0	277,916.0	671,807.0	109.45	0.29	MFN duties (Applied) 0%
8517.62	1,277,993.0	3,290,857.0	(2,012,864.0)	88.11	2.58	MFN duties (Applied) 0%
8471.50	1,409,532.0	2,760,619.0	(1,351,087.0)	64.80	1.96	MFN duties (Applied) 0%
8471.30	5,409,099.0	6,993,776.0	(1,584,677.0)	25.55	1.29	MFN duties (Applied) 0%
8517.12	8,572,125.0	15,219,423.0	(6,647,298.0)	55.88	1.78	MFN duties (Applied) 0%

Source: *Market Access Map, Market Access Condition (WTO, International Trade Centre, 2020)*. *Deviation percentage.

The third stage of mirror analysis involved goods classified under HS code 4202.92 MFN duties (Applied) 8%, HS code 4202.92 MFN duties (Applied) 16%, and customs tariffs of eight other goods are zero per cent. Another specific case, “Petroleum oils and oils obtained from bituminous minerals, crude” (HS code 2709.00) exported from China to Japan was valued at US\$ 721.13 million in 2018 but there is no report on Japan’s imports from China. This could be considered as “lost” imports and needs further analysis at the national level. The goods classified at HS codes 4202.22; 2601.11 and 9013.80 could also be considered as “lost” imports. China’s exported goods classified under HS Chapter 85 in bilateral trade between China and Japan, and also in bilateral trade between China and the Republic of Korea were assessed as a large asymmetry.

4.4 Mirror analysis: China’s exports to Mongolia, and Mongolia’s imports from China, 2018

Mongolia’s imports from China in 2018 were valued at US\$ 1.9 billion, while China’s exports to Mongolia were valued at US\$ 1.64 billion. Deviation is evident, and the CIF/FOB ratio was assessed as being at the medium-risk level with asymmetry calculated at US\$ 0.32 billion.

Table 15: Mirror analysis: China’s export to Mongolia, and Mongolia’s imports from China, by HS Chapters, 2018 (US dollars thousand)

Deviation risk level	Asymmetry (US\$ thousand)		Asymmetry (HS Chapters)	
	(-)*	(+)**	(-)*	(+)**
High risk	2- 24,362.0	81 - 19,175.0	HS (32) Chapters: 04; 12; 16; 21; 22; 32; 33; 41; 42; 44; 45; 46; 48; 49; 52; 53; 61; 62; 64; 65; 66; 67; 68; 69; 71; 75; 79; 83; 86; 91; 92; 97	HS (10) Chapters: 05; 15; 17; 26; 37; 51; 57; 59; 89; 99
Medium risk	3 - 77,047.0	19 - 2,825.0	HS (22) Chapters: 07; 14; 18; 24; 25; 28; 36; 38; 43; 50; 56; 70; 72; 73; 74; 81; 82; 85; 93; 94; 95; 96	HS (8) Chapters: 03; 10; 34; 35; 55; 58; 60; 88
Low risk	17- 41,062.0	3 - 4,110.0	HS (12) Chapters: 09; 11; 13; 20; 31; 39; 40; 47; 63; 76; 84; 87	HS (11) Chapters: 02; 06; 08; 19; 27; 29; 30; 54; 78; 90; 99

Source: Calculation based on China’s exports to Mongolia and Mongolia’s imports from China in 2018 (WTO, International Trade Centre, 2020).

* IM_{MN} from $CN > EX_{CN}$ to MN (66 HS Chapters); ** EX_{CN} to $MN > IM_{MN}$ from CN (29 HS Chapters).

The mirror analysis of Mongolia's imports from China and China's exports to Mongolia covers 95 HS Chapters. Table 15 presents similar findings for China's imports from the Republic of Korea, Japan's imports from China and the Republic of Korea's imports from China.

The CIF/FOB ratio and deviation percentage was assessed at both high- and low-risk levels, the asymmetries have substantially large and low values. Also, there is still a trade gap at the HS 2-digit level, as shown in Annex 13. Followed by this HS 2-digit level categorization, goods involved in 37 HS Chapters³⁰ Mongolia's imports from China were valued higher than China's exports to Mongolia (ranged from US\$ 500,000 to US\$ 77.5 million) and goods involved in 16 HS Chapters³¹ exported from China to Mongolia were higher than Mongolia's imports from China (ranging from US\$ 500,000 to US\$ 19.5 million); thus, both these cases require further analysis

In 2018, 208 goods at the HS 6-digit level exported from China to Mongolia were valued at US\$ 22.24 million, but which are not reported in Mongolia's imports from China. This indicates "lost" imports. Also 704 goods at the HS 6-digit level imported by Mongolia from China were valued at US\$ 79.27 million, but which are not reported in China's exports to Mongolia. All these missing trades are listed in Annex 14 in one-way tabulation form.

As can be seen from the first step of mirror analysis, Mongolia's imports from China were higher than China's exports to Mongolia, and asymmetry was calculated at US\$ 0.32 billion. Table 16 presents the top 10 goods identified using mirror analysis as having a large asymmetrical value.

Table 16: Top 10 goods identified with asymmetries by value – China's exports to Mongolia, and Mongolia's imports from China, 2018 (US dollars thousand)

Product code	EX_{CN} to MN	Im_{MN} from CN	Asymmetry	D%	CIF/FOB	Customs tariffs
8701.20	55,085.0	1,251.0	53,834.0	191.12	0.02	MFN duties (Applied) 5%
7308.90	49,646.0	106,139.0	(56,493.0)	72.53	2.14	MFN duties (Applied) 5%
7308.20	23,887.0	10,776.0	13,111.0	75.65	0.45	MFN duties (Applied) 5%
8704.23	21,443.0	75,439.0	(53,996.0)	111.47	3.52	MFN duties (Applied) 5%
8716.39	21,346.0	10,088.0	11,258.0	71.63	0.47	MFN duties (Applied) 5%
1701.99	19,521.0	10000.9	19,511.0	199.80	High	MFN duties (Applied) 5%
8705.90	17,413.0	4,793.0	12,620.0	113.66	0.28	MFN duties (Applied) 5%

³⁰ HS Chapters: "73; 85; 84; 86; 21; 72; 68; 94; 69; 70; 48; 44; 87; 39; 32; 38; 28; 07; 62; 64; 25; 76; 42; 56; 83; 61; 24; 33; 96; 52; 95; 49; 82; 16; 63; 20; 71"

³¹ HS Chapters: "35; 54; 05; 29; 59; 02; 57; 19; 90; 10; 34; 27; 99; 15; 51; 17"

8502.31	13,069.0	170.0	12,899.0	194.86	0.01	MFN duties (Applied) 5%
2106.90	6,689.0	26,629.0	(19,940.0)	119.70	3.98	MFN duties (Applied) 5%
8716.40	575.0	27,323.0	(26,748.0)	191.76	47.52	MFN duties (Applied) 5%

* Deviation percentage.

Source: Calculation based on China's exports to Mongolia and Mongolia's imports from China in 2018 (WTO, International Trade Centre, 2020).

A detailed mirror analysis of Mongolia's imports from China and China's exports to Mongolia at the HS 6-digit level identified them as being at the high-risk level of CIF/FOB ratio, and with large-value asymmetries.

Another specific case appears in HS code 8605.00. Under this code, in 2018 Mongolia's imports from China were valued at US\$ 23.94 million but were not reported in China's exports to Mongolia. The deviation percentage was assessed at 200%. Therefore, further analysis of the national data bases of the trading countries is needed.

Goods classified as HS codes 8701.20; 7308.20; 8716.39; 1701.99; 8705.90 and 8502.31 could be considered as "lost" imports with a total value calculated at US\$ 123.32 million. Average customs and other taxes of Mongolia were assessed at 15.5% (customs tariff 5% and VAT rate 10%). If this percentage is used in calculating customs and other taxes of the value of these "lost" imports, Mongolia lost US\$ 19.11 million in revenue.

Mongolia did not apply any trade remedy for the 10 goods exported from China. MFN duty of 5% was applied to all the goods.

Mirror analysis should not only consider the value of goods at the HS 6-digit level, but also the quantity of goods at the HS 6-digit level.

Table 17: Mirror analysis: Mongolia's imports from China, and China's exports to Mongolia, 2018, HS Chapter 73

Value and Quantity	<i>Ex_{CN to MN}</i>	<i>Im_{MN from CN}</i>	Asymmetry	D%*	CIF/FOB ratio
<u>HS Chapter 73³²</u>					
Value (US\$ thousand)	181,991.00	259,039.00	(77,048.00)	34.94	1.42
Quantity (tons)	41,872.00	37,257.00	4,615.00	11.66	0.89
<u>HS code: 7308.90</u>					
Value (US\$ thousand)	49,646.0	106,139.0	(56,493.0)	72.53	2.14
Quantity (tons)	35,643.00	49,628.00	(13,985.00)	32.80	1.39
<u>HS code: 7308.20</u>					
Value (US\$ thousand)	23,887.0	10,776.0	13,111.0	75.65	0.45
Quantity (tons)	10,631.00	5,904.00	4,727.00	57.18	0.56

³² Articles of iron or steel; unit of quantity kg.

* Deviation percentage.

Source: Calculation based on China's exports to Mongolia and Mongolia's imports from China in 2018 (WTO, International Trade Centre, 2020).

Mongolia's imports from China under HS Chapter 73 consisted of 121 goods reported at the HS 6-digit level, while China's exports to Mongolia consisted of 109 goods reported at the HS 6-digit level. Mongolia's imports from China were reported to be US\$ 181.9 million but China's exports to Mongolia were reported to be US\$ 259.03 million. The deviation percentage was calculated at 34.94%, meaning that an additional analysis is required at the HS 6-digit level. In addition, the CIF/FOB ratio was assessed as being at the high-risk level. Twelve goods were not reported in China's exports to Mongolia and the total imported value of Mongolia's imports from China was reported as US\$ 2.09 million.

The customs tariff for HS Chapter 73 MFN is 5% duty and needs detailed analysis at the national level. The asymmetry in quantity is very low, and the deviation and CIF/FOB ratio were assessed as being at the low-risk level. Analysis at the HS 6-digit level shows that high-risk asymmetries occurred in goods classified under HS codes 7308.90 and 7308.20. Cases of specific trade mis-invoicing occurred in goods classified as HS code 7308.20, with the exported value and quantity being higher than the imported value and quantity, i.e., "lost" imports. The findings of the third stage of the mirror analysis presented many different results, some of which can be described as classification fraud as well as under- and over-valuation, both in the importing and the exporting countries.

The fourth stage of mirror analysis is based on the customs clearance data of Mongolia and China customs in 2018³³. As noted above, in 2010 Mongolian and Chinese customs signed an MoU on the exchange of international trade statistical data. Under this bilateral cooperation, they have already conducted mirror analyses more than 10 times.

Table 18 provides asymmetries and deviation estimations based on bilateral trade between Mongolia and China from 2010 to 2018.

Table 18: Comparison of asymmetries and deviations of the bilateral trade between China and Mongolia, 2010-2018 (US dollars million)

Years	Mongolia's exports to China				China's exports to Mongolia			
	Ex_{MN}	Im_{CN}	Asymmetry	D (%)	Ex_{CN}	Im_{MN}	Asymmetry	D (%)
2010	2,486.2	2,552.1	(65.9)	2.62%	1,449.8	987.6	(462.2)	37.93%
2011	4,403.2	3,700.8	702.4	17.33%	2,731.8	1,979.1	(752.7)	31.96%
2012	4,029.0	3,944.2	84.8	2.13%	2,653.5	1,825.9	(827.6)	36.95%

³³ Mirror statistical analysis of Mongolia and China (Customs, 2019).

2013	3,700.3	3,503.6	196.7	5.46%	2,449.5	1,785.8	(663.7)	31.34%
2014	5,070.1	5,098.3	(28.2)	0.55%	2,216.4	1,728.5	(487.9)	24.74%
2015	3,897.4	3,779.1	118.3	3.08%	1,572.2	1,359.2	(213.0)	14.53%
2016	3,888.8	3,622.6	266.2	7.09%	988.5	1,037.0	48.5	4.79%
2017	5,269.1	5,135.7	133.4	2.56%	1,248.3	1,411.7	163.4	12.29%
2018	6,508.1	6,342.3	165.8	2.58%	1,645.1	1,967.5	322.4	17.85%

Source: Calculation based on Mongolia's exports to China and China's exports to Mongolia from 2010 to 2018 (US\$ million) (WTO, International Trade Centre, 2020)

The asymmetries of China's exports to Mongolia from 2010 to 2015 ranged from US\$ 213 million to US\$ 827.6 million (negative) and were considered as "lost" imports during that period. For 2016-2018 the mirror analysis found that there were no more "lost" imports as shown from the general trade data.

A detailed mirror analysis was made of following types of goods, as shown in table 19, in order to estimate trade mis-invoicing in Mongolia's imports from China in 2018.

Table 19: Detailed mirror analysis on certain type of goods imported by Mongolia

HS	Description of goods	Mongolia's imports		China's exports		Asymmetries	
		Value	Quantity (tons)	Value	Quantity (tons)	Value	Quantity (tons)
0203	Meat of swine, fresh, chilled or frozen.	2,332.9	1,373.3	3,824.4	1,578.0	(1,491.5)	(204.8)
0803	Bananas, including plantains, fresh or dried.	225.1	439.9	535.9	1,602.0	(310.8)	(1,162.1)
0805.10	Oranges	418.8	1,190.1	813.4	4,852.6	(394.6)	(3,662.5)
1511.90	Palm oil	-	-	3,658.9	4,665.8	(3,658.9)	(4,665.8)
1902.30	Pasta	12,208.5	4,334.7	14,768.9	5,744.1	(2,560.4)	(1,409.3)
9015.80	Other instruments and appliances	281.5	0.01	4,296.2	0.9	(4,014.7)	0.4
9801	Travel goods	-	-	4,255.8	3,005.3	(4,255.8)	(3,005.3)
9804	Travel goods	-	-	226.4	0.0	(226.4)	(0.0)

Source: Customs automated information system of Mongolia (Customs M. , 2020)

Table 19 shows a number of discrepancies in Mongolia's imports from China. The analysis found the following types of trade mis-invoicing cases:

- Classification fraud. Meat of swine (HS code 0203) is normally declared under HS code 0209 (pig fat) in Mongolia's imports. In this case, it is also linked to the under-valuation fraud. Revenue losses on the customs tariff of 5% and VAT rate of 10% on this product were approximately US\$ 200,000;
- Valuation fraud, Bananas (HS code 0803) and oranges (HS code 0805.10) were declared as false unit values and quantities. These goods need to be registered in the customs risk management database as being at the high-risk level;
- Country of origin fraud. Palm oil (HS code 1511.90) and pasta (HS code 1902.30) were declared as transit goods for China. They were imported from a third country to Mongolia. In this case, there is no IFF bilateral trade between Mongolia and China, but a false country of origin was reported in Mongolia's international trade statistics (total imports – US\$ 3.9 million);
- Tariff fraud (HS code: 6810.19). Mongolian imports from China under HS code 6810 was assessed as "lost" imports. The main reason was customs tariff fraud, because the customs tariff for HS code 6810.19.10 is 20% and for HS code 6810.19.20 it is 15%. Traders declared the customs goods under HS code 6203 instead of HS codes 6810.19.10 and 6810.19.20. The reason is that the customs tariff for HS code 6203 is 5%; that is 10% to 15% lower than the original goods classification under HS codes 6810.19.10 and 6810.19.20);
- Travel goods (China's exports to Mongolia (HS codes 9801 and 9804). According to China's international trade registration methodology, e-commerce and online purchases of goods are categorized under HS codes 9801 and 9804 (travel goods); however, this HS Chapter (98) is not applied in Mongolia yet. Thus, the amount of "lost" imports increased on travel goods (HS codes 9801 and 9804). If the average customs and VAT taxes for those goods calculated, the revenue loss for Mongolia is approximately US\$ 700,000 (customs tariff of 5% and VAT rate of 10%);
- Other. The asymmetry of HS code 9015.80 for China's exports to Mongolia are assessed at \$US 4.01 million in "lost" imports. The reason is due to the different methodologies in the countries' trading systems. In this case, temporary import clearance data are not reported in Mongolian import statistics but are reported as China's exports.

The findings of the mirror analysis of the original customs clearance data³⁴ show that there are different types of commercial fraud in using trade mis-invoicing cases in customs clearance. It shows that by using customs clearance data for conducting a mirror analysis is beneficial for identifying mis-invoicing (fraudulent) activities. Following this action at the national level makes it easy to take preventative measures for mitigating such types of risks. By conducting this fourth stage sub mirror analysis

³⁴ "Internal mirror analysis report of China and Mongolia"

based on the national customs clearance data of Mongolia and China in 2018, we could come up with the following recommendations:

- Develop a risk profile on goods classified under HS codes, 0704.90.90, 0706.90.00, 6802.10.00, 6802.21.00, 6802.23.00, 6802.29.00, 6802.91.00, 6802.93.00, 6802.99.00, 6810.11.40, 6810.19.90, 6810.99.00, 6904.90.00, 6907.21.00, 6907.22.00, 6907.23.00, 6907.30.00 and 6907.40.00, using a combination of country of origin, HS code(s), importer, exporter and mode of transport;
- Increase information exchanges between Mongolia and the third country concerned as a destination for high volume goods in international trade;
- According to the Chinese international trade registration methodology, e-commerce and online sales of goods are categorized under HS Chapter 98. In 2018, imports of Chinese travel goods (HD code 9804.00) by Mongolia were reported as US\$ 32.36 million and 5,030 kgs, but HS Chapter 98 is not yet applied in Mongolia. Therefore, the Mongolian customs administration needs to find a solution for classifying e-commerce goods for customs clearance (HS codes 9801 and 9804);
- Improve capacity-building proficiency among customs officers and customs brokers for enhancing knowledge needed to detect miss-invoicing cases;

For 2016-2018, the customs clearance databases show that approximately 70% of import declarations were routed through the red channel (document and physical inspections). Only 0.7% of import declarations were shown as being non-compliant with customs and other legislation. Risk-based customs control is a one of the best tools available to modern customs administrations. Thus, targeting high risk by conducting mirror analyses is beneficial both to customs and to traders by targeting high-risk shipments more while facilitating legitimate trade.

5. Conclusion

Recognizing trade mis-invoicing as a main channel of IFFs, mirror analysis is one of the key tools used for assessing this problem. This study introduces a methodological framework for conducting mirror analyses by using data from available internationally accepted open sources. The findings of this study are as follows:

- The first stage of the mirror analysis focused on general trade statistics among the selected four countries, in order to calculate asymmetries, deviations and CIF/FOB ratios for each country as well as to assess risk levels for those indicators. Among the four countries, China was found to be the main trading partner of not only the Republic of Korea, Japan and Mongolia, but also the main

international trade partner of other countries around the world;

- In the second stage of the mirror analysis the most recent data, from 2018, show the trade in goods among the selected four countries. In the case of China's import statistics, exports by the Republic of Korea, Japan and Mongolia were China's main importing partners;
- More than 200 types of goods at the HS 6-digit level showed a trade gap, both in exports and in imports. The result of those trade gaps was a deviation calculated at 200% and a CIF/FOB ratio assessed as being at the high-risk level. In some cases, this included false classification of goods as well as misdeclaration of both exports and imports. This was dependent on the national trade policies of the trading partners;
- The mirror analysis at the HS 8-digit level on value and quantity asymmetries identified trade mis-invoicing. Under HS Chapter 73, China's exports to Mongolia, many types of commercial fraud (such as misclassification or false declarations of quality/quantity for those reported goods) were found. It is possible to calculate goods, using the HS 6-digit level, to identify mis-invoiced goods at the national level; and
- This study shows that there are many types of commercial fraud in international trade movements, such as misclassification, misdescription, over- or under-valuation, and false declarations of quality/quantity.

Recommendations

This study has attempted to address as many factors as possible in aggregating discrepancies in bilateral trade among the selected four countries. Mirror analysis makes it possible to assess both revenue and non-revenue risks as well as introduce a systematic approach to conducting a mirror analysis. The following activities are recommended for further study:

- The findings of a mirror analysis depend on the goods classification level. Goods at the HS 2-digit level provide some guidance, HS 4-digit level gives more results compared with the HS 2-digit level, and the HS 6-digit level presents the clearest findings for assessing high-risk as well as low-risk transactions. Therefore, it is recommended that mirror analyses need to be carried out at the HS national code level as well as the HS national subheading;
- Mirror analysis is one of the most useful ways of mitigating high-risk shipments and reducing IFFs. In addition, it plays a major role in the implementation of risk management at the national level. Customs administrations can easily calculate data from internationally available open sources (United Nations Comtrade and International Trade Centre) for mitigating high-risk shipments and facilitating legitimate trade;

- As shown by this study, an additional analysis needs to be done at the national level (by using customs clearance databases). Moreover, customs administrations should improve and develop cooperation and collaboration among the trading partner countries. Customs administrations should establish MoUs or similar agreements in order to conduct more successful mirror analyses at the national level, and to exchange cross-border trade information in real time (for example, from customs declaration databases and manifests);
- An effective and efficient data analysis system is required for reducing IFFs. Therefore, Customs administrations need to introduce high-level techniques for conducting mirror analyses by using this methodological framework;
- Customs administrations need to develop more effective data management and data security systems in line with modern information technologies, and to establish integrated information exchange frameworks with trading partner countries;
- HS codes at the 6-digit level and HS national subheadings, importers, exporters, country of origin, mode of transport, Incoterms, currency of contract and the type of payment transaction are the most essential data elements for reducing IFFs;
- Last but not least, without capable and skilled human resources, it is difficult to implement modern tools. Thus, customs administrations need to increase the number of big-data analysts and risk assessment officers at the national level.

In conducting this joint mirror analysis using customs clearance databases, a number of cases of trade mis-invoicing were found, including fraudulent trade practices (e.g., under- and over-invoicing of receipts). The success of such cooperating mechanisms among trading parties enables efficient and effective cooperation in targeting high-risk shipments while also decreasing trade gaps, year-by-year. The benefit of conducting a mirror analysis is the provision of an opportunity to use original customs data to target high-risk shipments and facilitate compliance by high-level traders.

Original customs data are one of most important sources of information needed to create a true risk profile of importers, exporters and means of transport. Other important sources data from border-crossing points and customs clearance offices. Thus, the combination of a risk profile and an early warning message makes it possible for customs officers to carry out effective and efficient customs control, and to reduce time and cost of compliance for high-level traders.

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Annex 1: International trade statistics of China, Republic of Korea, Japan and Mongolia from 2014 to 2018 (US\$ billion)

YEAR		2014	2015	2016	2017	2018
CHINA						
Import	1	1,808.7	1,566.6	1,500.6	1,740.3	2,022.3
Export	2	2,243.8	2,142.8	1,989.5	2,216.2	2,417.4
Trade balance	3 (1-2)	435.1	576.2	488.9	475.9	395.2
Total trade	4 (1+2)	4,052.5	3,709.3	3,490.1	3,956.5	4,439.7
REPUBLIC OF KOREA						
Import	1	527.3	422.8	395.5	466.7	513.6
Export	2	613.4	543.1	511.9	580.3	625.4
Trade balance	3 (1-2)	86.1	120.3	116.5	113.6	111.9
Total trade	4 (1+2)	1,140.6	965.9	907.4	1,047.0	1,139.0
JAPAN						
Import	1	799.0	629.4	584.7	644.8	724.5
Export	2	699.2	622.0	635.8	688.7	735.7
Trade balance	3 (1-2)	(99.8)	(7.3)	51.2	43.8	11.2
Total trade	4 (1+2)	1,498.2	1,251.4	1,220.5	1,333.5	1,460.1
MONGOLIA						
Import	1	5.3	3.9	3.5	4.3	5.9
Export	2	5.5	4.4	4.8	5.8	6.6
Trade balance	3 (1-2)	0.2	0.6	1.3	1.5	0.7
Total trade	4 (1+2)	10.8	8.3	8.3	10.2	12.4

Source: The World Integrated Trade Solution software (Software, 2020)

China's trade in goods: In 2018, the volume of trade from China increased by 12.1% compared to the previous year, and stood at US\$4,439.7 billion with a trade balance surplus of US\$395.2 billion. China's exports increased by 9% and imports increased by 16% from the previous year. Imports to China had the highest increased percentage rate compared to other countries.

Republic of Korea's trade in goods: In 2018, the volume of trade to and from Republic of Korea increased by 8.7% from that of the previous year, and stood at US\$1,139.0 billion with a trade balance surplus of US\$111.9 billion. Republic of Korea's exports increased by 10% and imports increased by 7% from that of the previous year.

Japan's trade in goods: In 2018, the volume of trade to and from Japan increased by 9.5% compared to the previous year, and stood at US\$1,460.1 billion with a trade balance surplus of US\$11.2 billion. Japan's exports increased by 12% and imports increased by 6% from that of the previous year.

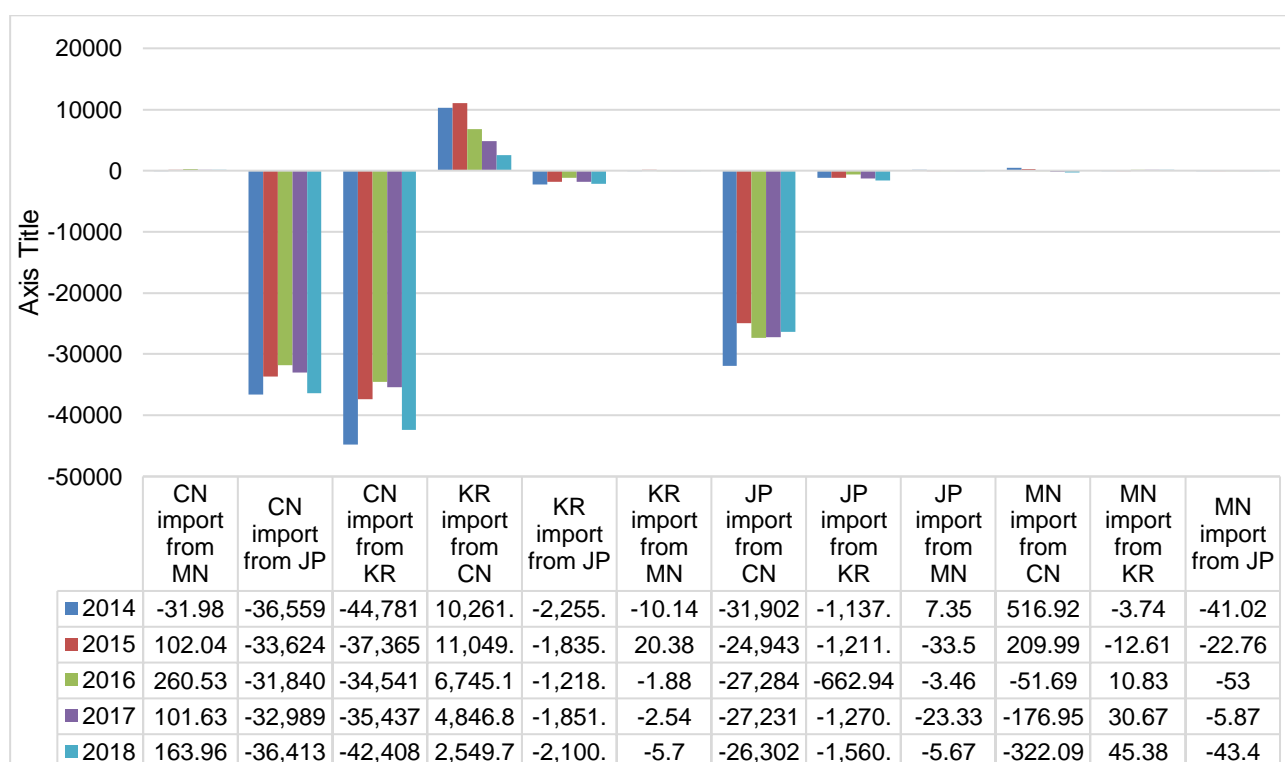
Mongolia trade in goods: The volume of trade with Mongolia stood at US\$12.4 billion in 2018, an increase of 12.1% from that of the previous year with a trade balance surplus of US\$0.7 billion. Mongolia's exports increased by 35% and import increased by 12% from that of the previous year. The volume of Mongolia's exports is not so big, but showed the highest increased percentage of trade among China, Republic of Korea, Japan and Mongolia.

Annex 2: Bilateral trade shares between China, Republic of Korea, Japan and Mongolia (from 2014 to 2018, by percentage)

Year	China's imports from ...					China's exports to ...				
	Japan	Republic of Korea	Mongolia	Other	Total	Japan	Republic of Korea	Mongolia	Other	Total
2014	8.3	9.7	0.26	81.7	100.0	6.4	4.3	0.09	89.2	100.0
2015	8.5	10.4	0.23	80.9	100.0	6.0	4.5	0.07	89.5	100.0
2016	9.2	10.0	0.23	80.6	100.0	6.2	4.5	0.05	89.3	100.0
2017	9.0	9.6	0.28	81.1	100.0	6.1	4.5	0.05	89.3	100.0
2018	8.4	9.6	0.30	81.7	100.0	5.9	4.4	0.07	89.7	100.0
Average	8.7	9.9	0.26	81.2	100.0	6.1	4.4	0.07	89.4	100.0
Year	Republic of Korea's imports from...					Republic of Korea's exports to ...				
	China	Japan	Mongolia	Other	Total	China	Japan	Mongolia	Other	Total
2014	17.1	10.2	0.004	72.6	100.0	25.4	5.6	0.06	69.0	100.0
2015	20.7	10.5	0.011	68.8	100.0	26.0	4.9	0.05	69.1	100.0
2016	21.4	11.7	0.003	66.9	100.0	25.1	4.9	0.04	69.9	100.0
2017	20.5	11.5	0.003	68.0	100.0	24.8	4.7	0.04	70.5	100.0
2018	19.9	10.2	0.005	69.9	100.0	26.8	5.1	0.05	68.1	100.0
Average	19.9	10.8	0.005	69.2	100.0	25.6	5.0	0.05	69.3	100.0
Year	Japan's imports from ...					Japan's exports to ...				
	China	Republic of Korea	Mongolia	Other	Total	China	Republic of Korea	Mongolia	Other	Total
2014	22.3	4.1	0.002	73.6	100.0	18.3	7.5	0.05	74.2	100.0
2015	25.7	4.3	0.009	70.0	100.0	17.5	7.0	0.04	75.4	100.0
2016	25.8	4.1	0.003	70.1	100.0	17.6	7.2	0.04	75.1	100.0
2017	24.5	4.2	0.006	71.3	100.0	19.0	7.6	0.05	73.3	100.0
2018	23.2	4.3	0.004	72.5	100.0	19.5	7.1	0.07	73.3	100.0
Average	24.3	4.2	0.005	71.5	100.0	18.4	7.3	0.05	74.3	100.0
Year	Mongolia imports from ...					Mongolia exports to ...				
	China	Japan	Republic of Korea	Other	Total	China	Japan	Republic of Korea	Other	Total
2014	33.1	7.2	6.8	52.9	100.0	87.8	0.4	0.23	11.5	100.0
2015	35.8	7.2	6.8	50.1	100.0	83.5	0.4	1.43	14.7	100.0
2016	31.1	9.9	5.9	53.0	100.0	79.0	0.3	0.17	20.6	100.0
2017	32.6	8.4	4.6	54.5	100.0	85.0	0.2	0.19	14.6	100.0
2018	33.5	9.5	4.5	52.5	100.0	92.8	0.4	0.30	6.5	100.0
Average	33.2	8.4	5.7	52.6	100.0	85.6	0.4	0.46	13.6	100.0

Source: Author's calculation, data from International trade centre: Trade statistics (2014-2018)

Annex 3: Comparison of asymmetries - Bilateral trade of China, People Republic of Korea, Japan and Mongolia (US\$ million, from 2014 to 2018)



Source: Author's calculation based on bilateral trade among China, republic of Korea, Japan and Mongolia trade in goods (WTO, International Trade Centre, 2020).

Annex 4: Comparison of asymmetries, deviation and CIF/FOB ratio - Bilateral trade among China, Republic of Korea, Japan and Mongolia (US\$ million, from 2014 to 2018)

CHINA (CN)' S IMPORT AND MONGOLIA (MN)' S EXPORT					
	2014	2015	2016	2017	2018
Export: MN to CN	5,070.11	3,897.42	3,883.13	5,268.94	6,505.53
Import: CN from MN	5,102.09	3,795.38	3,622.60	5,167.31	6,341.58
Asymmetry	(31.98)	102.04	260.53	101.63	163.96
Deviation %	1%	3%	7%	2%	3%
CIF/FOB ratio	1.01	0.97	0.93	0.98	0.97
CHINA (CN)' S IMPORT AND JAPAN (JP)' S EXPORT					
Export: JP to CN	126,361.39	109,277.77	113,830.23	132,804.59	143,988.60
Import: CN from JP	162,920.51	142,902.57	145,670.69	165,794.01	180,401.79
Asymmetry	(36,559.13)	(33,624.81)	(31,840.45)	(32,989.42)	(36,413.19)
Deviation %	25%	27%	25%	22%	22%
CIF/FOB ratio	1.29	1.31	1.28	1.25	1.25
CHINA (CN)' S IMPORT AND REPUBLIC OF KOREA (KR)' S EXPORT					
Export: KR to CN	145,327.74	137,140.48	124,432.72	142,115.18	162,157.60
Import: CN from KR	190,108.77	174,506.08	158,974.53	177,553.15	204,566.45
Asymmetry	(44,781.03)	(37,365.61)	(34,541.81)	(35,437.97)	(42,408.86)

Deviation %	27%	24%	24%	22%	23%
CIF/FOB ratio	1.31	1.27	1.28	1.25	1.26
REPUBLIC OF KOREA (KR)' S IMPORT AND CHINA (CN)' S EXPORT					
	2014	2015	2016	2017	2018
Export: CN to KR	100,333.45	101,286.38	93,707.10	102,703.78	109,028.75
Import: KR from CN	90,072.16	90,236.93	86,962.00	97,856.89	106,479.00
Asymmetry	10,261.29	11,049.45	6,745.10	4,846.89	2,549.75
Deviation %	11%	12%	7%	5%	2%
CIF/FOB ratio	0.90	0.89	0.93	0.95	0.98
REPUBLIC OF KOREA (KR)' S IMPORT AND JAPAN (JP)' S EXPORT					
Export: JP to KR	51,520.34	44,018.77	46,235.24	53,282.03	52,504.25
Import: KR from JP	53,775.98	45,854.37	47,454.09	55,133.80	54,605.04
Asymmetry	(2,255.64)	(1,835.60)	(1,218.85)	(1,851.78)	(2,100.78)
Deviation %	4%	4%	3%	3%	4%
CIF/FOB ratio	1.04	1.04	1.03	1.03	1.04
REPUBLIC OF KOREA (KR)' S IMPORT AND MONGOLIA (MN)' S EXPORT					
Import: KR from MN	23.64	46.19	10.35	14.15	26.90
Export: MN to KR	13.50	66.57	8.47	11.62	21.20
Asymmetry	(10.14)	20.38	(1.88)	(2.54)	(5.70)
Deviation %	55%	36%	20%	20%	24%
CIF/FOB ratio	1.75	0.69	1.22	1.22	1.27
JAPAN (JP)' S IMPORT AND CHINA (CN)' S EXPORT					
	2014	2015	2016	2017	2018
Export: CN to JP	149,391.34	135,616.44	129,268.49	137,258.93	147,235.10
Import: JP from CN	181,294.16	160,559.70	156,552.58	164,490.10	173,537.49
Asymmetry	(31,902.82)	(24,943.26)	(27,284.10)	(27,231.17)	(26,302.39)
Deviation %	19%	17%	19%	18%	16%
CIF/FOB ratio	1.21	1.18	1.21	1.20	1.18
JAPAN (JP)' S IMPORT AND REPUBLIC OF KOREA (KR)' S EXPORT					
Export: KR to JP	32,247.85	25,596.26	24,356.59	26,827.47	30,574.27
Import: JP from KR	33,385.31	26,807.29	25,019.53	28,097.66	32,134.49
Asymmetry	(1,137.46)	(1,211.03)	(662.94)	(1,270.19)	(1,560.22)
Deviation %	3%	5%	3%	5%	5%
CIF/FOB ratio	1.04	1.05	1.03	1.05	1.05
JAPAN (JP)' S IMPORT AND MONGOLIA (MN)' S EXPORT					
Export: MN to JP	24.45	20.32	14.03	14.82	26.47
Import: JP from MN	17.10	53.81	17.49	38.15	32.13
Asymmetry	7.35	(33.50)	(3.46)	(23.33)	(5.67)
Deviation %	35%	90%	22%	88%	19%
CIF/FOB ratio	0.70	2.65	1.25	2.57	1.21
MONGOLIA (MN)' S IMPORT AND CHINA (CN)' S EXPORT					
	2014	2015	2016	2017	2018
Export: CN to MN	2,216.38	1,570.70	988.54	1,235.61	1,646.74
Import: MN from CN	1,699.46	1,360.71	1,040.23	1,412.56	1,968.83
Asymmetry	516.92	209.99	(51.69)	(176.95)	(322.09)
Deviation %	26%	14%	5%	13%	18%
CIF/FOB ratio	0.77	0.87	1.05	1.14	1.20
MONGOLIA (MN)' S IMPORT AND REPUBLIC OF KOREA (KR)' S EXPORT					
Export: CN to MN	346.86	246.09	208.72	228.38	307.74
Import: MN from CN	350.61	258.70	197.89	197.70	262.37
Asymmetry	(3.74)	(12.61)	10.83	30.67	45.38
Deviation %	1%	5%	5%	14%	16%

CIF/FOB ratio	1.01	1.05	0.95	0.87	0.85
MONGOLIA (MN)' S IMPORT AND JAPAN (JP)' S EXPORT					
Export: JP to MN	326.44	251.88	277.60	357.28	517.65
Import: MN from JP	367.46	274.64	330.61	363.15	561.04
Asymmetry	(41.02)	(22.76)	(53.00)	(5.87)	(43.40)
Deviation %	12%	9%	17%	2%	8%
CIF/FOB ratio	1.13	1.09	1.19	1.02	1.08

Source: Author's calculation based on bilateral trade among China, republic of Korea, Japan and Mongolia trade in goods (WTO, International Trade Centre, 2020).

Annex 5: Deviation and risk level matrix of bilateral trade among China, Republic of Korea, Japan and Mongolia (from 2014 to 2018)

Trading partner countries ³⁵	2014		2015		2016		2017		2018	
	D (%)	Risk level	D (%)	Risk level	D (%)	Risk level	D (%)	Risk level	D (%)	Risk level
<i>Im_{CN} and Ex_{MN}</i>	0.63	L	2.65	L	6.94	L	1.95	L	2.55	L
<i>Im_{CN} and Ex_{JP}</i>	25.28	M	26.67	M	24.54	M	22.10	M	22.45	M
<i>Im_{CN} and Ex_{KR}</i>	26.70	M	23.98	M	24.38	M	22.17	M	23.13	M
<i>Im_{KR} and Ex_{CN}</i>	10.78	L	11.54	L	7.47	L	4.83	L	2.37	L
<i>Im_{KR} and Ex_{JP}</i>	4.28	L	4.08	L	2.60	L	3.42	L	3.92	L
<i>Im_{KR} and Ex_{MN}</i>	54.63	H	36.15	M	20.01	M	19.68	M	23.72	M
<i>Im_{JP} and Ex_{CN}</i>	19.29	M	16.84	M	19.09	M	18.05	M	16.40	M
<i>Im_{JP} and Ex_{KR}</i>	3.47	L	4.62	L	2.69	L	4.63	L	4.98	L
<i>Im_{JP} and Ex_{MN}</i>	35.39	M	90.37	H	21.95	M	88.11	H	19.33	M
<i>Im_{MN} and Ex_{CN}</i>	26.40	M	14.33	L	5.10	L	13.36	L	17.82	M
<i>Im_{MN} and Ex_{KR}</i>	1.07	L	5.00	L	5.33	L	14.40	L	15.92	M
<i>Im_{MN} and Ex_{JP}</i>	11.82	L	8.65	L	17.43	M	1.63	L	8.05	L

Source: Author's calculation (Formula 2) based on trading partner countries imports and exports between 2014 and 2018 (WTO, International Trade Centre, 2020); Country abbreviations based on ISO 3166.

Annex 6: The CIF/FOB ratio and risk level* matrix of bilateral trade among China, Republic of Korea, Japan and Mongolia (from 2014 to 2018)

Trading partners	2014		2015		2016		2017		2018	
	Ratio	Risk level	Ratio	Risk level	Ratio	Risk level	Ratio	Risk level	Ratio	Risk level
<i>Im_{CN} and Ex_{MN}</i>	1.01	L	0.97	L	0.93	L	0.98	L	0.97	L
<i>Im_{CN} and Ex_{JP}</i>	1.29	M	1.31	H	1.28	M	1.25	M	1.25	M
<i>Im_{CN} and Ex_{KR}</i>	1.31	H	1.27	M	1.28	M	1.25	M	1.26	M
<i>Im_{KR} and Ex_{CN}</i>	0.9	L	0.89	M	0.93	L	0.95	L	0.98	L

³⁵ *Im_{CN} and Ex_{MN}* (China's imports from Mongolia and Mongolia's exports to China).

<i>Im_{KR} and Ex_{JP}</i>	1.04	L	1.04	L	1.03	L	1.03	L	1.04	L
<i>Im_{KR} and Ex_{MN}</i>	1.75	H	0.69	H	1.22	M	1.22	M	1.27	M
<i>Im_{JP} and Ex_{CN}</i>	1.21	M	1.18	M	1.21	M	1.2	M	1.18	M
<i>Im_{JP} and Ex_{KR}</i>	1.04	L	1.05	L	1.03	L	1.05	L	1.05	L
<i>Im_{JP} and Ex_{MN}</i>	0.7	M	2.65	H	1.25	M	2.57	H	1.21	M
<i>Im_{MN} and Ex_{CN}</i>	0.77	M	0.87	M	1.05	L	1.14	M	1.2	M
<i>Im_{MN} and Ex_{KR}</i>	1.01	L	1.05	L	0.95	L	0.87	L	0.85	M
<i>Im_{MN} and Ex_{JP}</i>	1.13	M	1.09	L	1.19	M	1.02	L	1.08	L

* Low risk (0 to 10%); Medium risk (11% to 30%); High risk (>30%)

Source: Author's calculation (Formula 3) based on trading partner countries imports and exports between 2014 and 2018 (WTO, International Trade Centre, 2020); Country abbreviations based on ISO 3166.

Annex 7: Tabulation of asymmetries - Republic of Korea's exports to China and China's imports from Republic of Korea in 2018, by HS 2-digit level (US\$ million)

Included observations: 95 after adjustments; Number of categories: 34

Value (US\$ million)	HS chapters	Count	Percent	Cumulative Count	Cumulative Percent
[-33870, -33860)		85	1	1	1.05
[-1850, -1840)		84	1	2	2.11
[-1670, -1660)		90	1	3	3.16
[-1490, -1480)		70	1	4	4.21
[-1410, -1400)		27	1	5	5.26
[-1020, -1010)		39	1	6	6.32
[-400, -390)		76	1	7	7.37
[-390, -380000)		29	1	8	8.42
[-380, -370)		74	1	9	9.47
[-220, -210)		33	1	10	10.53
[-210, -200)		35	1	11	11.58
[-170, -160)		99	1	12	12.63
[-110, -100)	41; 89	2	2.11	14	14.74
[-100, -90)	79	1	1.05	15	15.79
[-90, -80)	59	1	1.05	16	16.84
[-80, -70)	72	1	1.05	17	17.89
[-70, -60)	28; 68	2	2.11	19	20.00
[-60, -50)	25	1	1.05	20	21.05
[-40, -30)	20; 48; 54	3	3.16	23	24.21
[-30, -20)	24; 34; 42; 47; 58; 82; 87	7	7.37	30	31.58
[-20, -10)	22; 52; 55; 67; 92	5	5.26	35	36.84
[-10, 0)	01; 17; 43; 46; 49; 50; 53; 63; 67; 80; 91; 96; 97	12	12.63	47	49.47
[0, 10)	02; 04; 05; 06; 07; 08; 09; 10; 11; 13; 14; 15; 18; 23; 44; 45;	28	29.47	75	78.95

	51; 56; 57; 60; 65; 66; 73; 75; 78; 86; 88; 93					
[10, 20)	16; 19; 31	3	3.16	78	82.11	
[20, 30)	61; 95	2	2.11	80	84.21	
[30, 40)	12; 30	2	2.11	82	86.32	
[50, 60)	38; 81	2	2.11	84	88.42	
[60, 70)	69; 71; 83	3	3.16	87	91.58	
[90, 100)	62; 64	2	2.11	89	93.68	
[100, 110)	21	1	1.05	90	94.74	
[150, 160)	26	1	1.05	91	95.79	
[160, 170)	37	1	1.05	92	96.84	
[170, 180)	03; 32	2	2.11	94	98.95	
[190, 200)	94	1	1.05	95	100.00	
Total		95	100.00	95	100.00	

Source: Author's calculation based on trade between Republic of Korea and China in 2018 (WTO, International Trade Centre, 2020)

Annex 8: Tabulation of asymmetries - Republic of Korea's exports to China and China's imports from Republic of Korea in 2018, by HS 6-digit level (US\$ thousand)

Included observations: 3995 (HS 6 digit); Number of categories: 26

Value	Count	Percent	Cumulative Count	Cumulative Percent
[-23700, -23600)	1	0.03	1	0.03
[-5700, -5600)	1	0.03	2	0.05
[-4600, -4500)	1	0.03	3	0.08
[-3400, -3300)	1	0.03	4	0.10
[-2100, -2000)	1	0.03	5	0.13
[-2000, -1900)	1	0.03	6	0.15
[-1300, -1200)	1	0.03	7	0.18
[-1200, -1100)	1	0.03	8	0.20
[-900, -800)	1	0.03	9	0.23
[-800, -700)	1	0.03	10	0.25
[-600, -500)	5	0.13	15	0.38
[-500, -400)	2	0.05	17	0.43
[-400, -300)	6	0.15	23	0.58
[-300, -200)	6	0.15	29	0.73
[-200, -100)	16	0.40	45	1.13
[-100, 0)	1864	46.66	1909	47.78
[0, 100)	2053	51.39	3962	99.17
[100, 200)	18	0.45	3980	99.62
[200, 300)	3	0.08	3983	99.70
[300, 400)	2	0.05	3985	99.75
[400, 500)	3	0.08	3988	99.82
[500, 600)	3	0.08	3991	99.90
[600, 700)	1	0.03	3992	99.92
[1200, 1300)	1	0.03	3993	99.95

[2200, 2300)	1	0.03	3994	99.97
[2400, 2500)	1	0.03	3995	100.00
Total	3995	100.00	3995	100.00

Source: Author's calculation based on trade between Republic of Korea and China in 2018 (WTO, International Trade Centre, 2020)

Annex 9: Tabulation of asymmetries - China's exports to Republic of Korea and Republic of Korea's imports from China in 2018, by HS 2-digit level (US\$ million)

Included observations: 97; Number of categories: 21

Value (US\$ million)	HS Chapters	Count	Percent	Cumulative Count	Cumulative Percent	
[-2150, -2100)		84	1	1.03	1	1.03
[-700, -650)		73	1	1.03	2	2.06
[-450, -400)		38	1	1.03	3	3.09
[-400, -350)		29	1	1.03	4	4.12
[-350, -300)		90; 72	2	2.06	6	6.19
[-250, -200)		81	1	1.03	7	7.22
[-200, -150)		39; 95; 70	3	3.09	10	10.31
[-150, -100)		91; 28; 64; 71	4	4.12	14	14.43
[-100, -50)		32; 44; 48	3	3.09	17	17.53
[-50, 0)		96; 25; 42; 76; 33; 88; 34; 17; 92; 49; 74; 23; 47; 08; 83; 01; 31; 56; 97; 40; 51; 79; 80; 36; 15; 58; 93; 45; 41; 78; 02	31	31.96	48	49.48
[0, 50)		15; 58; 93; 45; 41; 78; 02; 19; 10; 12; 14; 11; 89; 57; 18; 75; 05; 43; 50; 22; 06; 59; 24; 35; 67; 55; 04; 21; 46; 37; 66; 54; 60; 09; 13	28	28.87	76	78.35
[50, 100)		52; 63; 07; 65; 99; 82; 87	7	7.22	83	85.57
[100, 150)		26; 86; 69; 16	4	4.12	87	89.69
[150, 200)		53; 30	2	2.06	89	91.75
[250, 300)		03	1	1.03	90	92.78
[300, 350)		62	1	1.03	91	93.81
[400, 450)		68; 94	2	2.06	93	95.88
[450, 500)		20	1	1.03	94	96.91
[900, 950)		61	1	1.03	95	97.94
[1550, 1600)		27	1	1.03	96	98.97
[2300, 2350)		85	1	1.03	97	100.00
Total		97	100.00	97	100.00	

Source: Author's calculation based on trade between Republic of Korea and China in 2018 (WTO, International Trade Centre, 2020)

Annex 10: Tabulation of asymmetries - China's exports to Republic of Korea and Republic of Korea's imports from China in 2018, by HS 6-digit level (US\$ thousand)

Included observations: 4475; Number of categories: 23

Value	Count	Percent	Cumulative Count	Cumulative Percent
[-750000, -700000)	1	0.02	1	0.02
[-650000, -600000)	1	0.02	2	0.04
[-450000, -400000)	3	0.07	5	0.11
[-400000, -350000)	3	0.07	8	0.18
[-350000, -300000)	3	0.07	11	0.25
[-300000, -250000)	1	0.02	12	0.27
[-250000, -200000)	6	0.13	18	0.40
[-200000, -150000)	11	0.25	29	0.65
[-150000, -100000)	12	0.27	41	0.92
[-100000, -50000)	37	0.83	78	1.74
[-50000, 0)	2706	60.47	2784	62.21
[0, 50000)	1621	36.22	4405	98.44
[50000, 100000)	40	0.89	4445	99.33
[100000, 150000)	10	0.22	4455	99.55
[150000, 200000)	8	0.18	4463	99.73
[200000, 250000)	3	0.07	4466	99.80
[250000, 300000)	2	0.04	4468	99.84
[300000, 350000)	2	0.04	4470	99.89
[400000, 450000)	1	0.02	4471	99.91
[600000, 650000)	1	0.02	4472	99.93
[1400000, 1450000)	1	0.02	4473	99.96
[2150000, 2200000)	1	0.02	4474	99.98
[5100000, 5150000)	1	0.02	4475	100.00
Total	4475	100.00	4475	100.00

Source: Author's calculation based on trade between Republic of Korea and China in 2018 (WTO, International Trade Centre, 2020)

Annex 11: Tabulation of asymmetries - China's exports to Japan and Japan's imports from China in 2018, by HS 2-digit level (US\$ million)

Included observations: 97; Number of categories: 23

Value (US\$ million)	HS chapters	Count	Percent	Cumulative Count	Cumulative Percent	
[-12900, -12850)		85	1	1.03	1	1.03
[-5600, -5550)		84	1	1.03	2	2.06
[-1650, -1600)		95	1	1.03	3	3.09
[-1550, -1500)		99	1	1.03	4	4.12
[-950, -900)		62	1	1.03	5	5.15
[-650, -600)	39; 42	2	2.06	7	7.22	
[-600, -550)	73	1	1.03	8	8.25	
[-550, -500)	91; 61	2	2.06	10	10.31	
[-500, -450)	64	1	1.03	11	11.34	
[-300, -250)	38; 90; 29	3	3.09	14	14.43	
[-250, -200)	68; 70	2	2.06	16	16.49	
[-200, -150)	71; 44; 30; 28; 74; 12; 83	7	7.22	23	23.71	
[-150, -100)	63; 07; 25	3	3.09	26	26.80	
[-100, -50)	33; 49; 65; 32; 40; 96; 97; 82; 81; 72	10	10.31	36	37.11	
[-50, 0)	48; 09; 57; 58; 31; 94; 87; 66; 92; 41; 79; 59; 67; 14; 24; 05; 45; 06; 54; 17; 02; 11; 52; 15; 55; 43; 50; 36; 01	29	29.90	65	67.01	
[0, 50)	78; 60; 80; 18; 93; 47; 75; 51; 21; 34; 10; 19; 04; 56; 37; 08; 76; 22; 35; 23; 46; 53; 89; 88	24	24.74	89	91.75	
[100, 150)	69; 13	2	2.06	91	93.81	
[200, 250)	86	1	1.03	92	94.85	
[250, 300)	20	1	1.03	93	95.88	
[300, 350)	16	1	1.03	94	96.91	
[600, 650)	26	1	1.03	95	97.94	
[700, 750)	27	1	1.03	96	98.97	
[800, 850)	03	1	1.03	97	100.00	
Total		97	100.00	97	100.00	

Source: Author's calculation based on trade between Japan and China in 2018 (WTO, International Trade Centre, 2020)

Annex 12: Tabulation of asymmetries - China's exports to Japan and Japan's imports from China in 2018, by HS 6-digit level (US\$ thousand)

Included observations: 4371 after adjustments; Number of categories: 22

Value	Count	Percent	Cumulative Count	Cumulative Percent
[-6700000, 6600000)	1	0.02	1	0.02
[-2100000, 2000000)	1	0.02	2	0.05
[-1600000, 1500000)	2	0.05	4	0.09
[-1400000, 1300000)	1	0.02	5	0.11
[-1300000, 1200000)	1	0.02	6	0.14
[-1100000, 1000000)	1	0.02	7	0.16
[-1000000, -900000)	1	0.02	8	0.18
[-900000, -800000)	1	0.02	9	0.21
[-700000, -600000)	1	0.02	10	0.23
[-600000, -500000)	2	0.05	12	0.27
[-500000, -400000)	2	0.05	14	0.32
[-400000, -300000)	3	0.07	17	0.39
[-300000, -200000)	13	0.30	30	0.69
[-200000, -100000)	31	0.71	61	1.40
[-100000, 0)	2471	56.53	2532	57.93
[0, 100000)	1807	41.34	4339	99.27
[100000, 200000)	17	0.39	4356	99.66
[200000, 300000)	5	0.11	4361	99.77
[300000, 400000)	5	0.11	4366	99.89
[400000, 500000)	2	0.05	4368	99.93
[600000, 700000)	2	0.05	4370	99.98
[700000, 800000)	1	0.02	4371	100.00
Total	4371	100.00	4371	100.00

Source: Author's calculation based on trade between Japan and China in 2018 (WTO, International Trade Centre, 2020)

Annex 13: Tabulation of asymmetries - China's exports to Mongolia and Mongolia's imports from China in 2018, by HS 2-digit level (US\$ thousand)

Included observations: 95; Number of categories: 23

Value	HS Chapters	Count	Percent	Cumulative Count	Cumulative Percent	
[-77500, -77000)		73	1	1.05	1	1.05
[-55000, -54500)		85	1	1.05	2	2.11
[-41500, -41000)		84	1	1.05	3	3.16
[-24500, -24000)		86	1	1.05	4	4.21
[-21000, -20500)		21	1	1.05	5	5.26
[-18000, -17500)		72	1	1.05	6	6.32
[-17000, -16500)		68	1	1.05	7	7.37
[-15000, -14500)		94	1	1.05	8	8.42
[-12000, -11500)		69	1	1.05	9	9.47
[-11500, -11000)	70; 48; 44	3	3.16	12	12.63	
[-7000, -6500)	87; 39	2	2.11	14	14.74	
[-6000, -5500)	32	1	1.05	15	15.79	
[-5500, -5000)	38	1	1.05	16	16.84	
[-4500, -4000)	28; 07	2	2.11	18	18.95	
[-4000, -3500)	62; 64	2	2.11	20	21.05	
[-3500, -3000)	25	1	1.05	21	22.11	
[-2500, -2000)	76; 42; 56; 83	4	4.21	25	26.32	
[-2000, -1500)	61; 24; 33; 96	4	4.21	29	30.53	
[-1500, -1000)	52; 95; 49; 82	4	4.21	33	34.74	
[-1000, -500)	16; 63; 20; 71	4	4.21	37	38.95	
[-500, 0)	91; 53; 22; 65; 75; 50; 40; 92; 31; 36; 11; 18; 74; 23; 09; 12; 43; 04; 67; 66; 13; 97; 47; 46; 41; 81; 79; 93; 14; 45	30	31.58	67	70.53	
[0, 500)	06; 88; 78; 60; 03; 89; 58; 26; 37; 30; 55; 08	12	12.63	79	83.16	
[500, 1000)	35; 54; 05; 29	4	4.21	83	87.37	
[1500, 2000)	59; 02	2	2.11	85	89.47	
[2000, 2500)	57; 19	2	2.11	87	91.58	
[2500, 3000)	90; 10; 34	3	3.16	90	94.74	
[4000, 4500)	27; 99	2	2.11	92	96.84	
[6000, 6500)	15	1	1.05	93	97.89	

Value	HS Chapters	Count	Percent	Cumulative Count	Cumulative Percent	
[7000, 7500)		51	1	1.05	94	98.95
[19000, 19500)		17	1	1.05	95	100.00
Total		95	100.00	95	100.00	

Source: Author's calculation based on trade between Mongolia and China in 2018 (WTO, International Trade Centre, 2020)

Annex 14: Tabulation of asymmetries - China's exports to Mongolia and Mongolia's imports from China in 2018, by HS 6-digit level (US\$ thousand)

Included observations: 2909 after adjustments; Number of categories: 22

Value	Count	Percent	Cumulative Count	Cumulative Percent
[-58000, -56000)	1	0.03	1	0.03
[-54000, -52000)	1	0.03	2	0.07
[-28000, -26000)	1	0.03	3	0.10
[-24000, -22000)	1	0.03	4	0.14
[-20000, -18000)	1	0.03	5	0.17
[-18000, -16000)	1	0.03	6	0.21
[-16000, -14000)	1	0.03	7	0.24
[-14000, -12000)	2	0.07	9	0.31
[-12000, -10000)	3	0.10	12	0.41
[-10000, -8000)	2	0.07	14	0.48
[-8000, -6000)	5	0.17	19	0.65
[-6000, -4000)	9	0.31	28	0.96
[-4000, -2000)	25	0.86	53	1.82
[-2000, 0)	1981	68.10	2034	69.92
[0, 2000)	840	28.88	2874	98.80
[2000, 4000)	18	0.62	2892	99.42
[4000, 6000)	7	0.24	2899	99.66
[6000, 8000)	1	0.03	2900	99.69
[10000, 12000)	4	0.14	2904	99.83
[12000, 14000)	3	0.10	2907	99.93
[18000, 20000)	1	0.03	2908	99.97
[52000, 54000)	1	0.03	2909	100.00

Total	2909	100.00	2909	100.00
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Source: Author's calculation based on trade between Mongolia and China in 2018 (WTO, International Trade Centre, 2020)