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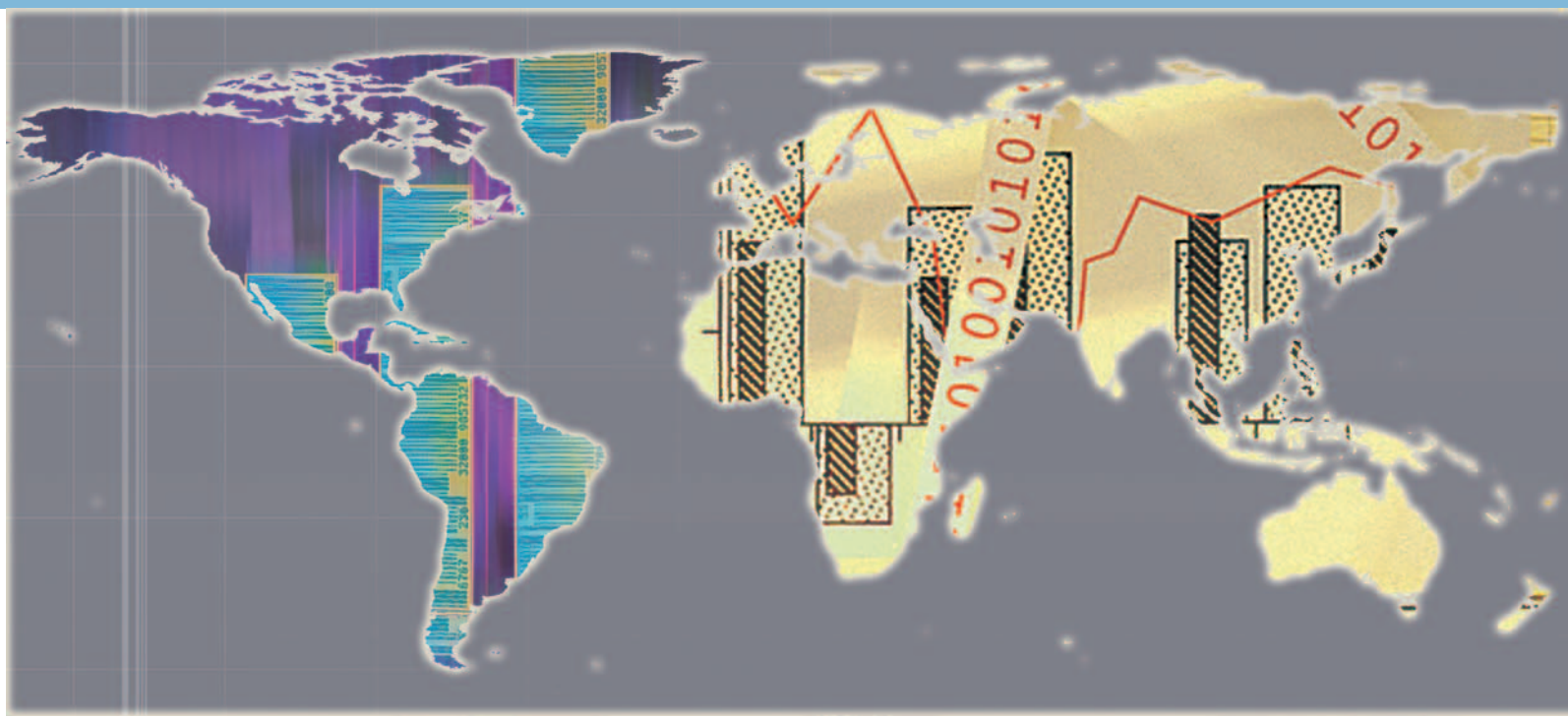

Mirror Statistics of International Trade in Manufacturing Goods:
The Case of China

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Mirror Statistics of International Trade in Manufacturing Goods: The Case of China

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Abstract

As the process of globalization deepens, asymmetry in international trade statistics continues to be of great concern to trade statisticians and policy makers alike, despite the fact that international trade in goods—especially manufacturing goods—and services is increasing between countries. In general, as far as trade statistics are concerned, one would expect to see symmetric patterns between countries, that is, the amount that country A exports to country B should be the same as what country B imports from country A. This paper analyzes the asymmetric pattern of international trade statistics among countries, with a focus on China and its top five trading partners during the period 1992 to 2008.

The reasons for asymmetry in international trade statistics to occur include the different price systems between exports and imports, the different trade systems among countries, and also emerging issues such as re-exports and re-imports. The results in the case of China and its top five trading partners show that the asymmetric pattern of international trade among countries varies not just within time periods but also from industry to industry. While it is difficult to find a systematic way to correct asymmetries in international trade statistics among countries, by focusing on a specific country and time period, it is possible to determine the reasons for such asymmetry.

Keywords: Mirror statistics; international trade statistics; China; asymmetries.

1. Introduction

To enhance trade capacity and economic growth of developing countries and countries with economies in transition, their participation in global trade is becoming increasingly important. Moreover, even as their manufacturing capabilities increase, the ability of enterprises in these countries to trade internationally needs to be strengthened so that they can become a part of the global value chains. On the one hand, this entails focusing on the supply side to ensure that enterprises can manufacture products that have a high export potential and sustain the level of quality and quantity needed to meet global demand. On the other hand, it requires evidence of market conformity—to assist enterprises so that their products conform to the relevant international standards, in particular private buyer requirements, and technical requirements.

As more and more developing countries benefit from their involvement in the international trade system, strengthening their capacity to participate in global trade is critical for their future economic growth. UNIDO is one of the largest providers of trade-related development services, including statistics on industrial and international trade,[1] and is therefore in a position to offer customer-focused advice and integrated technical assistance in competitiveness, trade policies, industrial modernization and upgrading, compliance with trade standards, testing methods and metrology. [2] Currently, international trade statistics and relevant industrial statistics are maintained by UNIDO Industrial Demand and Supply Balance Database (IDSB).[3]

However, despite the fact that international trade in goods and services, especially manufacturing goods, is increasing between countries as the process of globalization deepens, asymmetry in international trade statistics is becoming more and more evident, thus causing great concern among trade statisticians and policy makers. In general, as far as trade statistics are concerned, one would expect to see symmetric patterns between countries, whereby the amount that country *A* exports to country *B* should equal that what country *B* imports from country *A*. However, in reality, this is seldom the case. Asymmetric international trade was first observed in the early nineteenth century (Tsigas et al., 1992) and has since been the main concern to both the public sector and academia (Morgenstern, 1974). The very classic case is that between China and the

[1] See UNIDO Statistics on http://www.unido.org/index.php?id=1000077
[2] For example, see UNIDO *Industrial Development Report 2009*.
[3] See Appendix 1 for more information about IDSB, UNIDO.

United States (see, for example, Fung and Lau, 1998), and more recently also Hong Kong (Special Administrative Region (SAR) of China) (see Ferrantino and Wang, 2008).

The main objective of this paper is to explore the asymmetric trade pattern of international trade in manufacturing goods between countries using mirror statistics, focusing specifically on China and its top five trading partners between 1992 and 2008. Note that mirror statistics are defined as a "bilateral comparison of two basic measures of a trade flow by EuroStat to consider it as a traditional tool for detecting the causes of asymmetries in statistics" (EuroStat, 1998).

This paper is structured as follows. Section 2 presents possible reasons for existing asymmetry in international trade statistics. Section 3 discusses the emerging issue of re-exports in detail, and also provides a description of the data source. Section 4, for its part, describes how asymmetry can be measured. While sections 5 and 6 provide some primary results and analyze some of the possible reasons, section 7 concludes.

2. Possible reasons for the mismatch in international trade statistics

2.1 Existing issues

Trade, in general, involves buying, selling, or exchanging goods or services within a country or between countries. As mentioned earlier, the focus here is on international trade between countries, especially that of manufacturing goods. Statistically, international trade is measured when merchandized goods cross international frontiers.[4] Accordingly, when conducting analyses on trade flows between countries or regions, it is extremely important that data recorded by country *A* as exports to country *B* match the data recorded by country *B* as imports from country *A*. Unfortunately, this is rarely the case.[5] Several reasons can be attributed to such asymmetry in trade statistics, for example:

[4] Trade in services is defined as the supply of a service with four GATS modes of supply (see UN, 2002, page 11).

[5] At the aggregate level, in the context of National Accounts and Balance of Payments (BoP), adjustments are made to trade in goods (and services) to produce more consistent estimates. For example, c.i.f. adjustments are made for imports (that is, costs of insurance and freight are deducted from imports of goods and added to imports of services), and adjustments are made to account for 'small transactions' and goods sent by post. However, national authorities do not make such BoP adjustments at more detailed levels—neither by partner country nor by commodity (even at aggregate levels). Also, while United

- different valuations for imports (c.i.f.) and exports (f.o.b);
- different trade recording systems for imports and exports, general versus special trade;
- differences in definitions of trade partners;
- differences in thresholds for recording international trade which, by extension, mean differences in the definition of trade in small transactions;
- other differences include timing of measurement (recording by customs) differing allocation of product classification to goods or mis-attribution; and smuggling (Tsigas et al., 1992);
- irregularity in proper recording of exchange rate fluctuations. (Exchange rate fluctuations are not always properly recorded in international trade statistics. Values are normally aggregated over the period of one year in local currency and converted into United States dollars);
- mirror statistics are rarely used. Those countries that do not report trade data to the United Nations, partner country data are often used.[6]

Note that mirror statistics are considered a second-best solution; the best being nationally reported data. They are however better than having no data at all, especially considering that more than 50 countries do not consistently report national trade statistics to COMTRADE. At the same time, mirror statistics have a number of shortcomings. First, they do not include trade with other non-reporting countries. As a result, mirror statistics barely cover South-South trade and hence cannot be considered as a suitable source for any assessment of intra-African trade. Second, is the problem of trans-shipments, which may hide the actual source of supply. Third, mirror statistics invert the reporting standards by valuing exports in c.i.f. terms (that is, transport costs and insurance are included) and imports in f.o.b. terms (both these items are excluded).

Nations (1998) provides clear recommendations for defining trade partners' practices, they differ across countries when compiling trade statistics. Close attention needs to be paid to national definitions when looking at trade statistics.

[6] Parniczky (1980) mentioned similar sources where reported trade statistics are inconsistent, including those on trans-shipment.

2.2. Re-exports: an emerging issue

While the general problems associated with asymmetric statistics need to be addressed, a crucial problem across an increasing number of countries is the presence of re-exports in recorded trade statistics (Guo et al., 2009).

Due to the increasing liberalization of global trade, more countries/regions, particularly those with special trade status or geographical locations (such as the Belgium, Hong Kong (SAR), Netherlands and Singapore), are starting to pay more attention to their trade flows for two specific reasons. First, traditionally domestically-produced goods account for way below their total volume of trade with their partner countries. Second, increasing asymmetries in trade statistics with partner countries are becoming apparent (Geyer-Schaefer, 2007). A well-known case, as mentioned earlier, is the trade discrepancy between China and the United States (Ferrantino and Wang, 2008; Fung and Lau, 1998, among others), as illustrated in table 1, where the share of re-exports from Hong Kong (SAR) is very significant. In the case of the Netherlands, the trend of increasing re-exports started in the mid-1980s and has continued ever since. Currently, re-exports account for more than 40 per cent of the total exports in the country, which were less than 20 per cent in 1990 (Mellens et al., 2007, Kusters and Verbruggen, 2001). Re-exports are also becoming a worldwide trend, affecting not only the Netherlands, but other countries, such as Germany, Hong Kong (SAR) and Singapore, as well. In the case of the Netherlands, the average growth rate of re-exports was some 9 per cent between 1985 and 1997, while for Germany, it was some 14 per cent between 1992 and 2002, and for Hong Kong (SAR) some 18 per cent between 1983 and 2005. Estimates of re-exports as a share of total exports vary across countries—in Germany it is some 15 per cent, in Singapore, over 50 per cent, while in Hong Kong (SAR), it is approximately 95 per cent (Mellens et al., 2007).

Table 1. Official merchandise trade data - United States and China (Billions of current United States dollars)

Year	Official U.S. exports to China (U.S. data)	Official Chinese imports from the U.S. (Chinese data)	Official U.S. imports from China (U.S. data)	Official Chinese exports to the U.S. (Chinese data)	Official U.S.-China trade balance (U.S. data)	Official U.S.-China trade balance (Chinese data)
1995	11.7	16.1	45.6	24.7	-33.8	-8.6
1996	12.0	16.2	51.5	26.7	-39.5	-10.5
1997	12.8	16.3	62.5	32.7	-49.7	-16.4
1998	14.3	17.0	71.2	38.0	-56.9	-21.0
1999	13.1	19.5	81.8	41.9	-68.7	-22.4
2000	16.2	22.4	100.0	52.1	-83.8	-29.7
2001	19.2	26.2	102.3	54.3	-83.1	-28.1
2002	22.1	27.2	125.2	70.0	-103.1	-42.8

Source: Fung and Lau (2003) table 1.

According to the United Nations definition of general trade flows (United Nations, 1998), re-exports take place when goods enter the customs territory of a country and are then shipped to another, without being transformed. This is also known as trans-shipment (see Mellens et al., 2007, Andriamananjara et al., 2004, Fung and Lau, 1998). Although rarely recorded separately in published national or international databases, re-exports can be distinguished from other trade flows, as demonstrated by Roos (2005, 2006) in the case of the Netherlands, where re-exports currently account for over 40 per cent of recorded exports.

The presence of re-exports is visible in countries and regions with favourable geographical positions, from a perspective of intercontinental transportation. These include Belgium, Germany, the Netherlands, and probably France, in Europe, and Hong Kong (SAR) and Singapore in Asia, to the extent that these countries act as hubs for shipments of goods between countries within the region and the rest of the world. For example, major hubs in Europe are located at Dutch and Belgian ports, while in eastern Asia, the major hub is Hong Kong (SAR). In this context, it should be noted that some 90 per cent of the world's trade in goods is transported by sea.[7]

When coupled with differences across countries, in definitions on country of origin and country of consignment for import partners, re-exports (and re-imports) can significantly increase export/import discrepancies between countries. If, for example, China exports US$5 million of

[7] Possible reference: http://www.unescap.org/oes/state/st020211.htm).

domestically-produced goods to the United States via Hong Kong (SAR), effectively, China exports US$5 million domestically-produced goods to Hong Kong (SAR), and Hong Kong (SAR) then re-exports the equivalent amount to the United States (see table 2).

Table 2. An example of flows of goods in three countries

	China	Hong Kong (SAR)	United States
	Exports US$5 million domestically-produced goods to Hong Kong (SAR)	Imports US$5 million domestically-produced goods from China (recorded as imports from China) Re-exports US$5 million to China (recorded as re-exports to the United States	Imports US$5 million goods from Hong Kong (SAR)
Situation	Exports record - China	Imports record – United States	Induced possible trade discrepancy between China and the United States
(1)	Exports to the United States	Imports from China	-
(2)	Exports to the United States	Imports from Hong Kong (SAR)	US$5 million
(3)	Exports to Hong Kong (SAR)	Imports from China	US$5 million
(4)	Exports to Hong Kong (SAR)	Imports from Hong Kong (SAR)	US$10 million

Source: Author's description.

However, depending on how the transaction is recorded by each country, discrepancies in trade data may or may not arise. Taking the above example, whereby China exports domestically-produced goods to the United States via Hong Kong (SAR), from the perspective of Hong Kong (SAR), imports from China are recorded as re-exports to the United States, as shown in table 2. On the other hand, for both China and the United States, data compilers may record the transaction differently—depending on the information at hand. Nevertheless, both countries follow the recommendations of the United Nations (1998), whereby a trading partner is defined as the country of origin for imports and the last known destination for exports. But in the case of the United States, it lists the country of shipment as its import partner country if the country of origin cannot be identified. Hence there are potentially four different combinations that can be used when recording the US$5 million trade transaction:

1. For China, the last known destination of exported goods is the United States, and the United States identifies the origin of the goods as China;

2. For China, the last known destination of the exported goods is the United States, but the United States is unable to identify the origin of the imports, since the shipment is tracked from Hong Kong (SAR);

3. China is only aware that the exports are shipped to Hong Kong (SAR), and although no further information of future destination is available, somehow the United States is aware that the country of origin of their imports is China;

4. China is only aware that the exports are shipped to Hong Kong; no further information of final destination is available, neither can the United States track the origin of the imports, other than that the port of shipment is Hong Kong (SAR).

The different recordings are illustrated in figure 1. In fact, this example reflects the reality of the long-existing and controversial trade discrepancies between China and the United States, as shown in table 1. (Note that this example does not deal with the possibility of significant mark-ups in Hong Kong (SAR) (via branding, re-packaging etc.) before the goods are shipped to the United States. Hence the US$50 million worth of goods shipped from China to Hong Kong (SAR) becomes US$60 million worth of goods imported by the United States). Another important issue is that of correspondence between different international classifications. The international trade statistics provided by UNComtrade are based on classifications with different principles—BEC (broad economic categories) and HS (harmonized system) are based on products/commodities, while SITC (Standard International Trade Classifications) is based on production activities.[8] Furthermore, for certain political and economic reasons, some countries do not classify traded commodities as they should. For example, in the HS classification, there is a code labelled "99999" for "unspecified items". If a country trades a certain good that it does not wish to specify, it can be coded under "unspecified commodities". A case in point is that South Africa. As it does not wish to specify its exports of diamonds to a country, South Africa could categorize the exported diamonds as "unspecified commodities". Thus, if a country does not specify the commodities as they should, there is the risk of such exports being classified as "unspecified

[8] For more details see website: http://unstats.un.org/unsd/cr/registry/regct.asp

commodities". This could in turn lead to correspondence issues when transferring data from one classification to another.

3. Data source

The data sources used in this paper—the case of China and its top five export/import partners during the period 1992 to 2008—are international trade statistics by ISIC Rev.3, provided by UNIDO Statistics contained in the IDSB database (see Appendix 1 for description of international trade statistics on manufacturing goods by UNIDO).

China's top five international trading partners, namely, Japan (JPN), the United States (USA), Germany (DEU), Hong Kong (SAR) (HKG), and Taiwan Province of China (TWN), have been used here to illustrate the degree of trade discrepancies. General information on international trade of China and its partners, which includes the trade system, trade flow valuation and partner definition, is given in table 2. Note that all the countries listed in the table—with the exception of Hong Kong (SAR), which defines the partner of imports as "consignment"—follow the United Nation's recommendation, namely, listing the "origin of the product " as well as other aspects, such as valuation on trade flow, trade systems and so on, as the import partner.

Table 3. General information on trade between China and its top five trading partners

Reporter	Trade flow	Trade system	Valuation	Partner
China (CHN)	Imports	General	c.i.f.	Origin
	Exports	General	f.o.b.	Last known destination
Germany (DEU)	Imports	General	c.i.f.	Origin
	Exports	General	f.o.b.	Last known destination
Hong Kong	Imports	General	c.i.f.	Origin
(SAR) (HKG)	Exports	General	f.o.b.	Last known destination
Japan (JPN)	Imports	General	c.i.f.	Origin
	Exports	General	f.o.b.	Last known destination
Korea, Republic	Imports	General	c.i.f.	Origin
of (KOR)	Exports	General	f.o.b.	Last known destination
Russia (RUS)	Imports	General	c.i.f.	Origin
	Exports	General	f.o.b.	Last known destination
United States	Imports	General	c.i.f.	Origin
(USA)	Exports	General	f.o.b.	Last known destination

Source: Author's summary.

At the ISIC Rev.3, 2-digit level, China's top five trading partners in total trade (imports and exports) between 1992 and 2008 are shown in table 4. Apparently, the top three partners of China, in total trade volume during this period, were Japan (JPN), United States (USA) and Hong Kong (HKG), albeit, the hierarchy changed periodically. Japan ranked first in the 1990s and in the early 2000s, while the United States ranked first in the last four years of the 2000s. Hong Kong (SAR), on the other hand, ranked third for the major part of this period. Taiwan Province of China (TWN) and the Republic of Korea (KOR) ranked either fourth or fifth during most of the time period, while Germany ranked fifth between 1992 and 1994.

Table 4. China's top five trading partners in total trade, 1992-2008

Rank	Japan	United States	Hong Kong (SAR)	Taiwan Province of China	Republic of Korea	Germany
1992	2	3	1	4	--	5
1993	1	3	2	4	--	5
1994	1	3	2	4	--	5
1995	1	3	2	4	5	--
1996	1	2	3	5	4	--
1997	1	3	2	5	4	--
1998	1	2	3	4	5	--
1999	1	2	3	5	4	--
2000	1	2	3	5	4	--
2001	1	2	3	5	4	--
2002	1	2	3	4	5	--
2003	1	2	3	5	4	--
2004	1	2	3	5	4	--
2005	2	1	3	5	4	--
2006	2	1	3	5	4	--
2007	2	1	3	5	4	--
2008	2	1	3	5	4	--

Source: Calculations based on IDSB, UNIDO.

Table 5. China's top five export trading partners, 1992-2008

Rank	Japan	United States	Hong Kong (SAR)	Germany	Republic of Korea	Russia
1992	2	3	1	4	--	5
1993	3	2	1	4	--	5
1994	3	2	1	4	--	--
1995	2	3	1	5	5	--
1996	2	3	1	5	4	--
1997	3	2	1	5	4	--
1998	3	1	2	4	5	--
1999	3	1	2	4	5	--
2000	3	1	2	5	4	--
2001	3	1	2	5	4	--
2002	3	1	2	5	4	--
2003	3	1	2	4	5	--
2004	3	1	2	5	4	--
2005	3	1	2	4	5	--
2006	3	1	2	5	4	--
2007	3	1	2	5	4	--
2008	3	1	2	5	4	--

Source: Calculations based on IDSB, UNIDO.

The pattern of China's top five trading partners for exports during the same period differs slightly compared to that of total trade, as shown in table 5. The top five largest export partners of China

were the United States, Hong Kong (SAR), Japan, Republic of Korea and Germany. The hierarchy has not changed since 1998, with the exception of the Republic of Korea and Germany switching fourth and fifth ranks. Russia ranked fifth only in 1992 and 1993.

As far as imports are concerned, the ranking of China's top five trading partners differs from that of exports. Japan, Taiwan Province of China and the Republic of Korea are among the top three throughout the period, while the United States and Hong Kong (SAR) appear in the top three only before 1995. An interesting observance is that China re-imports from the country itself and, as can be seen in table 6, China is included among its import partners, and ranked fourth since 2004. This is clearly another example which illustrates that re-exports/imports are becoming a major cause for concern in international trade statistics.

Table 6. China's top five import trading partners, 1992-2008

Rank	Japan	Taiwan Prov. of China	United States	Republic of Korea	Germany	Hong Kong (SAR)	China
1992	2	4	3	--	5	1	--
1993	1	2	4	--	5	3	--
1994	1	2	3	5	--	4	--
1995	1	3	3	4	--	5	--
1996	1	3	3	4	--	5	--
1997	1	2	4	3	--	5	--
1998	1	2	3	4	5	--	--
1999	1	2	3	4	5	--	--
2000	1	2	4	3	5	--	--
2001	1	2	4	3	5	--	--
2002	1	2	4	3	5	--	--
2003	1	2	4	3	5	--	5
2004	1	2	5	3	--	--	4
2005	1	3	5	2	--	--	4
2006	1	3	5	2	--	--	4
2007	1	3	5	2	--	--	4
2008	1	3	5	2	--	--	4

Source: Calculations based on IDSB, UNIDO.

4. Measurement of the degree of trade discrepancy

Mirror statistics, as mentioned earlier, are bilateral comparisons of two basic measures of a trade flow, which is a traditional tool used for detecting the causes of asymmetry in statistics. Accordingly, mirror statistics are used to compare importer's imports with its partner's exports, and vice versa. Three different indices can be used to show the discrepancies between mirror statistics (Ferrantino and Wang, 2008). In this paper, the following equation is used to measure such discrepancies.

$$DIF_{st}^{ij} = \frac{Imp_{st}^{ij} - Exp_{st}^{ij}}{Imp_{st}^{ij}} \quad (1)$$

Where *Imp* is the partner *j* reported imports of commodity *s* from country *i* at year *t*, while where *Exp* is the reporting country *i* reported exports of commodity *s* at the same time period *t*. Here the discrepancies can be shown in two ways: (1) reporting countries are exporters; (2) reporting countries are importers.

In the case of China and its top five trading partners, the asymmetric degree is shown as a share of the difference between exports and imports compared to imports (see equation 1). First, take China as an export reporter, then get the mirror imports from China's corresponding export partner as import reporter. Next, take China as import reporter, then get the mirror exports from China's corresponding import partner as export reporter (table 7). In other words, the degree is computed based on imports reported by China, and imports reported by China's trading partners. (Note that the asymmetric degree between countries can be shown either by total manufacture or by ISIC division (2-digit level)).

Table 7. Two ways to measure the degree of asymmetry between countries

Method 1 – China as exporter (compared to imports of China's trading partner)

$$DIF_1 = \frac{Imp^{CHN,Partner} - Exp^{CHN,Partner}}{Imp^{CHN,Partner}} \quad (2)$$

Method 2 – China as importer (compared to imports of China)

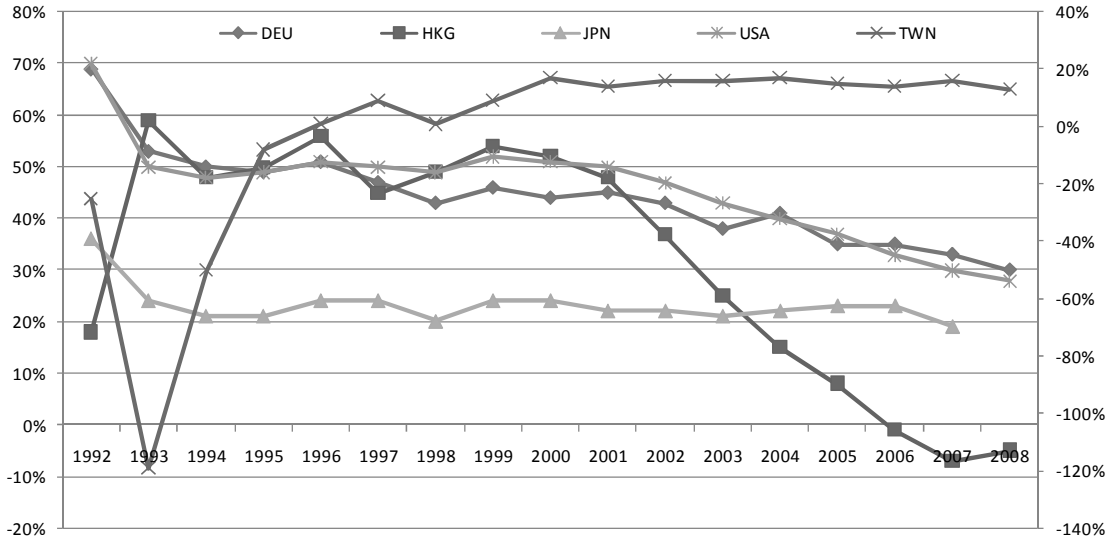
$$DIF_2 = \frac{Imp^{Partner,CHN} - Exp^{Partner,CHN}}{Imp^{Partner,CHN}} \quad (3)$$

5. Results

5.1 Total traded manufacturing goods

If China is taken as an exporter, the asymmetric degree will be calculated by comparing its exports to the imports of China's partners. As can be seen from figure 1, the asymmetric degree ranges between zero and 70 per cent, except in one extreme case, namely, that of Taiwan Province of China (TWN), where the degree ranges between -120 per cent to -20 per cent. The other four partner countries of China show a declining trend during the period. Japan (JPN) reveals a much more stable level, some 20 per cent, while Taiwan Province of China is usually below 20 per cent. And as regards Hong Kong (SAR) and Taiwan Province of China, a very close to no asymmetry exists for certain years: for Hong Kong (SAR), it is in 2006, while for Taiwan Province of China, 1993 and 1998.

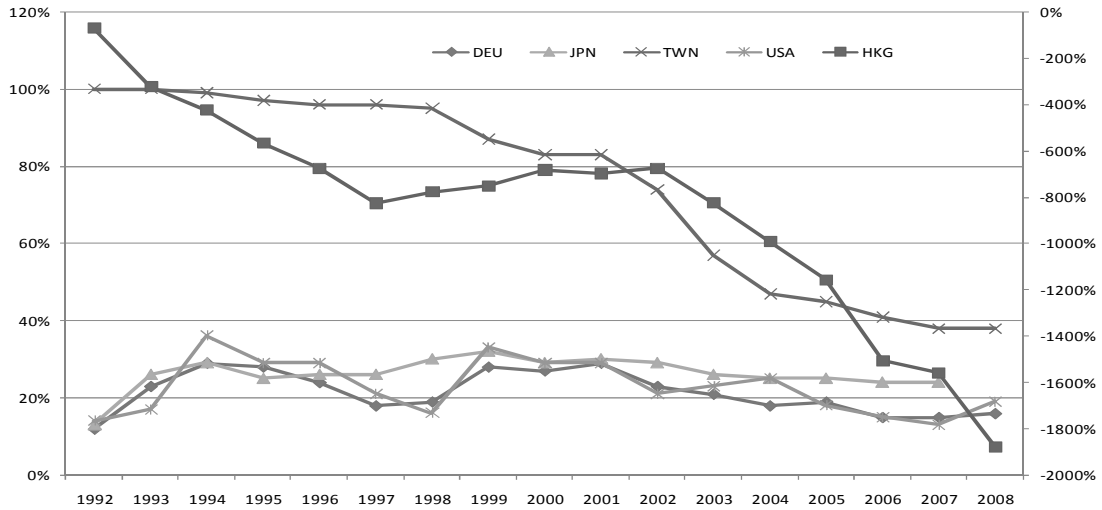
Figure 1. Asymmetric degree of total manufacturing goods compared to partners' imports



Source: Based on calculations from IDSB, UNIDO.

However, in the case of China being an importer, when comparing the trade differences to imports reported by China, as can be seen from figure 2, a totally different picture can be observed. Where Hong Kong (SAR) (HKG) and Taiwan Province of China (TWN) should reveal extreme asymmetries compared to other partner countries, Germany, Japan and the United States reveal very stable asymmetries throughout the period, ranging between 10 and 40 per cent.

Figure 2. Asymmetric degree of total manufacturing goods compared to China's imports



Source: Calculations are based on IDSB, UNIDO.

Table 8. Comparison of degree of asymmetry (Percentage)

Year	Germany		Hong Kong (SAR)		Japan		Taiwan Prov. of China		United States	
	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
1992	69	12	18	-74	36	13	-25	100	70	14
1993	53	23	59	-326	24	26	-119	100	50	17
1994	50	29	48	-425	21	29	-50	99	48	36
1995	49	28	50	-569	21	25	-8	97	49	29
1996	51	24	56	-677	24	26	1	96	51	29
1997	47	18	45	828	24	26	9	96	50	21
1998	43	19	49	-778	20	30	1	95	49	16
1999	46	28	54	-753	24	32	9	87	52	33
2000	44	27	52	-684	24	29	17	83	51	29
2001	45	29	48	-699	22	30	14	83	50	29
2002	43	23	37	-677	22	29	16	74	47	21
2003	38	21	25	-826	21	26	16	57	43	23
2004	41	18	15	992	22	25	17	47	40	25
2005	35	19	8	-1,158	23	25	15	45	37	18
2006	35	15	-1	-1,506	23	24	14	41	33	15
2007	33	15	-7	-1,557	19	24	16	38	30	13
2008	30	16	-5	-1,876	-	-	13	38	28	19

Source: Calculations are based on IDSB, UNIDO.

Note: A1 in the table is the asymmetric degree compared to non-China's imports, while A2 is the one compared to China's imports.

Apparently, the changing degree of asymmetry in international trade statistics by country depends on the basis of comparison, that is, both imports and the degree of asymmetry vary from country to country, as shown in table 8. In general, for Hong Kong (SAR) and Taiwan Province of China, the absolute value of the asymmetric degree A1 is larger than A2, while for Germany, Japan and the United States, it is the other way around.

5.2 By ISIC industry[9]

Not only does the degree of asymmetry differ from country to country and industry to industry, but the comparison base also differs. Nevertheless, the degree of asymmetry can be traced in two different ways: by comparing imports of China's partners, and China's imports. Table 9 shows the arithmetic average by industry (ISIC Rev.3, 2-digit level).

Table 9. Degree of asymmetry using ISIC Rev.3, 2-digit level, with China as exporter (Percentage)

ISIC	Germany	Japan	United States	Taiwan Prov. of China	Hong Kong (SAR)
15	44.2	23.0	45.7	21.0	33.8
16	17.2	10.5	20.9	150.7	11.3
17	2,399.0	238.3	2,405.8	51.3	21.1
18	32.0	24.0	38.2	177.2	23.7
19	54.4	21.3	46.6	2,278.7	40.8
20	57.5	51.5	51.2	35.6	76.2
21	39.7	13.6	43.4	15.6	38.0
22	66.3	14.3	58.9	388.1	15.0
23	73.8	30.5	68.2	257.6	52.4
24	36.1	11.2	26.6	38.7	155.7
25	10.7	10.8	14.9	10.3	16.6
26	52.5	32.3	39.2	63.0	43.0
27	41.5	21.3	48.6	13.9	41.5
28	66.7	7.2	15.5	30.3	33.2
29	37.6	14.4	35.0	35,072.2	34.3
30	32.8	23.1	40.0	95.4	48.7
31	46.1	27.4	44.6	12,563.4	56.1
32	56.4	32.6	53.3	359.9	44.0
33	46.1	14.8	47.2	76.6	39.7
34	49.0	26.9	44.1	40,548.9	53.3
35	154.9	82.0	58.4	2,004.6	384.4
36	79.2	19.9	19.2	61.9	74.7
37	61.8	52.9	61.8	160.7	49.2

Source: Calculations are based on IDSB, UNIDO.

[9] In this paper, the industry is by ISIC Rev.3, 2-digit level. Note that the description of ISIC Rev.3, 2-digit level industry is provided in Appendix 2.

The most asymmetric industry of China with its partners is textiles (ISIC 17) as it has a significantly high value for Germany, Japan and the United States. For Taiwan Province of China, industries related to machinery and vehicles (ISIC 29, 31 and 34) are the most asymmetric.

A comparison of China's imports by industry is shown in table 10. Note that the value is also the yearly arithmetic value throughout the period, per se. For Hong Kong (SAR), Taiwan Province of China and the United States, textiles (ISIC 17) is the most asymmetric industry. In fact, if compared with China's imports, most of the manufacturing sectors reveal extreme asymmetries.

Table 10. Degree of asymmetry using ISIC Rev.3, 2-digit level, with China as importer (Percentage)

ISIC	Germany	Japan	United States	Hong Kong (SAR)	Taiwan Prov. of China
15	21.4	26.2	22.7	847.2	75.1
16	23.5	31.9	26.4	4,001.8	70.5
17	83.3	76.3	115.1	5,672.5	1,427.1
18	8.2	9.3	25.5	462.9	78.4
19	145.7	72.2	79.1	329.7	81.8
20	41.2	29.2	57.5	2,097.0	82.9
21	23.1	26.4	43.5	8,182.6	65.0
22	29.3	36.0	33.8	460.7	72.2
23	51.1	21.5	36.3	81.9	79.4
24	28.6	38.4	38.7	1,417.0	72.8
25	37.0	22.0	31.4	1,082.1	64.4
26	8.2	22.6	41.5	519.0	72.9
27	22.6	13.4	25.7	730.2	80.0
28	15.5	24.6	24.5	1,867.0	73.9
29	26.9	16.5	29.9	402.0	63.8
30	23.8	23.6	24.2	814.4	70.3
31	25.7	35.5	31.8	2,504.8	68.0
32	14.9	19.9	37.8	791.0	67.1
33	21.2	42.3	24.9	818.1	80.7
34	21.2	44.4	36.1	641.5	70.5
35	34.2	20.9	22.7	23,401.0	57.5
36	59.9	49.3	36.0	2,335.9	63.7
37	35.6	14.1	24.5	683.0	73.1

Source: Calculations are based on IDSB, UNIDO.

6. How can asymmetries in China be explained?

6.1 Different valuations for imports (c.i.f.) and exports (f.o.b.)

The degree of asymmetry is comparatively severe, as seen from the earlier analyses. As already mentioned, the most plausible reason is the pricing system, since exports and imports apply a different price system. In this section, an attempt is made to detect whether there is some system in the asymmetric pattern, albeit based on the assumption that all other reasons, including the different price systems, for asymmetry in international trade statistics are ineffective. Accordingly, the geometric means of the variable Imp_{ij}/Exp_{ij} of China and its top five trading partners during the period of 1992 to 2008 are presented (Tsigas et al., 1992). The reason for using geometric means is because they are more appropriate for measuring a specific trend. The results in table 11 show the geometric means of total exports and imports during the period 1992 to 2008.

Variations in the systematic pattern are due to the price system which varies from country to country. Moreover, it also depends on whether China is the exporter or importer. When China is an importer, both the geometric means of asymmetries with Japan and Hong Kong (SAR) are comparatively larger. The most severe case occurs when China is an exporter because countries experience the largest export and import differences with Japan and Taiwan (Province of China). But when China is an importer, the largest difference is with Hong Kong (SAR). Note that normally, the average of the variable Imp_{ij}/Exp_{ij} defined by IMF statistics is around 1.15 or 1.20.

Table 11. Geometric means for variables X/M by China's trading partners, 1992-2008

	Germany	Japan	United States	Hong Kong (SAR)	Taiwan Prov. Of China
China as exporter	0.5901	1.6760	0.6209	0.7504	1.5354
China as importer	0.7660	10.6171	0.6646	13.5248	0.4513

Source: Calculations based on IDSB, UNIDO.

Table 12. Geometric means for X/M by China's trading partners: China as exporter

Year	Germany	Japan	United States	Hong Kong (SAR)	Taiwan Prov. of China
1992	0.3912	----	0.2611	0.8877	9.9624
1993	0.4786	1.4972	0.7020	0.4664	5.6757
1994	0.5132	2.4512	0.7625	0.5704	3.1585
1995	0.6186	2.3411	0.7638	0.6110	2.3085
1996	0.5456	1.6767	0.6315	0.5694	1.6980
1997	0.6922	2.8255	0.6576	0.7053	1.4669
1998	0.6707	1.3946	0.6541	0.6496	1.4545
1999	0.5832	1.9240	0.5728	0.5628	1.2518
2000	0.5712	2.7383	0.5554	0.5904	1.1351
2001	0.5527	3.2471	0.5684	0.6531	1.2320
2002	0.7614	1.3382	0.5917	0.7476	1.0936
2003	0.6881	1.2470	0.6363	0.8630	1.0670
2004	0.5180	1.2652	0.6432	0.9778	0.9041
2005	0.6306	0.9092	0.6564	1.0448	0.9584
2006	0.6586	1.4057	0.6803	1.1239	0.9011
2007	0.6227	0.9651	0.7242	1.1369	0.9215
2008	0.6456	----	0.7376	1.1022	0.8722

Source: Calculations are based on IDSB, UNIDO.

Table 13. Geometric means for X/M by China's trading partners: China as importer

Year	Germany	Japan	United States	Hong Kong (SAR)	Taiwan Prov. of China
1992	0.8103	2.4665	0.6193	0.8877	0.0002
1993	0.8459	5.5096	0.5280	0.4664	0.0005
1994	0.6756	8.1733	0.5681	0.5704	0.0084
1995	0.6528	9.1187	0.5043	0.6110	0.0181
1996	0.7857	8.7441	0.4661	0.5694	0.0288
1997	0.7242	12.3112	0.6331	0.7053	0.0263
1998	0.7742	0.8821	0.6547	0.6496	0.0437
1999	0.7407	13.3860	0.5953	0.5628	0.1358
2000	0.6810	11.6056	0.6904	0.5904	0.1325
2001	0.5984	11.1760	0.7396	0.6531	0.1452
2002	0.7234	3.2060	0.6971	0.7476	0.2202
2003	0.7375	2.1102	0.7420	0.8630	0.4183
2004	0.7792	2.3787	0.7678	0.9778	0.5858
2005	0.8528	2.6388	0.7933	1.0448	0.6066
2006	0.9660	0.4456	0.8255	1.1239	0.7450
2007	0.8695	4.4223	0.8186	1.1369	0.8803
2008	0.8718	21.3451	0.8228	1.1022	0.8587

Source: Calculations are based on IDSB, UNIDO.

The geometric mean of the ratio of total exports and total imports reveal large differences (table 11). If the geometric mean is considered annually, the difference will vary from year to year. It also depends on whether China is an exports reporter or an imports reporter (see tables 12 and 13). Following the classic case of China, the United States and Hong Kong (SAR) on asymmetric international trade, as can be seen, the geometric mean of China increased vis-à-vis the United States, which actually decreased between 1999 and 2002 before increasing again between 2003 and 2008. The geometric mean of China vis-à-vis Hong Kong (SAR), on the other hand, shows an increasing trend. Significant changes in the geometric mean of the ratio between exports and imports indicate that other issues that cause such asymmetries cannot be ignored.

6.2. Re-exports: the issue that causes asymmetries in international trade

As the ratio between exports and imports prices of China and its top five trading partners are not set in the general range, the hypothesis is that re-exports would continue to be the main reason for large asymmetries between China and the United States and Hong Kong (SAR), especially since the beginning of the twenty-first century when international trade started increasing rapidly. As mentioned earlier, re-exports take place when goods enter into the customs territory of one country and are then shipped to another country without being transformed. Asymmetries in international trade are indeed becoming a global issue that demands urgent attention. It is estimated that currently more than 90 per cent of Hong Kong's (SAR) exports represent re-exports either from China or from a third country. This compares with less than 30 per cent in the late 1970s, while in the case of the United States, on the other hand, 10 per cent of total exports represent re-exports. Table 14 shows the trade statistics on re-exports of Hong Kong (SAR) in relation to the United States and China. It shows that more than 90 per cent of total goods re-exported to the United States are goods that originated from China between 1995 and 2006. Therefore, it is assumed that re-exports are the main cause for asymmetry in international trade statistics between China, the United States and Hong Kong (SAR). Further research needs to be undertaken to explore this issue in detail. For example, statistics need to be viewed at a more detailed level, such as 4-digit level pf international trade statistics, to explore all possible reasons for asymmetric statistics between China, the United States and Hong Kong (SAR).

Table 14. Re-exports of Hong Kong (SAR) in relation to the United States and China, 1995-2006

Year	Goods originated from China as percentage of total Hong Kong re-exports to the US	Hong Kong re-exports as percentage of US total imports from China
1995	92.4	60.6
1996	93.3	56.8
1997	92.7	50.0
1998	92.1	43.4
1999	92.1	39.1
2000	91.2	36.4
2001	91.9	32.5
2002	91.9	27.4
2003	91.2	21.9
2004	91.3	18.1
2005	92.2	15.7
2006	92.2	13.9

Source: Ferrantino et al. (2008) Table 1.

As with other top trading partner countries of China, such as Germany, Japan and Taiwan Province of China, re-exports could be attributed to asymmetries as well. However, considering that data on re-exports are not available for a large trader such as Japan as well as for most countries in the European Union, re-exports statistics are accordingly not available for a large number of countries. Obtaining statistics on re-exports is undoubtedly a daunting task but nevertheless need to be considered. Moreover, differences in recording re-exports similarly need to be pursued. For example, the United States has detailed data on re-exports, but only records the country of destination, and not the country of origin. Although data for Hong Kong (SAR) are better, they still do not fully capture the complexity of shipments that pass through its ports.

6.3. Other issues

a. Trading partner definition by countries

Since China and its trading partners follow the United Nations recommendation of taking the country of origin as the imports partner and the last known destination as the exports partner, it is still possible that the origin of imports and the last known destination are hard to track. And as illustrated in the example earlier (see table 2), possible asymmetries in international trade statistics among countries can be significantly large in this case.

b. Thresholds for recording international trade statistics by country

It is also possible that China and its top five trading partners set up different thresholds for recording international trade which, by extension, means differences in the definition of trade in small transactions. Other statistical issues, including timing of measurement (recording by customs) differing allocation of product classification to goods or mis-attribution; and smuggling could also result in a significant degree of asymmetry in international trade between China and its top five trading partners.

c. Exchange rate fluctuations

Exchange rate fluctuation is another issue that needs to be taken into account. Exchange rate fluctuations are not always properly recorded in international trade statistics. The general recording rule is that trading values are normally aggregated over the period of one year in local currency and converted into United States dollars. This could well be the cause of large imbalances in international trade statistics among countries, and as such is not exceptional in the case of China and its top five trading partners. As shown in table 15, the average exchange rate between United States dollar and Chinese renminbi yuan between 1992 and 2008 and the exchange rate fluctuations of United States dollars and Chinese renminbi yuan are significant, which resulted in the large asymmetries in international trade between China and the United States.

Table 15. Average exchange rate of United States dollar and Chinese renminbi yuan, 1993-2000

Year	Exchange rate (yuan)	Year	Exchange rate (yuan)
1993	5.79338	2001	8.27426
1994	8.56513	2002	8.26691
1995	8.35051	2003	8.26715
1996	8.31416	2004	8.26636
1997	8.28978	2005	8.18376
1998	8.27891	2006	7.96460
1999	8.27609	2007	7.59719
2000	8.27841	2008	7.15540

Source: http://www.oanda.com/currency/average

d. Mirror statistics

Needless to mention, for those countries that do not report trade data to the United Nations, data of the partner country are often used. However, although this is not the case with China and its

top five trading partners, asymmetries still occur, and are worth of mentioning as asymmetry is a general issue among countries.

7. Conclusions

Existing asymmetries in international trade statistics between countries are illustrated in this paper with regard to China and its top five trading partners in manufacturing goods during the period 1992 and 2008. As shown in the analysis, the degree of asymmetry varies depending on various issues, such as the basis of comparison, which are the import statistics used in this paper. Note that as imports statistics are applied from both the reporting country and partner countries to calculate and compare the degree of asymmetry, the results reveal great differences from country to country and from industry to industry. While asymmetries in trade statistics have existed for a long time, the new emerging issue, namely, re-exports demands urgent attention. To detect systematic patterns for asymmetries, it is necessary to take into account specific countries, their trading partners, and also focus on a specific industry.

As the quality of the database is the central issue, to maintain the UNIDO IDSB database, it is very important to ensure that the quality of the database is of a high standard. Apart from the general issues on dealing with the asymmetric patterns of international trade among countries, such as the valuation system of trade flows, the trade system, and definition of trading partner, efforts made to ensure that international trade statistics are less asymmetric should include the following aspects. First of all, due account should be taken of the specific characteristics of countries/regions. As already analyzed in the paper, trade with certain countries, such as Hong Kong (SAR), where actual exports and imports are re-exports/re-imports, the trade statistics compiled in the country/region have to be more detailed, that is, by value in industry to show incoming and outgoing trade. Secondly, for countries where international trade increased significantly in the last decade, such as China, more efforts should be made to detect the new trend of international trade partnership. As shown in the paper, China itself became one of the largest import partners from 2004 to 2008. Thirdly, it is extremely necessary to detect the general asymmetric pattern of international among countries by applying econometric modeling. However, based on the analysis made in this paper, as different countries show different degrees of asymmetries in different industries, the general pattern for tracking should focus on a specific industry and on trading partner countries. Note that, as in UNIDO IDSB, international trade

statistics are re-categorized by transferring the UNComtrade from classification by SITC to ISIC. UNIDO also needs to cooperate with UNComtrade on delimitate the degree of international trade asymmetries. Currently, probably a more feasible way to detect the asymmetric pattern of international trade is to select the United States and China by using ISIC at Division level (2-digit ISIC code) IDSB, UNIDO. As can be seen, the apparent importance and representative aspect of selecting these two countries are: (1) both countries are among the largest economies in the world; (2) China is the fastest growing country in international trade of manufacturing goods in the world; and (3) in trade between these two countries, Hong Kong (SAR) is very much involved in re-exports and re-imports, an emerging issue for the treatment of trade asymmetries.

It is equally important to control the occurrence of unavoidable errors to ensure least disruption in the database. Currently, international trade statistics on manufacturing goods contained in the UNIDO IDSB need to be transferred from UN Comtrade SITC classification to ISIC classification. It is therefore necessary to make timely checks so that the correspondence between SITC and ISIC is as precise as possible, especially since more products and activities are involved in both classifications.

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Appendix 1. International trade statistics on manufacturing goods by UNIDO

International trade statistics on manufacturing goods by UNIDO is part of the dataset contained in the IDSB database (industrial demand and supply balance) maintained by UNIDO, which aims to calculate the apparent consumption. Note that for a certain industry, the apparent consumption is formulated as its domestic output plus imports minus exports.

Apparent consumption = Domestic output + imports - exports

In general, the IDSB database comprises two datasets: IDSB-Rev.2, at the 4-digit level of ISIC (Revision 2), and IDSB-Rev.3, at the 4-digit level of ISIC (Revision 3). The data are derived from output data reported by NSOs (National Statistical Offices) together with UNIDO estimates for ISIC-based international trade statistics, by utilizing the United Nations Commodity Trade Database (COMTRADE). The data pertain to manufacturing and are arranged according to Revisions 2 or 3 of ISIC at the 4-digit level, which comprises 81 manufacturing industries, or 127 industries, respectively. These are presented by country, industry and year. Note that coverage, in terms of years, as well as data items, may vary from country to country depending on data availability.

IDSB contains annual time series data (in current US dollars) as follows:

1) Domestic output
2) Total imports (=(5) + (6))
3) Total exports (=(7) + (8))
4) Apparent consumption (=(1) + (2) - (3) above)
5) Imports from industrialized countries
6) Imports from developing countries
7) Exports to industrialized countries
8) Exports to developing countries

Note that the trade statistics by ISIC Rev.2 and Rev.3 are transferred from UNComtrade by SITC Rev.2 and SITC Rev.3, respectively.

Appendix 2. Manufacturing

15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office, accounting and computing machinery
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c.
37	Recycling

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