

Accounting for Discrepancies in Bilateral Trade: The Case of China, Hong Kong, and the United States

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ABSTRACT

China's reported exports to the United States have long been smaller than U.S.-reported imports from China. Earlier explanations for this focused on re-exports through Hong Kong, and appeared to account for most of the difference. Now, even after taking Hong Kong into account properly, there has emerged a new and growing discrepancy which amounted in 2005 to \$46 billion, perhaps 20 percent of the "true" value. Comparisons of detailed customs records from China, Hong, Kong, and the United States shows that direct exports from Chinese ports and Chinese exports through third countries account for much of the discrepancy, relative to trade flows involving Hong Kong. The extent of the problem varies markedly across sectors. Some robust correlates for the discrepancy relate to valuation issues, U.S. tariffs, and re-exporting through the United States itself. The estimated behavior of other potentially important influences is sensitive to the econometric specification employed.

JEL Classification Numbers: F10, F14

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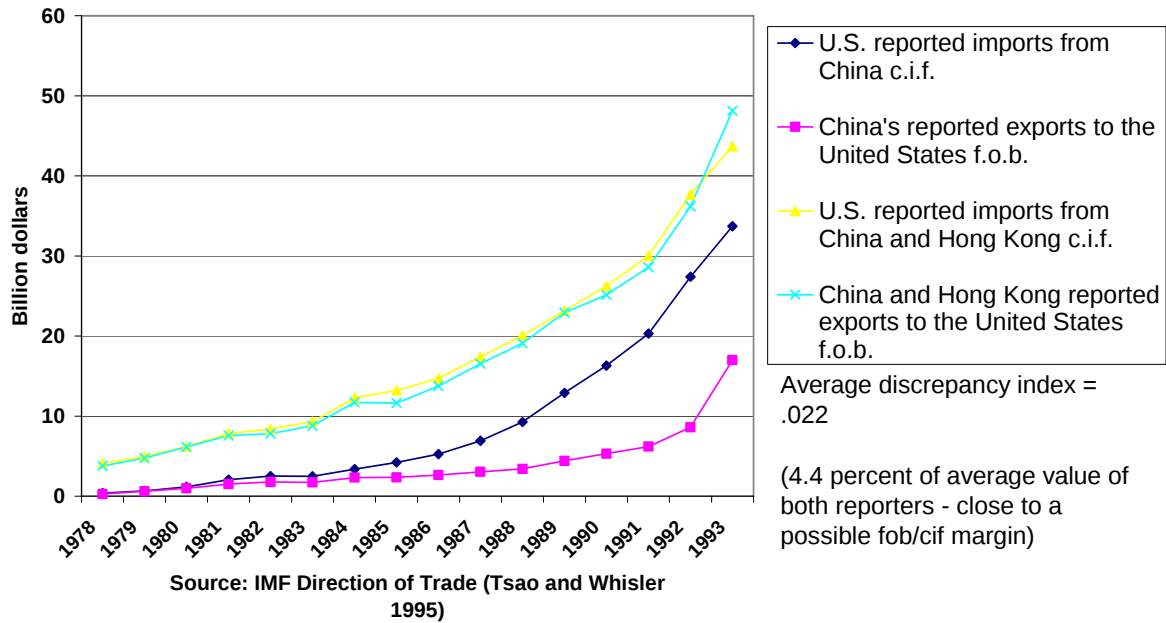
I. Introduction

It has long been known that the international trade data reported by importers and exporters are unlikely to be the same, and in fact may vary greatly from each other for a wide variety of reasons. Tsigas, Hertel and Binkley (1992) cite investigations of this question going back to the 19th century. By the 1970s, trade discrepancies had already become the focus of national and international statistical agencies and economists (U.S. Bureau of the Census (1970), Morgenstern (1974), U.N. Economic and Social Council (1974)). Economists working on problems for which the data needed to be reconciled have adopted methods for choosing either the importer's or exporter's data, or some weighted average of the two, as more reliable (e.g. Gehlhar (1996), for the GTAP model, and the documentation for Statistics Canada's *World Trade Analyzer*).

The standard methods for data reconciliation have generally not worked well for China's trade with the rest of the world. As this trade grew in the 1980s and 1990s, the differences between China's reported trade and comparable data reported by China's trade partners was widely noted. (West (1995), Joint Committee on Commerce and Trade (1996), Fung and Lau (1998, 2001, 2003, 2004), Feenstra, Hai, Woo and Yao (1999), Fung, Lao and Xiong (2006). For example, in 1991 the United States reported merchandise imports from China of \$20.3 billion, or over three times as large as China's reported exports to the United States of \$6.2 billion.¹ Most of this discrepancy was explained by the large share of China's trade which is re-exported through the customs territory of Hong Kong. In most countries, it is believed that in the case of transshipment, the importer's statistical agencies know more about the country of origin than the exporter's statistical agencies know about the country of final destination. Thus, for example, goods which are exported from China to Hong Kong, and then to the United States, are likely to be counted in U.S. data as imports from China but in China's data as exports to Hong Kong. Hong Kong's own data record both an import from China and a re-export to the United States. When exports of China and Hong Kong together to the United States are compared with U.S. imports from China and Hong Kong together, most of the discrepancy disappeared (Figure 1). This was accepted by many researchers as a sufficient explanation for the data problem, and led to further inquiries on the special role of Hong Kong, in particular the "Hong Kong markup" for goods re-exported through Hong Kong (Feenstra and Hanson (2004)).

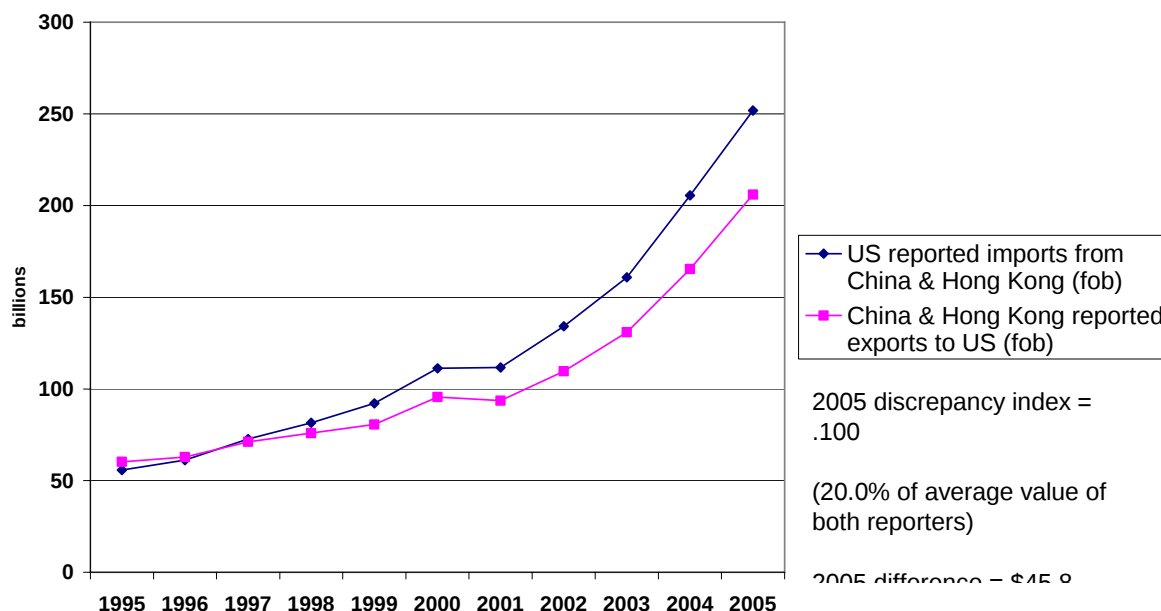
¹ Both numbers are taken from the IMF's *Direction of Trade* data, as reported in Tsao and Whisler (1995).

Figure 1
Eastbound U.S.-China trade 1978-1993



This paper reports on newly emerging data discrepancies between statistics reported by the United States on the one hand, and China and Hong Kong on the other. Even when the role of Hong Kong is very carefully accounted for, taking into account transport costs and geographical definitions, U.S. reported imports from China and Hong Kong have grown persistently larger than the sum of China's and Hong Kong's reported exports to the United States. (Figure 2) The difference in 2005 is now nearly \$46 billion, amounting to about 18 percent of the reported U.S. number, or about 22 percent of the total figure reported by China and Hong Kong together. This discrepancy has grown at the same time that the role of Hong Kong as a "middleman" between China and the United States has shrunk. Expressed as a share of U.S. reported imports from China, the share of Hong Kong re-exports of goods of Chinese origin has declined from about 61 percent in 1995 to about 14 percent in 2006 (Figure 3).

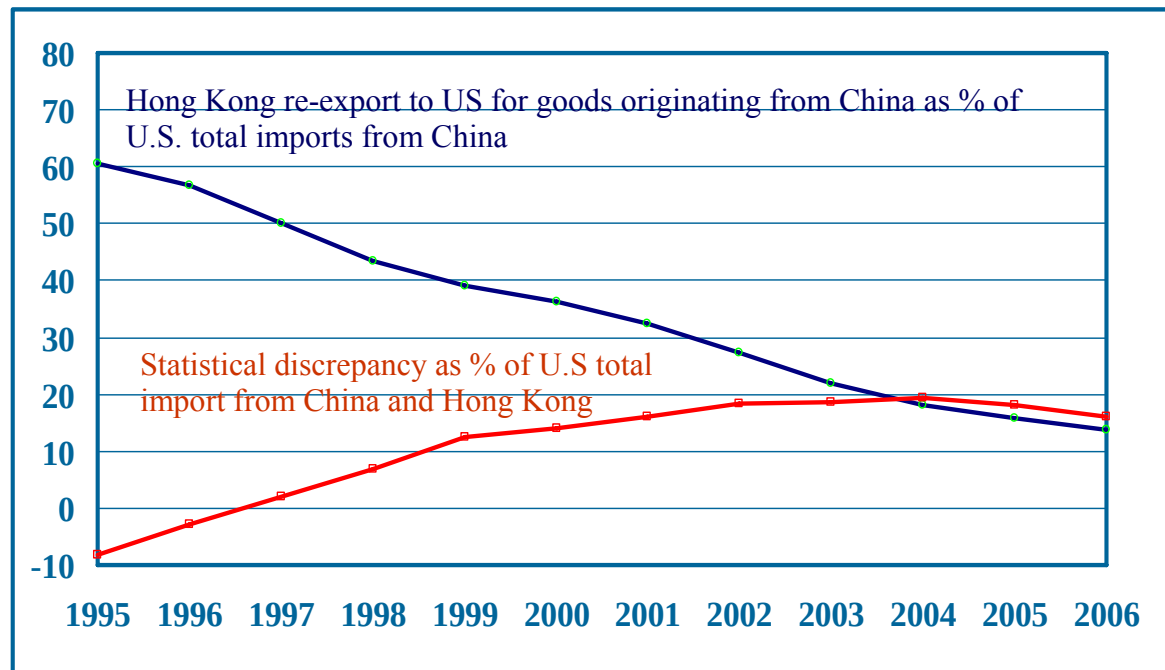
Figure 2
China-Hong Kong Exports to United States, 1995-2005, with
corrections for shipping margins and geography



The newly emerging discrepancy in the data cannot, like the old discrepancy, be explained simply by a failure to account for re-exporting through Hong Kong. If it does relate to Hong Kong, it must be in a more complex way. It is likely to have other explanations that have nothing to do directly with Hong Kong; perhaps more than one explanation, or different explanations for different types of products. This paper is dedicated to exploring some available explanations for this growing discrepancy.

The rest of the paper is organized as follows. Section 2 outlines the methodology of our inquiry. Section 3 presents the data sources for compiling the mirror statistics of U.S-China trade and makes necessary accounting adjustments to estimate the actual size of the statistical discrepancy, then compares them with discrepancies between China, Hong Kong and their other major trading partners to draw some stylized facts about the discrepancies. Section 4 provides a more detailed accounting of the discrepancy by subcategories in eastbound trade, made possible by direct comparisons of data provided by Chinese, Hong Kong, and U.S. primary sources. This allows us, for example, to distinguish between direct exports to China, exports through Hong Kong (both re-exports which clear Hong Kong Customs and transshipments which do not), domestic exports of Hong Kong, and exports of Chinese origin passing through third countries. Section 5 provides an econometric analysis to identify some possible factors contributing to the discrepancy, focusing on U.S. imports from China and Hong Kong. Section 6 concludes with a discussion of possible directions for future research.

Figure 3. The Declining role of Hong Kong in U.S.-China Merchandise Trade and the Widening Discrepancy in Trade Statistics.



II. Theoretical considerations

2.1 Possible sources of discrepancies in trade data²

Reasons that trade data as reported by exporters and importers may differ from each other include, at the very least, the following:

Timing

If, for example, a shipment leaves the exporting country in December 2004 and arrives in the importing country in January 2005, then one would expect the exporter's data to be larger in 2004 and the importer's data to be larger in 2005. This could be a big problem for monthly data, but for annual data the differences in the beginning and end of the year are likely to balance out, unless trade is growing very fast and shipping times are long.

Shipping and insurance costs

The presence of shipping and insurance costs, which must be added to the value of merchandise in order to move it from one place to another, creates a systematic reason for import data to be a little larger than export data. Most countries report export data on an f.o.b.

² For a further discussion of this topic see Tsigas et al. (1992) and the earlier sources cited therein.

(free on board) basis, which reflects all costs including loading the good in the exporter's port, or sometimes on an f.a.s. (free alongside ship) basis, which equals f.o.b. minus the costs of loading the ship. Import data is usually reported on a c.i.f. (cost, insurance, freight) basis. The difference between the f.o.b. and c.i.f. values is known as the f.o.b./c.i.f. margin and is usually estimated to equal a few percentage points. If the importing country's data were consistently larger than the partner country's corresponding export data, but by small amounts, we might consider the f.o.b./c.i.f. margin to be the main reason for the difference.

U.S. import data are somewhat unusual in that the insurance and freight costs are collected and reported. This is because the United States assesses duties on the f.o.b. value (known officially as "customs value") rather than on the c.i.f. value, as is the practice in most countries. Insurance and freight costs can be measured as the difference between the c.i.f. value and the customs value of imports. According to U.S. data, the total f.o.b./c.i.f. margin on all imports from China has fluctuated between about 5 and 8 percent of the customs value in the last decade, while the margin on imports from Hong Kong has been between about 3 to 5 percent of customs value.

General vs. special trade, and goods in transit

In most countries, trade data often make a distinction between "general" trade data, which is meant to represent goods either physically entering or leaving a country, and "special" trade data,³ which are meant to reflect exports actually produced or transformed in a country and imports actually consumed. Not all countries use the same practice, and not all users of trade data are careful to report which form is being used. Examples of imports included in "general" but not "special" trade are imports entered into special warehouses or free trade zones, but not clearing customs. Exports included in "general" but not "special" trade consist of re-exports of merchandise produced outside of the country and not transformed within the country.⁴ Although it seems paradoxical, there are cases in which the value of "special" imports can exceed those of "general" imports for certain products, because of value added in warehouses or foreign trade zones outside the customs territory.

Even general trade data may not represent *all* the merchandise which physically enters or leaves ports. There is an additional category, known as "goods in transit," which includes merchandise which passes through ports but is not unloaded from the ship or aircraft. Most countries have little or no data on goods in transit, though the value of them can be quite large for ports like Hong Kong, Singapore, Long Beach or Rotterdam. The possibility exists that traders may accidentally (or deliberately) confuse true re-export or transshipment with goods in transit.

³ Singapore Department of Statistics (2005) provides a good discussion of the U.N. standards in this area and the differences between national practices.

⁴ The United States maintains both general trade data, known as "general imports" and "total exports," and special trade data, known as "imports for consumption" and "domestic exports." The difference between total exports and domestic exports in U.S. data is called "foreign exports."

Classification of goods

Even when the same transaction is reported by both sides, at the same value, the goods may be classified differently by the exporter and the importer. This poses problems for users of the data who want to identify particular products and industries. Using the Harmonized System maintained by the World Customs Organization, goods are classified by type in Chapters 1-97. However, countries may use Chapter 98 and, for imports, Chapter 99 to identify goods covered by special programs and policies, in which case their classification is according to the program or policy. It is not uncommon for one trading partner to record a transaction according to the actual type of good (Chapter 1-97) while another trading partner records it in Chapter 98 or 99.

Even when both trading partners try to identify the type of good, they may classify it differently, particularly for emerging technologies which have not been assigned a classification, or for which the classification is ambiguous. Examples of such goods are fuel cells, and devices which serve simultaneously as photocopiers, printers, and fax machines.

Re-export

Re-export takes place when goods enter into a customs territory from one country and are shipped to another country without being transformed. Re-export is a growing phenomenon in the world economy.⁵ More than 90 percent of Hong Kong's total exports now represent re-exports either from China or from a third economy, up from less than 30 percent in the late 1970s. More than 10 percent of U.S. total exports now represent re-exports. The term "transshipment" should be interpreted with caution. It is often used as a synonym for "re-export", but can also mean "goods in transit" as defined above, depending on the context.

The practice of re-exporting gives rise to a wide variety of possibilities either for the origin or the final destination of commodities to become confused. This is particularly troublesome when policymakers desire to see statistics on the "special" basis, where exports represent national production and imports represent what has been entered into national markets for consumption. If a shipment goes from A to B to C, we usually think of A as the "true" origin and C as the "true" destination, but country A could easily record its exports as going to the country of shipment (B) rather than the final destination C, while country C could record its imports as coming from the country of shipment (B) rather than the ultimate origin A.

It is usually thought that the importer is more likely to know the ultimate origin than the exporter is likely to know the ultimate destination, particularly if a "middleman" in B decides where the product will ultimately be shipped to. If this is true, then the importer's data are likely to be larger. As we saw above, recognizing that Hong Kong acts as such a middleman was enough to produce a good reconciliation of U.S. and Chinese trade data through about the mid-1990s. However, this rule of thumb may not always hold, and there may be certain

⁵ See Andriamananjara, Arce, and Ferrantino (2004).

types of transactions for which the exporter knows more about the final destination than the importer knows about the ultimate origin. In this case, the exporter's data would likely be larger.

The phenomenon of goods in transit can potentially give rise to problems similar to those caused by re-export, as can confusion between true re-export (when the goods actually enter the customs territory in B) and transit (when the goods simply pass through the port without clearing customs).

Fung and Lau (2003) noted that "some Chinese exports to Central and South America, including the Caribbean countries, have been routed through U.S. ports such as Los Angeles and Miami. There is a question of whether these exports may have been included in the U.S. trade statistics as Chinese exports to the United States."

Differences in recording re-exports between countries also provide challenges. For many large traders, including Japan and most of the European Union, re-export data are not readily available. The United States has detailed re-export data, but only records the country of destination, rather than the country of origin. Hong Kong's data make it possible to identify both sides of a re-export transaction. However, even Hong Kong's re-export statistics may not fully capture the complexity of shipments that pass through its ports.

Some of the challenges of reconciling Hong Kong data to China and U.S. data are illustrated in Tables 1 and 2. Table 1 provides an attempted reconciliation of the bilateral trade between China and Hong Kong, as reported by the two customs authorities, while Table 2 gives some data on trade and cargo shipping with the United States, as reported by China's and Hong Kong's customs authorities. There are four types of shipment are classified by Hong Kong Census and Statistics Department: imports, exports (including domestic exports and re-exports), inward transshipment, and outward transshipment. Goods imported into or exported from Hong Kong are classified as direct shipment, while goods transshipped in Hong Kong under a through bill of lading are classified as transshipment. This refers to cargo that is consigned from a place outside Hong Kong to another place outside Hong Kong but is or is to be removed from one vessel and either returned to the same vessel or transferred to another vessel within Hong Kong waters⁶. It is different with goods imported into Hong Kong for subsequent re-exports and usually do not go through Hong Kong custom valuations. This means a large portion of China's exports via Hong Kong to the world may be only transferred through Hong Kong and do not reflect in Hong Kong re-export statistics. Section A in Table 1 compares trade statistics reported by China and Hong Kong with Hong Kong's "Port Cargo Discharged by Major Country/Territory and Port of Loading" statistics, it shows that as the difference between China reported exports via Hong Kong (but Hong Kong may be or may not be the final destination) and Hong Kong reported imports from China increase, the inward transshipment from China as percent of Hong Kong's total cargo shipment received from China also increase. The similar correlation also can be found from the statistics of China and Hong Kong export to the United States and Hong Kong's outward transshipment to the United States as percent of Hong Kong's total shipment to the United States (Section a of Table 2).

⁶ Definition provide by Hong Kong Census and Statistical Department.

Section B of Table 1 compares trade statistics reported by China and Hong Kong with Hong Kong's "Port Cargo Loaded by Major Country/Territory and Port of discharge" statistics, it shows that as the difference between China reported imports through Hong Kong (but Hong Kong may be or may not be the country of origin) and Hong Kong reported exports to China increase, Hong Kong outward transshipment to China as percent of Hong Kong's total shipment to China also increase. The similar correlation also can be found from the statistics of China and Hong Kong import from the United States and Hong Kong's inward transshipment for the United States as percent of Hong Kong's total shipment received from the United States (section B Table 2).

It is very possible that in China's customs statistics, exports via Hong Kong may include part of re-exports through Hong Kong and part of transshipment through Hong Kong. However, this is very difficult to confirm empirically, since re-exports are measured in dollars and transshipments in tons in Hong Kong's trade and cargo shipment statistics, it is difficult to directly compare the one with the other. A proper way to measure China's transshipment through Hong Kong and its relation with direct exports and imports reported by China Customs is needed to fully understand the observed discrepancy in trade statistics reported by both sides. The unpublished U.S. shipping statistics may provide additional information in this regard and this area needs to be examined further.

Partner country attribution and treatment of processing trade

Attribution of imports to country of origin and exports to country of destination often explain many significant differences when goods move from the country of origin to the country of destination via a third location in international trade statistics. In the case of Chinese exports, the country of final destination may not know at the time of exports, and the status of Hong Kong as a free ports increase the incentive for exporter to declare their merchandise are for home use in Hong Kong, even the goods actually is used for re-exports. The large portion of Chinese exports belongs to processing parts and components, making the attribution of country of origin more complex, however, without discuss the differences of partner country attribution and treatment of processing trade between the U.S. and Chinese statistical system to recording merchandise trade, we can not see the logical link between processing trade and statistical discrepancies,⁷ because the discrepancy we discussed here treat China and Hong Kong as one side of the mirror, as a results, the difference between statistics from China and Hong Kong become less relevant.

Mis-invoicing, transfer pricing, and mis-attribution

⁷ A recent presentation made by China's Statistics Department of Customs General Administration, conclude that "despite the decreasing trend in reliance on Hong Kong in (China's external trade), the increasing scale of the processing trade means large discrepancies will still exist in the future" (Hongman Jin, "Reasons for Discrepancies in China's External Trade Statistics with partners: the Particular Role of Processing Trade", 6th OECD International Trade Statistics Expert Meeting, Statistics Directorate, September, 2005 <http://www.oecd.org/dataoecd/51/6/35308958.pdf>)

Mis-invoicing (under invoicing and over invoicing) involves declaring the value of goods to be either higher or lower than their true value. Mis-attribution takes place when traders deliberately make false declarations about the origin or destination of a good. Incentives for mis-invoicing may include tax evasion, tariff evasion, and circumvention of a quota or tariff-rate quota. For example, if tariffs are high there is an incentive for the exporter to under-invoice the good. The incentives for mis-attribution could include taking advantage of special programs which provide duty reductions or drawbacks. For example, imports into the United States from outside NAFTA might be misattributed as being imports from Canada or Mexico. Firms that wish to take advantage of China's processing trade programs must identify certain imports into China as being intended for use in producing Chinese exports, while firms using the provisions of U.S. Section 9802 must identify certain U.S. exports as being intended to be processed outside the United States and returned as U.S. imports. False declarations to take advantage of such programs could lead to both mis-valuation and geographical mis-attribution.

Transfer pricing refers to mis-invoicing engaged in by related parties in different countries, such as different branches of a multinational corporation. By under- or over-invoicing, firms can shift profits from high-tax countries to low-tax countries, as well as avoid tariffs.⁸ The incentives to do this are particularly strong when firms ship to themselves specialized "firm-specific" components or intermediate goods for which there is no obvious market equivalent to establish an "arms' length" price. On the other hand, the practice of transfer pricing is limited both by the fact that keeping "two sets of books" may impede the firm's ability to monitor its own operations and by the fact that national tax authorities have some enforcement powers to prevent abuses of transfer pricing. The role of Hong Kong, which is both a duty-free customs area and a low-tax location, in U.S.-China trade suggests that the incentives for mis-invoicing and mis-attribution may be particularly high.⁹

Smuggling

Smuggling may be treated conceptually as the most extreme case of under-invoicing; the transaction is not recorded at all, so its value is zero. Situations which provide incentives for under-invoicing also provide incentives for smuggling, particularly if the incentives are large. Particular incentives for smuggling exist if either exports or imports of a commodity are illegal (e.g. for certain drugs, explosives, weapons, pornography, endangered species, etc., or for goods which otherwise would be legal except for intellectual property violations.) Smuggling can lead to discrepancies in trade statistics if goods which are legal to export (or import) in one partner are illegal in the other partner, if the degree of enforcement is different in the exporting and importing countries, or if smugglers engage in misattribution of origin or destination.

It may be the case that even large volumes of smuggling could take place without leaving any visible discrepancy in official trade statistics. This could take place if the smuggling activity produces neither an export record nor an import record.

⁸ See Bernard, Jensen, and Schott (2006) for a recent study of transfer pricing by U.S.-based multinational firms.

⁹ See in particular Fisman, Moustakierski, and Wei (2004) on the potential role of tariff evasion in trade involving Hong Kong.

2.2 Measuring discrepancies among the trade statistics of China, Hong Kong and the United States

Trade data reported by each country and its partners are often used in international economic literature to check the quality of trade statistics. Theoretically, export statistics from one country to its partner countries should match the import statistics from their partner countries. This often refers to as mirror statistics. An approximate match of mirror statistics implies trade data reported via that routine are reliable. However, discrepancies always occur for many reasons as discussed in previous section.

Mirror statistics is used as the basis to calculate the magnitude of statistical discrepancy in this paper. However, there is an import aspect the methodology used here differs from methodologies used in previous studies. We compile the mirror statistics by treating data reported by China and Hong Kong as one side of the mirror and data reported by the United States as the other side.¹⁰ Because U.S. records imports based on country of origin according to UN guidelines, its reported imports from China include goods directly shipped from China and indirect shipped from Hong Kong and other countries, while U.S. reported imports from Hong Kong only include good originated from Hong Kong¹¹. Therefore, in eastbound trade, the exports side of the mirror should equal China's reported exports to the United States, plus Hong Kong domestic exports and Hong Kong reported re-exports for China to the United States, while import side of the mirror should equal the sum of U.S. reported total imports from China and Hong Kong. Similarly, in westbound trade, the exports side the mirror should equal U.S. reported exports to China, plus U.S. reported total exports to Hong Kong, while import side of the mirror should equal the sum of China and Hong Kong reported imports originated from U.S. after fob/cif adjustment minus Hong Kong re-exports for the U.S. to China, because U.S indirect exports to China through Hong Kong will be counted twice in the sum of China and Hong Kong reported imports: once when it enters Hong Kong Customs, then counted again by China's Customs when it is re-exported to China. It implies both China and Hong Kong also records imports based on country of origin according to UN guidelines similar to the United States. The advantage of doing this is it simplifies the estimation of actual statistical discrepancies by avoiding adjust Hong Kong re-export markup first, which often varies widely (Feenstra and Hanson, 2004)¹², depending on the source data and methodology. In other words, the actual size of statistical discrepancies calculated by this method will free from the complication of the error generated by the estimation of Hong Kong's re-export markup, thus statistically more desirable. The mirror relation of the

¹⁰There are many good reasons treat trade statistics from Hong Kong separately besides it is a separate customs territory. For instance, there have historically been significant amount textile quotas allocated to Hong Kong.

¹¹ In general, for nonpreferential trade the United States considers the country of origin to be the last country where a "substantial transformation" took place, regardless of the portion of the final import value of the product that is added by processing that takes place in other countries after the "substantial transformation."

International Economic Review, United States International Trade Commission, Oct./Nov., 1996, p. 13.

¹² In this paper, Feenstra and Hanson reported Hong Kong's re-export markup has a mean of 0.375 with a standard error of 0.358 based on official data from China and Hong Kong at 4 digit SITC level covering period 1988-1998. They also report the presence of negative markups are a genuine feature of their data, similar with what find by Feenstra et.al (1999) in China-US westbound trade.

reported trade statistics in both directions is depicted in Figure 4a and 4b. For a complete consistent accounting relation between China, Hong Kong and their trading partner reported trade statistics, please refer to (Wang, Gehlhar and Yao, 2006).

After properly identifying the two sides of mirror statistics in US-China trade, three measures of statistical discrepancy can be defined. The first one measures the discrepancies at commodity level for each trading partner.¹³

$$DIF_{it}^{sr} = 100 \frac{M_{it}^{sr} - E_{it}^{sr}}{M_{it}^{sr}} \quad (1)$$

where M is partner r reported imports of commodity i from country s at year t, E is reporting country s reported exports of commodity i to partner r at year t. This index always measures discrepancies between the two sides of mirrored trade statistics as a percent of reported import flows.

The second index uses the sum of the two partner reported data as the denominator,¹⁴ It varies between -100 (M=0, E≠0) and 100 (M≠0, E=0). When the two reported statistics are not far away, the numeric value of the two measures should be very close to each other.

$$ER_{it}^{sr} = 100 \frac{M_{it}^{sr} - E_{it}^{sr}}{0.5(M_{it}^{sr} + E_{it}^{sr})} = 200 \frac{M_{it}^{sr} - E_{it}^{sr}}{(M_{it}^{sr} + E_{it}^{sr})} \quad (2)$$

In eastbound trade, E equals the sum of China reported exports to partners, Hong Kong reported domestic exports to partners, and Hong Kong reported re-exports for China to partners; M equals the sum of partner reported imports from China and Hong Kong. In westbound trade, E equals the sum of partner reported exports to China and Hong Kong, while M equals the sum of China and Hong Kong reported imports from partner minus Hong Kong reported re-exports for partner to China.

¹³ There is a consensus in trade statistics reconciliation work to use import data as a benchmark for comparison of most commodities. Import data usually are considered to be more reliable than export data because imports have to be reported in sufficient details to allow Customs to apply tariffs, taxes, trade agreements or other regulatory controls. For the same reason, Customs offices generally more attentive to goods entering the country as opposed leaving the country. Therefore, for those countries consistently report exports higher than its partners' imports, there may be double counting involved.

¹⁴ This index is due to Austin Barron of American University (International Trade Centre (2005)). A similar index can be constructed using the mean of the importers' and exporters' data (M + E)/2 as the denominator, rather than the sum. If the mean is taken as a first estimate of the true value (or put differently, if the values of the ER index are multiplied by 2) this produces an index which is more directly comparable to DIF.

Figure 4a Mirror Relation among China, Hong Kong and US Officially Reported Trade Statistics - *Eastbound Flows*

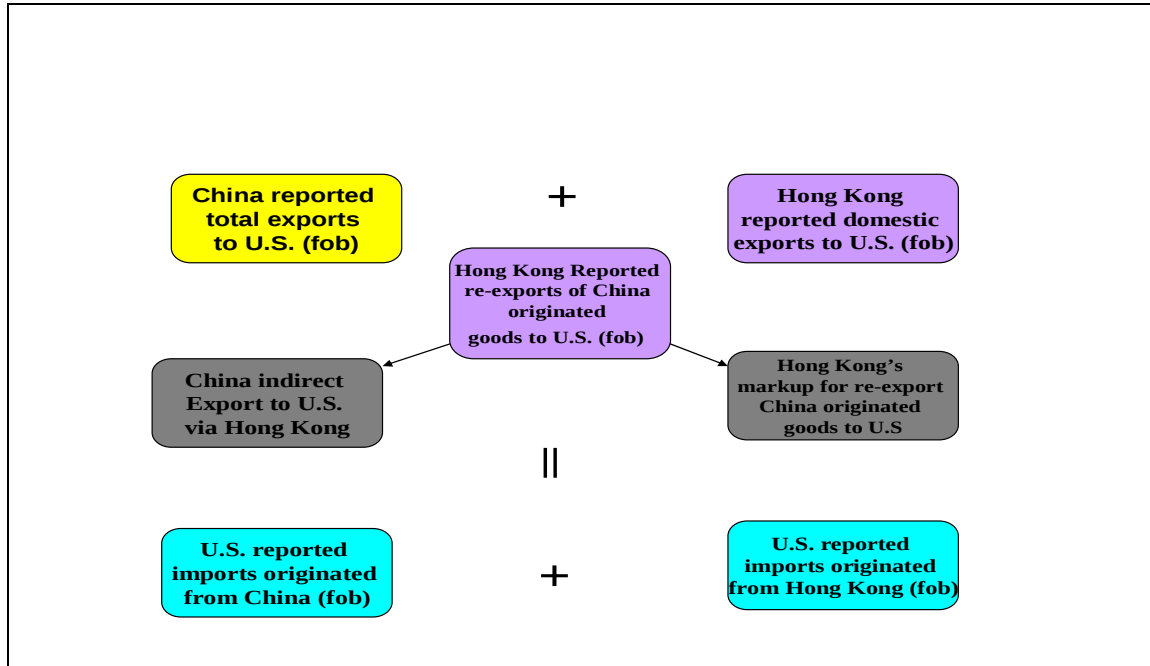
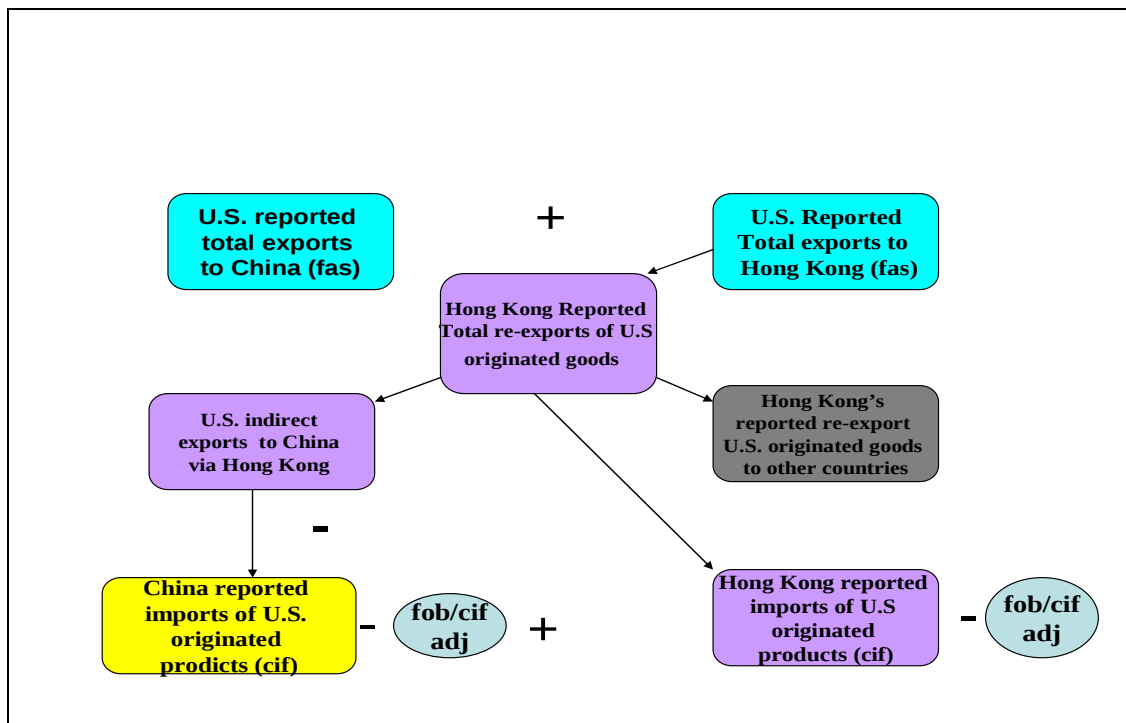


Figure 4b Mirror Relation among U.S., China and Hong Kong Reported Trade Statistics - *Westbound Flows*



The third measures are absolute average aggregation index by partners or by commodities from the second one, and defined as follows:

$$AER_t^{sr} = \sum_i w_{it}^{sr} |ER_{it}^{sr}| \quad (3)$$

Where

$$w_{it}^{sr} = \frac{M_{it}^{sr} + E_{it}^{sr}}{\sum_i (M_{it}^{sr} + E_{it}^{sr})}$$

$$AER_{it}^s = \sum_r s_{it}^{sr} |ER_{it}^{sr}| \quad (4)$$

Where

$$s_{it}^{sr} = \frac{M_{it}^{sr} + E_{it}^{sr}}{\sum_r (M_{it}^{sr} + E_{it}^{sr})}$$

The two indexes vary between 0 to 200. The lower the value of the indexes, the smaller the size of the discrepancies, the higher and the degree of consistency for the mirror trade statistics.

III. Stylized facts from the data

3.1 Data sources

We obtained China reported trade statistics at the most detailed HS level (8 digit) from Customs General Administration of China, Hong Kong reported trade and re-export statistics (8 digit HS) from Census and Statistical Department of Hong Kong, and U.S. reported data (6 digit HS) from USITC's Oracle database. All data cover 12 years from 1995 to 2006. To check whether the pattern of statistical discrepancies between trade data reported by China and Hong Kong with the United States are different from discrepancies with their other trading partners, we also download trade data at 6 digit HS from the United Nation COMTRADE database for about 150 reporting countries from 1995 to 2004, to compile the mirror statistics and calculate the discrepancy measures for China and Hong Kong with all their major trading partners in a similar way.

Before we calculate the discrepancy measures according equations (1) to (3) based on mirror trade statistics from official data sources, three adjustments are made to bring statistics from both sides comparable:

a. Geographical coverage difference: The United States includes Puerto Rico and the U.S. Virgin Islands as part of its statistical territory while China and Hong Kong treats them as

separate jurisdictions. To make the mirror statistics comparable, exports to and imports from Puerto Rico and the U.S. Virgin Islands are subtracted from U.S. reported statistics based on data from U.S. Census;

b. Classification coverage difference (treatment of HS 98 and 99). The U.S. includes certain special programs and transactions in HS Chapter 98 & 99. These are not directly comparable to China's or Hong Kong's data, which may record the same goods in HS 1-97 or exclude them altogether for their data. Thus, data for HS 98 and 99 are omitted in the comparison.

c. Valuation difference: in westbound trade, China and Hong Kong values its imports on a c.i.f. (cost, insurance, freight) basis, while the United States values its exports on an f.a.s. (free alongside ship) basis that does not include shipping costs, therefore, adjustments are made based on 60 percent of actual f.o.b./c.i.f. ratio calculated from detail U.S. import data, based on transportation cost is much lower for goods shipped westbound than eastbound.¹⁵ However, in the eastbound trade, U.S. Census reports import as general customs value, along with custom duty collected and cost of insurance and freight. The former by definition is "value of the imports, as appraised by U.S. Customs, excluding U.S. imports duties, freight, insurance, and other charges incurred in bringing the merchandise to the U.S. for General Imports", which is equivalent to the fob value, therefore, no c.i.f. to f.o.b. adjustment need to be made.

3.2 Eastbound trade¹⁶

Table 3 presents the official mirror statistics of China's and Hong Kong's exports to the United States, related adjustments, and resulted estimates of statistical discrepancies during 1995 to 2006. It starts from U.S. officially reported merchandise imports from China and Hong Kong, adjusts by geographic coverage difference, plus the statistical discrepancies and finally arrive at China and Hong Kong officially reported exports (include Hong Kong reported re-exports of China originated good to the United States) covering the same period.

There are four interesting observations. First, China and Hong reported more exports to the United States than U.S. reported imports during 1995 and 1996 and reached a rough consistency in 1997. The discrepancy increase rapidly since then and reached its peak at nearly 20 percent in 2004. From 1998 to 2006, the difference between China reported exports to the United States and U.S. reported its imports from China more than doubled. Second, the role of Hong Kong in intermediating China's exports to U.S. market decline rapidly in last decade, from more than 60 percent to about 14 percent, while share of China originated

¹⁵ This is approximately the ratio found in a sample of comparable westbound to eastbound rates between China and the United States obtained from the Maersk shipping company (<http://www.maerskline.com>). The economic incentives for such a difference in rates arise from China's bilateral surplus with the United States; it costs more to reserve space on a full eastbound container going, e.g. from Shanghai or Hong Kong to Los Angeles than to get the same space on a more-empty westbound container on the same route.

¹⁶ The measured discrepancy on the westbound trade (exports of the United States to China plus Hong Kong) is a good deal smaller than on the eastbound trade and shows no apparent trend. Discrepancies of China-Hong Kong trade data with those of trading partners other than the United States show substantial variation and can be of either sign. While the full analysis of these trade flows exceeds the scope of the present paper, relevant summary statistics are available from the authors on request.

goods in Hong Kong total re-exports to the US stay constant at more than 90 percent. Third, Hong Kong's domestic exports to the United States decline consistently, re-exports of Chinese made products consisted more than 80 percent of its gross exports to the United States since 2002 and this trend probably will continue in the coming years, as Hong Kong's economy become more and more service-oriented. Finally, the geographical coverage adjustment were small relative to the remaining unexplained statistical discrepancies, indicating there are other important contributing factors besides Hong Kong's re-export activities need further exploration.

Look at the computed discrepancies index for major HS sections reported in Table 4, textile (HS chapter 51-63) seems to be the best matched mirror trade statistics between China and Hong Kong reported exports and U.S. reported imports, largely due to the quota system in place that provides sufficient incentives for both sides to precisely record the trade flows. Arms and ammunition (HS chapter 93) and works of art, collections' pieces and antiques (HS chapter 97) are the two major HS sections with consistently under reported exports by China and Hong Kong during the 12 year period (U.S. reported imports is more than two times of China & Hong Kong reported exports in most years); while vehicles, other transport equipment and their parts (HS chapter 86-89) and beverages and tobacco (HS chapter 16-24) are the two major HS sections that China & Hong Kong reported exports consistently exceeds U.S. reported imports. This may imply that under-invoicing behavior is a common practice for certain commodities in eastbound trade, however, whether under-invoice happens at the point of exports or imports depends on the specific characters of the traded products. For instance when Chinese exporters export art work and antiques, they usually intend to under-value the commodity, while when U.S. importer imports tobacco products from China, they may intentionally under report the value of their imports (smuggling ?) for tariff evasion purpose. In the meantime, over-invoice behavior also could happen, for example, when Chinese exporter exports auto parts to the United States, they may over-value their exports for export tax rebate purpose.

In order to see whether the rapid growing statistical discrepancies are unique features between China and Hong Kong's exports to the United States and U.S. reported imports, we further compile mirror statistics in a similar way for their exports to their other major trade partners using data from UN COMTRADE database and compute three indexes of statistical discrepancy. The results for China's top exporting countries are listed in Table 5.¹⁷ Those indexes reveal that there are only two countries (Japan and Korea), among China's major trading partners, reported imports matched closely with China and Hong Kong reported exports (The discrepancy as % of partners reported imports was consistently less than 10 percent in the ten year period). While other partner countries can be classified into two groups according to the sign of the statistical discrepancies. The first group is characterized by increasing positive discrepancies over the 10 year period as the United States, while the second group all has a negative, although diminishing, discrepancy during the same period, implying their reported imports from China and Hong Kong were consistently lower than

¹⁷ Because we did not have fob/cif ratio for China and Hong Kong's trade with most their trading partners except the United States, all imports are valued at cif price in this calculation. A less than 10 percent positive discrepancy in the compiled mirror trade statistics indicates a close match of the reported trade data.

what China and Hong Kong reported exports to them. The first group includes all the countries in North American, most countries in Europe, Australia and New Zealand, Argentina, Malaysia, Thailand and Indian. The second group includes Taiwan, Russia, Chile and most of the large developing countries such as Indonesia, Philippines, Brazil, Saudi Arabia, and South Africa. The aggregation of all other smaller reporting countries also fell into this group. Aggregate all reporting partners, the discrepancy increase from less than negative 1 percent in 1995 to over 18 percent in 2004, quite consistent with the growing pattern of discrepancies in the mirror statistics of U.S.-China eastbound trade.

3.3 Westbound trade

Table 6 presents the official mirror statistics of China's and Hong Kong's imports from the United States, related adjustments, and resulted estimates of statistical discrepancy from 1995 to 2006. It starts from U.S. officially reported merchandise exports to China and Hong Kong, deduct geographical coverage difference from U.S. reported data, plus fob/cif margin, Hong Kong reported re-exports U.S. originated goods to China, and a statistical discrepancies, finally arrive at China and Hong Kong published imports from the United States covering the same period.

Different from the east bound data, there seems no obvious pattern in the aggregate statistical discrepancy during the 12 year period. However, Hong Kong and China reported imports from the United States slightly exceeded U.S reported exports to China and Hong Kong only in two of the twelve years (1999, 2004), export side of the mirror statistics are larger than the import side in a relatively large magnitude for rest the ten years. This suggests under-invoicing of Chinese imports from the United States for the purpose of tariff evasion and other incentive reasons seems more common and dominated more sectors in westbound trade than eastbound trade, a similar finding to Fung, Lau and Xiong (2005). Other notable features of the data are the decline role of Hong Kong in facilitating U.S. exports to China. Hong Kong re-exports for U.S. originated goods as percent of total China imports from the United States has declined from over 30 percent in 1995 to about 12 percent in 2005. In the meantime, U.S. share in total Hong Kong re-exports to China for all countries declined from more than 10 percent in 1995 to less than 5 percent in 2005.

Look at the computed discrepancies index for major HS sections reported in Table 7, the most consistently under-reported China & Hong Kong imports is arms and ammunition (HS chapter 93)¹⁸, followed by miscellaneous manufactured products (HS chapter 94-96), precious stones and metals (HS chapter 71), while only two of the 22 major HS sections, paper & paperboard products (HS chapter 47-49), and instruments, clock & watches (HS chapter 90-92), China & Hong Kong reported imports are consistently exceeded U.S. reported exports. However, at the aggregate level, the magnitude of discrepancies between China & Hong Kong's imports and U.S. reported exports is much smaller than the discrepancies in eastbound mirror trade statistics, implies possible classification inconsistency problems between the two traded sides.

¹⁸ Based on Statistical department of China's Custom Administration, arm imports and exports are reclassified into Chapter 98.

To put the statistical discrepancy of U.S-China westbound trade in perspective and check whether under-invoice is a common feature of China's imports, we also compiled mirror statistics for imports of China and Hong Kong from their other major trading partners using data from UNCOMTRADE, estimate the three indexes of statistical discrepancy similar to what we did in eastbound trade. The results are listed in Table 8.

Similar to China-US west bound trade, seems there are consistent under invoice for China's imports, especially before 2000¹⁹. Most major trading partners reported exports consistently larger than China and Hong Kong reported imports from them. Singapore and Israel, in particular, reported exports significantly higher than China and Hong Kong reported imports during the whole period. The pattern of discrepancies is quite similar for EU15, Japan and the United State, and the magnitude is relatively small, indicating the quality of data reported in those routines are relatively better than other routines. Particular large positive discrepancies appear with some large developing countries, such as Mexico, Saudi Arabia, South Africa, Russia, Philippines and other reporting partner countries, while the magnitude of discrepancies is much smaller when aggregate across all partners, implying misreported country of origin for Chinese imports may be also one of the major causes of the inconsistencies between China & Hong Kong reported imports and partner country reported exports.

In both direction of trade flows, some of the estimated discrepancies with partner reported trade data may be easy to explain such as with Netherlands (transshipped to other EU countries) and Panama (a large portion of China's export there may actually went to the United States), because they are also world center of entrepôt trade. But with many of the other partners may be caused by very different reasons such as smuggling (Russia and some large developing countries), under-invoice (incentives in particular sectors), therefore, further decomposition of the overall discrepancies into their sources at data collection is in order, which may provide some useful hints to identify the major factors underlying the growing discrepancies.

IV. Decomposition of eastbound discrepancies by subcategories of flows

In Chinese export statistics, China Customs asks traders to declare both a "country of departure", which refers to the next stop exported goods arrive at after they depart a Chinese port (not necessarily the final destination country), and "countries of consumption", which refers to the final destination country where goods will be consumed. Based on such information, China's exports to the United States can be subdivided into three categories:

- a. The United States is both "country of departure" and "country of consumption." These represent direct exports from China to the United States, e.g. shipments which travel non-stop from Shanghai to San Francisco;

¹⁹ Please note the import data used here to calculate the measure of discrepancies are valued at cif price, which is different with the data used in calculating the measure of discrepancies with the United States reported in tables 6 and 7, therefore, a 5% or less positive discrepancy in the compiled mirror trade statistics still indicates China & Hong Kong reported imports is less than partner reported exports.

- b. The “country of departure” is Hong Kong but “country of consumption” is the United States, which is product shipped to the United States via Hong Kong;
- c. The “country of departure” is a third country other than Hong Kong, and the “country of consumption” is the United States.

As has already been mentioned, Hong Kong’s statistical authority reports both Hong Kong’s domestic exports (goods made in Hong Kong) and Hong Kong re-exports for other countries, which refers to products which clear Hong Kong customs as imports and are then re-exported. These products undergo Hong Kong Customs valuation twice, at the time of importing and at the time of re-exporting, with the difference in valuation being the “Hong Kong markup.” In the case of transshipments through Hong Kong (goods passing through Hong Kong ports without clearing Customs), only weight data are reported, not value, so that Hong Kong data on transshipment is reported in the aggregate, in metric tons, with no commodity breakdowns.

There is a question as to whether category b. in China Customs data reflects re-exports through Hong Kong (goods passing through Hong Kong Customs) or transshipment (goods passing through Hong Kong ports but not through Customs). The most straightforward interpretation is that category b reflects transshipments. This is because the “country of consumption” in most cases will be the same as the first country where the products clear customs, and thus re-exports would be recorded in Chinese data as exports to Hong Kong as country of consumption, rather than exports to the United States. These are the transactions that have traditionally been assigned the leading role in the discrepancy. Since the goods usually are handled by a Hong Kong middleman, the Chinese exporter may not in fact know the final destination. If the exporter in fact knows that the final destination is the United States, but the shipment passes through Hong Kong for logistical reasons, it is more likely to have a through bill (i.e. be a transshipment) in order to avoid the trouble and expense of clearing Hong Kong customs. However, this interpretation may not always be reliable. If some Chinese exporters may confuse the categories of re-export and transshipment through Hong Kong in their reporting, so that some re-exports may in fact generate type b statistical records. As we shall see, there are some features of the data that lend credence to this possibility.

In summary, we identify five possible trade flows in the data from China and Hong Kong Customs and designate them as follows:

- C1. China’s direct exports to the United States;
- C2. China’s reported exports to the United States via Hong Kong;
- C3. China’s reported exports to the United States via third countries other than Hong Kong (C1-C3 correspond to a – c above);
- C4. Hong Kong’s reported domestic exports to the United States; and
- C5. Hong Kong’s reported re-exports of goods of Chinese origin to the United States.

As we discussed earlier, based on U.N. guidelines, U.S. reported imports from China include goods of Chinese origin, whether directly shipped from China or indirectly shipped from Hong Kong and other countries, while U.S. reported imports from Hong Kong only include goods originated from Hong Kong. Official U.S. trade data as reported only identify

countries of origin. However, the detailed U.S. import records we have obtained from U.S. Census, which cover all U.S. imports from China during 1995-2005, allow us to identify ports of shipment, as well as whether the goods entered into commerce (cleared customs) in a third country en route to the United States. Supplementing these with the publicly reported official data on U.S. imports from Hong Kong, we can identify the following five categories in U.S. data:

- U1. Shipment to the United States directly from ports within China;
- U2. Shipments to the United States from China, but last port of departure is Hong Kong, and the goods did not enter into commerce in Hong Kong (Hong Kong transshipment);
- U3. Shipment to the United States from China, but the last port is in a third country other than Hong Kong;
- U4. U.S. imports of Hong Kong origin (from the official published data);
- U5. Shipment to the United States from China of goods which have entered commerce in Hong Kong and for which the last port of departure is Hong Kong, i.e. Hong Kong re-exports.

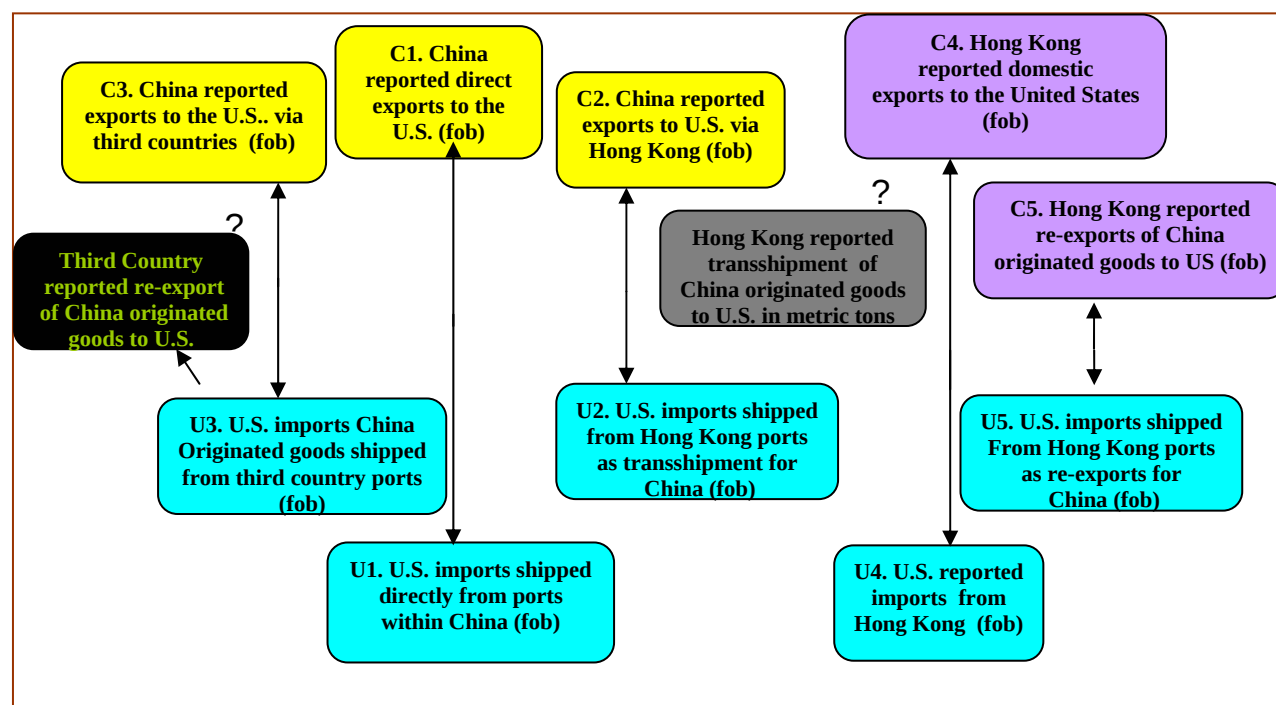
Adopting the simplest interpretation of C2 above, there is a one-to-one correspondence between C1-C5 and U1-U5 in that order, which yields five mirrored relationships as portrayed in figure 5.

There are two additional boxes in the figure. The grey box with a question mark indicates transshipment through Hong Kong as reported in the Hong Kong cargo data. As noted above, since these data are only available in tons rather than in values and are not identified by commodity, they cannot be easily entered into the analysis. The black box with a question mark represents goods of Chinese origin re-exported through third countries. If we interpret C3 as being transshipment only and U3 as including both transshipment and re-export, then there is potentially a missing piece (re-exports by third countries other than Hong Kong) as represented by the black box.

Tables 9 and 10 contain an analysis of the data as per the five-way mirror. Of the total discrepancy in 2005, amounting to \$46.3 billion, \$36.5 billion, or 79.9 percent of the total, consists of the discrepancy for direct trade from China to the United States.²⁰ This compares with a share of direct trade in the total China-Hong Kong exports to the United States of 68.5 percent (according to China-Hong Kong data) or 70.6 percent (as per U.S. data), indicating that the degree of underreporting in China-Hong Kong export records (or over reporting in U.S. import records) is above-average.

²⁰ In US shipping data, direct imports from China can be further break down into three parts: 1. Shipment to US from a know ports within China; 2. The goods enter commerce in China, shipped from an unknown ports believed within China, and 3. US imports shipped from an unknown country, and the last ports before the goods shipped to US is a ports outside China, but for some reasons, US custom classified the imports is from China.

Figure 5 Mirror Relation among China and Hong Kong Officially Reported Trade Statistics and U.S Unpublished Shipping Data - *Eastbound Flows*



The discrepancy in trade passing through countries other than Hong Kong is very large. In 2005, imports from China passing through third countries reached \$11.1 billion per the U.S. Census data, over 20 times larger than the \$459 million reported by China Customs. It is the second-largest source of the discrepancy in dollar terms, accounting for 23.0 percent of the discrepancy as compared to only 4.4 percent of the imports, using U.S. data. This is in part explained by the usual asymmetry in information between importers and exporters, with importers knowing more about ultimate origins than exporters about final destinations. Moreover, China's relations with third-party reporters other than Hong Kong are likely to be weaker than those with Hong Kong.

The data in Table 9 also show that the three types of Hong-Kong based transactions as a group account for a smaller share of the discrepancy than they do of the total trade. Using U.S. data as the denominator, the three Hong Kong related trade flows account for 25.1 percent of U.S. imports from China-Hong Kong in 2005 but only a small and in fact negative discrepancy (-\$362 million, or 0.5 percent of the total.) Concealed within this total are several larger discrepancies. U.S.-reported imports of Hong Kong domestic goods are almost twice those reported by the Hong Kong authorities. The large negative value of the discrepancy in transshipments more than offsets the positive discrepancy in re-exports. This may be indirect evidence for the hypothesis advanced above that some exports reported to China Customs as "via Hong Kong" may in fact represent re-exports rather than transshipments.

V. Preliminary econometric analysis of the discrepancies in eastbound trade

5.1 The basic model

We apply a simple linear model of the discrepancy between the values of eastbound trade as reported by U.S. import data vs. those reported by China and Hong Kong. The model is estimated on a panel of 960 observations on data at the HS2 (chapter) level from 1996 to 2005.²¹ It can be stated as follows, with time and chapter subscripts omitted for convenience:

$$\text{Discrepancy} = \beta_0 + \beta_1 * \text{processing trade share} + \beta_2 * \text{state-owned enterprise share} + \beta_3 * \text{Hong Kong re-export share} + \beta_4 * \text{Hong Kong domestic export share} + \beta_5 * \text{U.S. import share passing through third countries} + \beta_6 * \text{U.S. re-exports as a share of U.S. exports} + \beta_7 * \text{time} + \beta_8 * \text{valuation indicator} + \beta_9 * \text{homogeneity} + \beta_{10} * \text{U.S. import tariffs} + \epsilon_{it}$$

In some specifications, the model is estimated using fixed effects for HS2 chapters. In others, it is estimated using weighted data, with the weights being the mean of (China + Hong Kong) f.o.b. exports and U.S. f.o.b. imports.²² In other cases, the model is estimated with some outliers omitted.

For each variable, a positive sign on the corresponding coefficient means that an increase in the variable is associated with the importer (United States) reporting relatively larger trade values, while a negative sign is associated with the exporters (China and Hong Kong) reporting relatively larger trade values. Because the analysis deals with one bilateral relationship, it is not designed to reveal whether the estimated effects have to do with importers in general and exporters in general, or with the United States as a particular importer and China and Hong Kong as particular exporters. A multilateral analysis would be required to reveal this.²³

5.2 Data for dependent and explanatory variables

The measure of the discrepancy used as the dependent variable is simply ER as defined in equation (2) in section 2.2. The underlying data come from original national sources (Customs General Administration of China, Census and Statistical Department of Hong Kong, and the version of U.S. Customs data maintained at the U.S. International Trade Commission). The data, available at a fine level of disaggregation (HS 6, 8, or 10) have been aggregated to HS2, using the “customs value” definition of U.S. imports to place data from all sources on a comparable F.O.B. basis. HS chapters 98 and 99 were deleted from the sample, since their definition and coverage are not standard across countries.

²¹ Not all variables are currently available for 1995. There are only 96 chapters in HS 1-97 because one chapter (HS 77) is reserved for future use.

²² We also experimented with weighting schemes using U.S. imports, or China + Hong Kong exports, as weights. All of the weighting schemes yield comparable results.

²³ In preliminary work, we experimented with using the absolute value of the discrepancy as a dependent variable, based on the idea that causes of bad trade data might induce random errors in either direction. We found that using these data, we obtained much better results using the actual discrepancy. This means that the difference between the importer and the exporter does matter, whatever that means in the context of these particular trading partners.

In characterizing the data below, means and standard deviations calculated by HS chapter is used. For most of the variables in the data set, the variation by chapter exceeds the variation by year. In cases where we have so far only generated the variable for a single year (2000), that year's values are presented.

The share of processing trade, and the share of trade by state-owned enterprises are calculated from China Customs trade statistics. China Customs categorizes the trade data by type of firm trading, type of customs regime, and type of incentive scheme (such as special enterprise zones (SEZs), economic and technology development zones (ETDZs), etc. "Processing trade" represents the sum of the two customs regimes "process and assembly" and "processing with imported materials." Defined this way, for a typical observation in our data set (an HS2 chapter in a given year) over 98 percent of exports is either "processing trade" or "normal trade," the two most common customs regimes. Similarly, about 91 percent of exports are either state-owned enterprises or foreign-invested enterprises (which includes both joint venture and wholly foreign invested firms), the two most common types of exporting firms. Thus, processing trade is high whenever normal trade is low, and vice versa, and similarly for exports of state-owned enterprises and foreign-invested enterprises. Not surprisingly, when we did the same analysis using normal trade instead of processing trade, or foreign-invested enterprises instead of state-owned enterprises, in most cases we found similar results with the opposite sign.

Some chapters with a particularly high share of processing trade in Chinese exports to the United States over 1996-2006 are HS 86 (shipping containers and railway equipment), HS 18 (cocoa), HS 37 (photographic and cinematographic goods), HS 85 (electronics), and HS 49 (printing), for all of which the share of processing trade exceeds 90 percent on the average. On the low end, with an average share of processing trade below 1 percent, are HS 01 (live animals), HS 10 (cereals), HS 31 (fertilizers), HS 04 (dairy products), and HS 80 (tin and articles thereof).

The share of China's exports to the United States accounted for by SOEs is particularly high in HS 47 (pulp and paper), HS 24 (tobacco), HS 80 (tin and articles thereof), HS 1 (live animals), and HS 75 (nickel and articles thereof), ranging from 80-98 percent, and particularly low in HS 86 (shipping containers and railway equipment), HS 84 (machinery and computers), HS 17 (sugar and candy), HS 49 (printing), and HS 64 (footwear), ranging from 7 to 24 percent.

Hong Kong re-exports of Chinese goods to the United States, and of Hong Kong domestic exports to the United States, is expressed as a share of China's and Hong Kong's total exports to the United States and are derived using Hong Kong's and China's data together. The share of U.S. imports from China and Hong Kong passing through third countries other than China and Hong Kong is based on unpublished data of the U.S. Census Bureau.²⁴

²⁴ While we can identify the third countries in these data, we do not know whether the third countries consider the shipments to be re-exports or goods in transit.

The share of China's exports to the United States accounted for by Hong Kong's re-exports is particularly high for HS 97 (art and antiques), HS 49 (printing), HS 91 (clocks and watches), HS 43 (fur and skins) and HS 71 (jewelry and precious stones), ranging from 58 to 77 percent. The Hong Kong re-export share is particularly low for HS 86 (shipping containers and railway equipment), HS 31 (fertilizers), HS 27 (oil), HS 47 (wood pulp), and HS 02 (beef), ranging from 0.1 to 10 percent. The highest shares of Hong Kong domestic exports in total China-Hong Kong exports to the United States are for fabrics and apparel (HS 60, 61, 62), cotton (HS 52), and miscellaneous edible preparations (HS 21), ranging from 31-48 percent. There are seven HS chapters for which there are no domestic exports from Hong Kong to the United States in the period in question.

The share of China-Hong Kong exports to the United States passing through third countries is particularly high for HS 50 (silk), HS 97 (art and antiques), HS 37 (photographic or cinematographic goods), HS 15 (fats and oils), and HS 51 (wool), ranging from 17 to 46 percent. Particularly low shares of travel through third countries, all less than 1.5 percent, occur for HS 47 (wood pulp), HS 2 (beef), HS 1 (live animals), HS 64 (footwear), and HS 61 (knit apparel).

The measure of U.S. re-exports is the ratio, by HS2 and year, of U.S. re-exports to U.S. general imports, for all trading partners taken together. Because U.S. data identify the destination of re-exports but not the source of corresponding imports, it is not possible to measure directly the specific propensity of U.S. imports from China and Hong Kong to be re-exported. The variable does, however, show a great deal of variation across chapters and is increasing over time, so it probably does capture some of the general tendency of goods to be re-exported. The time variable captures the general trend of the discrepancy to increase over time, in the direction of relatively larger U.S. data, for many of the HS chapters.

The annual average share of all U.S. general imports, from all countries, which are re-exported, is highest in HS 97 (art and antiques), HS 71 (gems and jewelry), HS 85 (electronics), HS 08 (fruit and nuts), and HS 12 (oilseeds and miscellaneous vegetable products), ranging from 10-35 percent. Relatively low degrees of U.S. re-export, in all cases less than 1 percent, are observed for HS 27 (oil), HS 1 (live animals), HS 61 and 62 (apparel), and HS 79 (zinc and articles thereof).

The indicator of valuation problems is simply the value share, in each HS chapter, of U.S. imports for which no unit of measurement is defined. For goods which are measured with units (e.g. kilograms, square kilometers, barrels, number of autos, etc) trade statistics report both a value and a quantity. Dividing the value by the quantity gives a value per unit, or unit value, which can be interpreted like a price. Having past data on unit values can give the customs authorities and indication of suspicious undervaluation or overvaluation. When unit values are absent, the possibility of manipulating the valuation is likely to be greater. For example, for most of the transactions in HS 97, art and antiques, there are no unit values, and thus no convenient bases for comparison.

The value share of goods for which there were no unit values in 2000 was 99.9 percent in HS 97 (art and antiques), and ranged from 48-89 percent for HS 67 (feathers, artificial flowers,

and human hair), HS 90 (precision instruments), HS 94 (furniture and furnishings) and HS 95 (toys, games, and sports equipment). There were 49 chapters of the HS for which all U.S. import data contained unit values in 2000.

The measure of homogeneity describes whether each HS chapter contains mostly similar goods or a variety of goods. It may be that complicated goods are more subject to classification and valuation errors. It is defined in a manner similar to the Herfindahl-Hirschmann index in industrial organization, i.e.

$$Homogeneity_i = 100 * \sum_i s_{it}^2$$

where s_{it} represents the value share of each HS-10 commodity in U.S. general imports from the world within each HS2 chapter. The homogeneity index takes on values close to 1 for chapters with homogeneous products and values close to 0 for chapters with differentiated products. The index is relatively high for primary goods such as basic metals and grains, and relatively low for categories like electronics, machinery, and chemicals.

In 2000, the homogeneity index was highest for HS 80 (tin and products), HS 75 (nickel and products), HS 97 (art and antiques; but this is misleading since it simply reflects the lack of categories), HS 47 (wood pulp) and HS 75 (zinc and products), ranging from 37-53 percent. Low homogeneity scores on the order of 1-2 percent were observed for HS 85 (machinery and computers), HS 73 (articles of iron and steel), HS 90 (instruments), HS 72 (iron and steel), and HS 62 (non-knit apparel).

Both the valuation indicator and the homogeneity index are in principle measurable in both the time dimension and by HS2. At this point in the research, we have so far measured them only for a single year, the year 2000, approximately in the middle of our sample period. Thus we capture the variation across chapters but not across time. This has the consequence both that the variables drop out of our fixed-effects specifications (though we will address this in a revision) and that our current results for these variables may not generalize to the situation in which we measure them in a full panel ($i \times t$). We suspect that the time variation in these variables is small relative to the cross-sectional variation, but this remains to be confirmed.

The tariff variable for the United States is generated as the ratio of calculated duties collected to U.S. imports at customs value. This is in effect the same as trade-weighting the tariff. The variable as generated is likely to understate the tariff-equivalent effects of U.S. tariff-rate quotas in some agricultural commodities; at present we have made no adjustment for this.

The annual average peak tariffs in the U.S. data, ranging from 12-16 percent ad valorem, are for HS 60-62 (fabrics and apparel), HS 24 (tobacco) and HS 55 (man-made staple fibers). 22 chapters have annual average HS duties collected of less than 1 percent ad valorem, and 11 have duties of less than 0.2 percent ad valorem.

Unfortunately, there are no reliable measures of trade passing “in transit” (transshipped, not re-exported) from China to the United States through Hong Kong. We looked at several

tantalizing, but inadequate measures. Hong Kong Customs provide aggregate figures on the share of total tonnage which is shipped in transit per year. For such shipments, values and commodity categories are not observable. China Customs data identify shipments for which the consignment is Hong Kong but the ultimate destination is the United States. However, it is not possible to tell whether merchandise consigned for Hong Kong clears customs in Hong Kong (i.e. is a re-export) or simply passes through physically (i.e. is transshipped/in transit). Thus, it is not possible to test directly the hypothesis that discrepancies related to goods in transit may be different from either re-exports on the one hand or “pure” direct shipments on the other hand. Conceptually, these goods are included in our measure of direct shipments from China to the United States, but this should be interpreted with caution. We plan to use the unpublished U.S. shipping data obtained from U.S. census recently to further explore this issue in our next revision.

Descriptive statistics for the variables used in the analysis are presented in Table 11.

5.3 Analytical Challenges

There are some significant issues that arise in the analysis of the data. The reader will note that many of the variables are expressed as ratios to total imports or exports, using either China + Hong Kong data, or U.S. data, as the denominator. Of course, we do not know what the true values of the trade flows are, only what either side reports; this is the whole point of the analysis. Using either side’s data as the denominator of a ratio is likely to introduce measurement error into the measured dependent variables, and possibly bias. There are a number of potential ways of handling this problem, ranging from simple ones (use the other side’s value as the denominator, where this can be done: generally this only makes sense if the numerator data refers to Hong Kong) to complex ones, such as iterating back and forth between estimates of the “true” values and new estimates of the independent variables. The present method simply measures each ratio at the point in the data where it is most naturally defined.

The second issue is that there is clearly a great deal of difference between the discrepancies and their behavior in one sector and another. This is plainly visible in the raw data, and is also apparent in that the goodness-of-fit measures of the fixed-effects estimates are so much higher than the comparable OLS estimates. Moreover, some of the worst valuation problems are in sectors that account for very little trade according to either side’s data. This raises the question of whether the purpose of the analysis is to find the main determinants of the \$46 billion discrepancy, in which case it makes sense to use data weighted by the size of the trade flows, or whether the purpose is to identify the characteristics of the chapters with the worst discrepancies, in which case it makes sense to use un-weighted data. We use both approaches.

In order to provide an additional test for robustness, we perform an additional set of estimates systematically excluding outliers using a method similar to that in Leamer (1985, chapter 5). We identified all the chapters for which the values of the independent variable or any of the dependent variable were outliers, in the top or bottom 3. This amounted to 28 of the 96 chapters. We then excluded each of the chapters from the sample, and identified as outliers

cases in which the exclusion of the chapter led to a substantial change in any of the regression coefficients. This method identified four sectors as outliers:

HS 24, tobacco and tobacco products (high tariffs); HS 67, products made of feathers or human hair, and artificial flowers (few unit values); HS 86, railway and related goods (these are mostly shipping containers in HS 860900 which are usually not recorded as U.S. imports because they are “instruments of trade”, thus they have a large discrepancy in the opposite direction (exporters’ data is larger) and whose exports from China are heavily recorded as processing trade of foreign-invested enterprises), and HS 97, art and antiques (virtually no unit values, and a very high rate of transshipment through Hong Kong)

We added one additional chapter, HS 93 (armaments and ammunition), which has a very large discrepancy (importers’ values larger) even though it did not have a very large effect on the regression results when excluded. Anecdotal evidence indicates that Chinese export data may frequently record in HS 98 transactions which U.S. import data record in HS 93.

Estimates presented below as being “without outliers” exclude chapters 24, 67, 86, 93, and 97 as a group. The trade in these chapters accounts for less than 1 percent of recorded China/Hong Kong exports to the United States, and less than 2 percent of recorded U.S. imports from China and Hong Kong.

5.4 Primary results

Table 12 presents the results of regressions using the full set of available variables, while Table 13 presents the results of fixed-effects specifications which (at present) exclude the valuation and homogeneity variables, and comparable specifications using the same set of regressors for comparison purposes. The results confirm the impression that both the size of the discrepancy and the variables which correlate with the discrepancy vary greatly from sector to sector. For one thing, the inclusion of sector-specific intercepts in the fixed-effects specifications soak up a good deal of variation in the data, increasing R^2 from .25 to .77 in the full sample and .22 to .73 in the sample omitting outliers. In OLS, omitting outliers while simultaneously weighting the data improves the goodness-of-fit to about .40. The two procedures we used to vary the relative importance of the different chapters, weighting and the omission of outliers, often have the effect of changing the estimated signs of the coefficients, often from significantly positive to significantly negative. All this suggests that the general determinants of the currently \$46 billion discrepancy are, in some respects, different from the causes of the discrepancy for some of the smaller sectors with particularly bad data.

The robust determinants of the discrepancy, those which show up with the same sign and significant in most or all specifications, are as follows:

Valuation problems: For products with no recorded unit values, which might be easy to undervalue, U.S. import data are significantly larger than China’s export data. This is true even after we exclude the outliers, which include HS 97 (art and antiques) and HS 67 (feathers, artificial flowers, human hair and wigs) which are especially difficult to value.

This is an interesting result and suggests further exploration into the extent that mis-valuation may be attributed to deliberate strategies on the part of traders.

U.S. import tariffs: A one-percent increase in the U.S. ad valorem tariff is associated with a decrease in the discrepancy score of around 0.7 to over 2.4. This suggests that the exporters' numbers are relatively high when U.S. import tariffs are high. This pattern could be explained if exporters of high-tariff goods record relatively high values to the exporting authority (perhaps to report high revenues or profits in the enterprise) and relatively low values to the importing authority to avoid the tariff. It could also be that the higher scrutiny given by U.S. customs to revenue-producing shipments leads to an improvement in the data.²⁵

U.S. re-exports as a share of U.S. imports: A higher share of U.S. re-exports is associated in all specifications with higher China-Hong Kong data relative to U.S. data. This does not have an obvious explanation. One possibility is that exporters record as exports to the United States goods which are ultimately re-routed to third countries, and that the same goods are treated in the United States as goods in transit and not recorded as statistical trade. There are other, more complex, possibilities

Time: Even after controlling for all the other variables in the analysis, the tendency of U.S. import data to grow larger than China/Hong Kong export data shows a marked time trend, with the discrepancy index increasing by 1.2 to 2.9 points every year for reasons not related to the time trends of the other variables.

The results for type of Chinese customs regime, type of enterprise, variables pertaining to Hong Kong, third-country U.S. import share, and homogeneity are so far not robust with respect to specification.

VI. Conclusion and directions for future work

Our results both for valuation problems and for U.S. import tariffs, which can be avoided by under-valuation, suggest that reporting of different values to importing and exporting authorities might be a significant source of discrepancies in trade data. The misreporting of origins and destinations due to goods passing through many countries is also likely to be important. The fact that we find some variables to be very important in some specifications but less important or having the opposite sign is not proof that those variables are not important. It is more likely to mean that identifying how they are important requires a deeper analysis than we have done so far.

The most fruitful extension of this work is likely to be the extension of the analysis to the five-way mirror made possible by the detailed customs data of the three reporters. The sources of the discrepancies in direct trade, in third-country trade, and in the various Hong Kong -related trade flows are likely to be different, as are the incentives either to misreport

²⁵ We are indebted to Shang-Jin Wei for this idea.

each one or misattribute one for the other. A fuller behavioral model of the reporting practices of traders would be useful to this work.

The econometric analysis can also be done on the westbound trade (United States as exporter, China and Hong Kong as importers). Even though the overall discrepancies are much less severe in the westbound trade, the pattern of existing discrepancies may show some commonalities. The analysis already presented can be done at a higher degree of disaggregation, and the definitions of some of the variables improved. We also need to look further into the possibility that re-exports, which fully enter and leave the customs territory of Hong Kong and are often subject to a markup in price, may be confused with transshipments, which are simply moved from vessel to vessel without clearing customs.

We have taken preliminary steps to analyze the data for China and multiple trading partners. Using multilateral data can help to show which sources of the discrepancy are associated with particular roles in trade (importer, exporter, or re-exporter) and which are associated with particular countries or customs territories in different geographical situations or at different stages of economic development.

Persons involved in customs agencies and private import-export operations are likely to have insights into the matters analyzed in this paper that may confirm, contradict, or otherwise place in a new light the results we have gotten by purely statistical means. It would be very useful to compare the insights of people with operational contact with trading operations with those which appear to be emerging from the present analysis.

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Table 1. Trade and Cargo Shipping Statistics Reported By China and Hong Kong, 1995 to 2004

Section A China's exports		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
China Reported Exports (fob)	Hong Kong as final destination	35,988	32,904	43,798	38,785	36,917	44,530	46,489	58,465	76,289	100,878
	Hong Kong as consigned destination	74,493	64,209	77,852	76,547	72,674	82,409	83,423	99,295	123,600	154,885
	Export via Hong Kong (Transshipment)	38,505	31,305	34,054	37,762	35,757	37,879	36,934	40,829	47,312	54,007
Hong Kong Reported Imports	Hong Kong total Imports from China (cif)	69,736	73,758	78,581	74,966	78,312	91,771	87,445	91,944	100,889	117,909
	Hong Kong-China FOB/CIF ratio	0.9919	0.9919	0.9919	0.9919	0.9929	0.9938	0.9901	0.9912	0.9921	0.9927
Adjustment	Hong Kong total Imports from China (fob)	69,171	73,160	77,944	74,359	77,756	91,202	86,579	91,135	100,092	117,048
	Statistical discrepancy (Million U.S. Dollars)	5,321	-8,952	-92	2,188	-5,082	-8,793	-3,155	8,160	23,508	37,837
	Statistical discrepancy (Percent)	7.1	-13.9	-0.1	2.9	-7.0	-10.7	-3.8	8.2	19.0	24.4
Cargo Shipping, 1000 Metric Ton	Hong Kong Imports ¹ from China	5,330	5,177	4,666	4,465	3,715	19,334	22,422	24,983	24,723	22,313
	Inward transshipment ² for China	5,252	4,304	4,409	4,154	5,158	10,805	10,958	13,519	17,431	21,417
	Total Cargo Discharged	10,582	9,481	9,075	8,619	8,873	30,139	33,380	38,502	42,154	43,729
	Inward Transshipment as % of total	49.6	45.4	48.6	48.2	58.1	35.9	32.8	35.1	41.4	49.0
Section B China's imports											
Hong Kong Reported Exports (fob)	Re-export to China for third countries	49,644	54,015	57,334	52,597	51,455	62,742	63,672	73,326	90,637	109,225
	Domestic Export to China	8,216	7,967	8,249	7,239	6,498	6,951	6,353	5,305	4,720	4,866
	Total Exports to China	57,859	61,982	65,583	59,836	57,953	69,693	70,025	78,631	95,357	114,091
China Reported Imports(cif)	Imports originated from Hong Kong	8,599	7,839	6,990	6,667	6,893	9,431	9,420	10,741	11,119	11,800
	Total imports via Hong Kong	60,165	55,046	53,808	52,762	62,391	76,384	82,496	104,979	132,064	166,529
	Imports originated from third countries	51,566	47,207	46,818	46,096	55,497	66,952	73,076	94,237	120,945	154,729
Adjustment	Hong Kong-China FOB/CIF ratio	0.9919	0.9919	0.9919	0.9919	0.9929	0.9938	0.9901	0.9912	0.9921	0.9927
	Total imports via Hong Kong (fob)	59,678	54,600	53,372	52,335	61,948	75,910	81,680	104,055	131,021	165,314
	Statistical discrepancy (Million U.S. Dollars)	1,819	-7,383	-12,211	-7,501	3,994	6,217	11,655	25,424	35,664	51,222
	Statistical discrepancy (Percent)	3.0	-13.5	-22.9	-14.3	6.4	8.2	14.3	24.4	27.2	31.0
Cargo Shipping, 1000 Metric Ton	Hong Kong Exports ¹ to China	4,924	5,638	5,944	4,841	2,606	14,830	13,013	12,318	13,368	13,653
	Outward Transshipment ² to China	4,190	4,486	4,882	3,883	3,704	15,655	18,776	21,673	23,838	24,680
	Total cargo loaded	9,114	10,124	10,826	8,724	6,310	30,485	31,789	33,991	37,205	38,333
	Outward Transshipment as percent of total	46.0	44.3	45.1	44.5	58.7	51.4	59.1	63.8	64.1	64.4

Data source: All China reported trade data are from China Customs Authority; all Hong Kong reported trade data are from Hong Kong Census and Statistics Department. Port Cargo data are from Hong Kong Census and Statistics Department. The cargo statistics from 1995 to 1999 refer to HK's seaborne cargo statistics, while those for 2000-2004 refer to Hong Kong's seaborne and river port cargo statistics. The river cargo statistics have been compiled in recent years given the growing importance of the river trade between Hong Kong and the mainland of China, particularly the Pearl River Delta (PRD) region. Port cargo movements between HK and places other than the mainland of China and Macao are all classified as seaborne cargo movement.

Note:

1. Goods exported/re-exported from Hong Kong are classified as direct shipment, whereas goods shipped in Hong Kong under a through bill of lading are classified as transshipment. Goods in transit through Hong Kong are not included in the statistics.

2. It refers to cargo that is consigned under a through bill of lading from a place outside Hong Kong to another place outside Hong Kong but is or is to be removed from one vessel and either returned to the same vessel or transferred to another vessel with Hong Kong waters.

Table 2. Trade and Cargo Shipping Statistics Reported By China and Hong Kong, 1995 to 2004

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Section A China's and Hong Kong's exports to the United States										
<i>Trade Statistics</i>										
Hong Kong Domestic exports	7,918	6,964	7,114	7,081	6,620	6,987	6,102	5,374	5,025	4,961
Hong Kong re-export	29,860	31,335	33,760	33,551	34,731	39,924	36,183	37,318	36,610	38,901
China reported exports via Hong Kong	14,265	12,458	14,110	15,774	14,699	14,638	13,899	15,354	16,308	19,020
Total exports via Hong Kong	52,043	50,757	54,984	56,406	56,051	61,549	56,183	58,045	57,943	62,882
China reported as % of total	27.4	24.5	25.7	28.0	26.2	23.8	24.7	26.5	28.1	30.2
<i>Cargo Shipping Statistics</i>										
Hong Kong Exports ¹ to US	5,566	5,286	5,483	5,893	7,083	7,781	7,287	7,374	6,663	7,053
Outward transshipment ² to US	2,024	2,282	2,519	2,495	2,800	2,979	3,210	3,668	3,725	4,474
Total Cargo loaded for US	7,590	7,568	8,002	8,388	9,883	10,760	10,497	11,042	10,388	11,527
Outward Transshipment as percent of total	26.7	30.2	31.5	29.7	28.3	27.7	30.6	33.2	35.9	38.8
Section B China's and Hong Kong's imports from the United States										
<i>Trade Statistics</i>										
Hong Kong Import from US	14,876	15,653	16,195	13,756	12,706	14,478	13,456	11,729	12,679	14,380
Hong Kong re-export to China for US	4,982	5,866	5,965	5,294	5,373	6,109	6,466	6,197	6,238	5,787
China reported import via Hong Kong	4,877	4,565	4,351	4,778	6,397	6,189	6,978	7,018	7,593	7,613
Total imports via Hong Kong	19,753	20,218	20,546	18,534	19,103	20,667	20,434	18,748	20,271	21,994
China reported as % of total	24.7	22.6	21.2	25.8	33.5	29.9	34.1	37.4	37.5	34.6
<i>Cargo Shipping Statistics</i>										
Hong Kong Imports ¹ from US	5,164	5,081	5,486	4,641	3,998	3,785	3,321	3,690	3,441	3,681
Inward Transshipment ² from US	2,158	2,320	2,312	1,973	2,239	2,553	3,015	2,827	3,120	3,997
Total cargo discharged	7,322	7,401	7,798	6,614	6,237	6,338	6,336	6,517	6,561	7,678
Inward Transshipment as percent of total	29.5	31.3	29.6	29.8	35.9	40.3	47.6	43.4	47.6	52.1

Data source: All China reported trade data are from China Customs Authority; all Hong Kong reported trade data are from Hong Kong Census and Statistics Department. All data reported by the United State are from Census Bureau, U.S. Department of Commerce. Port Cargo data are from Hong Kong Census and Statistics Department.

Note:

1. Goods exported/re-exported from Hong Kong are classified as direct shipment, whereas goods shipped in Hong Kong under a through bill of lading are classified as transshipment. Goods in transit through Hong Kong are not included in the statistics.
2. It refers to cargo that is consigned under a through bill of lading from a place outside Hong Kong to another place outside Hong Kong but is or is to be removed from one vessel and either returned to the same vessel or transferred to another vessel with Hong Kong waters.

Table 3. Trade Statistics Reported by China, Hong Kong and the United States and Statistical Discrepancies, 1995-2006(Eastbound, to the US, in Million US dollars)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
US reported imports from China (fob) +	45,555	51,495	62,552	71,156	81,786	100,063	102,280	125,168	152,379	196,699	243,462	287,773
US reported imports from Hong Kong (fob) +	10,294	9,867	10,297	10,538	10,531	11,452	9,650	9,328	8,850	9,314	8,893	7,943
Geographical coverage adjustment for US reported data												
From China -	106	132	145	152	195	216	256	299	369	414	510	648
From Hong Kong -	36	67	50	60	43	35	26	18	24	25	27	16
US reported imports from China & Hong Kong (fob)	55,707	61,164	72,654	81,483	92,079	111,264	111,648	134,180	160,837	205,574	251,818	295,052
Statistical Discrepancy (Million US dollars) -	-4,528	-1,734	1,535	5,538	11,449	15,711	18,023	24,543	29,936	40,148	45,779	47,201
China & Hong Kong reported exports to US (fob)	60,235	62,898	71,119	75,945	80,630	95,553	93,625	109,637	130,901	165,426	206,039	247,851
China reported exports to US (fob) +	24,713	26,709	32,716	37,965	42,016	52,142	54,273	69,951	92,474	124,948	162,900	203,472
Hong Kong reported domestic exports to US(fob) +	7,918	6,964	7,114	7,081	6,620	6,987	6,102	5,374	5,025	4,961	4,856	4,269
Hong Kong reported re-exports to US for China(fob) +	27,604	29,225	31,289	30,899	31,994	36,424	33,251	34,313	33,402	35,518	38,283	40,110
Statistical Discrepancy as % of US reported imports	-8.13	-2.83	2.11	6.80	12.43	14.12	16.14	18.29	18.61	19.53	18.18	16.00
Statistical Discrepancy as % of sum of US, China & Hong Kong reported data, ITC consistency indicators (total)	-7.81	-2.80	2.14	7.04	13.26	15.19	17.56	20.13	20.52	21.64	20.00	17.39
Hong Kong re-export as % of U.S. total imports from China	60.6	56.8	50.0	43.4	39.1	36.4	32.5	27.4	21.9	18.1	15.7	13.9
Goods originated from China as % of total Hong Kong re-export to US	92.4	93.3	92.7	92.1	92.1	91.2	91.9	91.9	91.2	91.3	92.2	92.2

Data source: All China reported data are from China Customs Authority; all Hong Kong reported data are from Hong Kong Census and Statistics Department; all United State reported data are from International Trade Commission Oracle database. The data include HS Chapter 1 to 99.

Note: Geographical adjustments are based on U.S. reported data. China & Hong Kong reported data do not include Virgin Island and Puerto Rico.

Table 4. Discrepancy Indexes of Trade Statistics Reported by China, Hong Kong and United States in Major HS sections, 1995-2006 (export to the United States, in percent)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Statistical Discrepancy as % of U.S. reported imports ^a												
Live animals and animal products	-3.4	6.1	20.3	17.3	15.2	21.2	29.4	23.7	25.4	23.9	18.5	33.9
Vegetable products	5.1	14.4	21.0	25.6	30.9	34.3	26.6	27.8	21.3	24.5	23.8	14.5
Animal and vegetable fats and oils	9.8	44.4	8.9	17.2	-4.9	20.5	11.7	-1.1	6.7	2.5	-4.5	11.3
Prepared foodstuffs, beverages and tobacco	-4.7	1.4	-3.4	-6.6	1.5	-22.8	-16.7	-16.1	-10.2	3.5	0.9	-16.0
Mineral products	0.5	4.4	15.1	5.7	11.0	7.5	8.6	9.2	-5.4	12.5	-2.4	-9.1
Products of the chemical or allied industries	-10.1	0.5	-1.3	0.1	7.3	0.5	-1.1	-5.6	-6.0	-4.6	0.7	2.1
Plastics and rubber	-24.3	-24.0	-20.5	-24.9	-19.2	-16.7	-6.2	0.5	7.9	10.3	13.3	11.0
Raw hides and skins, leather, fur skins	-18.7	-14.8	-5.7	-2.3	-1.7	0.2	0.7	4.2	7.7	8.4	11.9	13.9
Wood and cork articles	-29.9	-13.6	-3.7	11.1	14.2	15.2	16.2	14.3	15.8	12.0	13.9	11.7
Wood pulp, paper and paperboard articles	10.3	17.0	10.2	14.4	18.0	23.4	23.0	24.0	26.6	26.0	28.2	25.9
Textiles	-0.3	1.2	5.2	3.8	4.7	3.5	4.9	7.0	8.1	10.5	0.1	-2.0
Footwear, headgear and umbrellas	-29.8	-23.4	-16.4	-0.4	7.6	7.9	14.4	18.3	20.6	21.4	23.2	24.5
Articles of stone, plaster, cement, ceramic & glass	-6.1	7.9	15.9	20.0	29.6	37.3	39.7	41.0	39.3	35.1	32.5	29.2
Pearls, precious stones and metals	10.5	14.5	13.4	11.2	8.7	12.4	9.4	5.2	-0.4	1.1	3.9	4.3
Base metals	-10.5	-6.9	-3.8	-6.9	4.3	5.9	11.4	8.9	11.3	8.8	10.6	7.3
Machinery and mechanical appliances	10.7	6.1	7.0	11.2	25.9	29.9	27.8	27.4	20.1	25.8	24.5	19.8
Electrical machinery and equipment	-7.3	-0.1	5.3	10.9	11.8	10.3	9.8	12.4	11.8	12.8	13.6	12.2
Vehicles, aircraft, vessels and other transport equipment	-88.3	-53.4	-23.9	-41.1	-28.4	7.5	-11.3	-10.5	-34.7	-46.7	-43.0	-35.8
Medical instruments, musical instruments, clocks and watches	-13.8	-11.3	-7.5	-2.7	-2.9	-1.8	-5.3	-3.8	8.6	6.9	-10.4	-22.5
Arms and ammunition	31.2	52.8	49.6	28.0	43.3	68.3	68.8	82.3	86.2	84.1	81.0	78.9
Miscellaneous manufactured articles	-9.7	0.1	5.3	12.8	19.2	22.1	29.0	31.8	36.9	36.7	38.0	38.1
Works of art, collectors' pieces and antiques	41.2	51.7	50.9	65.8	71.2	77.7	79.5	64.0	77.6	63.6	53.1	65.8
Total ^c	-9.7	-4.2	0.7	5.4	11.0	12.7	14.8	17.1	17.4	18.4	17.0	14.9
Statistical Discrepancy as % of sum of US, China & Hong Kong reported data, consistency indicators (total)^b												
Live animals and animal products	-3.4	6.3	22.6	18.9	16.4	23.8	34.4	26.9	29.1	27.2	20.4	40.8
Vegetable products	5.3	15.5	23.5	29.3	36.5	41.4	30.7	32.3	23.8	28.0	27.0	15.7
Animal and vegetable fats and oils	10.3	57.1	9.3	18.8	-4.8	22.8	12.4	-1.1	6.9	2.5	-4.4	12.0
Prepared foodstuffs, beverages and tobacco	-4.6	1.4	-3.4	-6.4	1.6	-20.5	-15.4	-14.9	-9.7	3.5	1.0	-14.8
Mineral products	0.5	4.5	16.3	5.9	11.7	7.8	9.0	9.7	-5.2	13.3	-2.4	-8.7
Products of the chemical or allied industries	-9.6	0.4	-1.3	0.1	7.6	0.4	-1.3	-5.8	-6.0	-4.6	0.6	2.2
Plastics and rubber	-21.7	-21.4	-18.6	-22.2	-17.6	-15.4	-6.0	0.5	8.2	10.9	14.3	11.6
Raw hides and skins, leather, fur skins	-17.1	-13.8	-5.6	-2.2	-1.7	0.2	0.7	4.3	8.0	8.8	12.7	14.9
Wood and cork articles	-26.0	-12.8	-3.6	11.8	15.3	16.5	17.7	15.4	17.2	12.7	15.0	12.5
Wood pulp, paper and paperboard articles	10.9	18.6	10.7	15.5	19.8	26.6	25.9	27.2	30.6	29.9	32.9	29.7
Textiles	-0.3	1.2	5.4	3.9	4.8	3.6	5.0	7.2	8.4	11.0	0.1	-2.0
Footwear, headgear and umbrellas	-25.9	-21.0	-15.2	-0.4	7.9	8.2	15.6	20.2	22.9	23.9	26.3	27.9
Articles of stone, plaster, cement, ceramic & glass	-5.9	8.2	17.2	22.2	34.7	45.8	49.5	51.5	48.8	42.6	38.8	34.2
Pearls, precious stones and metals	11.1	15.6	14.3	11.8	9.1	13.2	9.9	5.4	-0.4	1.1	3.9	4.3
Base metals	-10.0	-6.7	-3.7	-6.7	4.4	6.0	12.1	9.3	12.0	9.2	11.2	7.6
Machinery and mechanical appliances	11.3	6.3	7.2	11.8	29.7	35.2	32.3	31.8	22.3	29.6	28.0	21.9
Electrical machinery and equipment	-7.0	-0.1	5.5	11.5	12.6	10.9	10.3	13.2	12.6	13.7	14.6	13.0
Vehicles, aircraft, vessels and other transport equi.	-61.3	-42.1	-21.3	-34.1	-24.9	7.8	-10.7	-10.0	-29.6	-37.9	-35.4	-30.4
Medical instruments, musical instruments, clocks and watches	-12.9	-10.7	-7.3	-2.7	-2.9	-1.8	-5.2	-3.8	9.0	7.1	-9.9	-20.2
Arms and ammunition	37.0	71.8	65.9	32.6	55.3	103.8	104.9	139.7	151.3	145.1	136.2	130.3
Miscellaneous manufactured articles	-9.2	0.1	5.5	13.6	21.3	24.8	33.9	37.8	45.3	44.9	46.9	47.1
Works of art, collectors' pieces and antiques	51.9	69.8	68.2	98.0	110.6	127.0	132.0	94.2	126.9	93.2	72.4	98.0
Total ^c	-4.6	-2.1	0.4	2.8	5.8	6.8	8.0	9.3	9.5	10.1	9.3	16.0

Data source: All China reported data are from China Customs Authority; all Hong Kong reported data are from Hong Kong Census and Statistics Department; all United State reported data are from International Trade Commission Oracle database, both exports and imports are measured on fob price. a. Defined in equation (1) of the paper. b. Defined in equation (2) of the paper, which is modified from similar index developed by International Trade Center at UNCTAD/WTO in Geneva c. It includes HS Chapter 1-97.

Table 5 Discrepancy Indexes of Trade Statistics Reported by China, Hong Kong and their Major Partners, 1995-2004 (export to partner countries, in percent)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Statistical Discrepancy as % of U.S. reported imports^a										
Argentina	8.5	5.0	14.5	20.0	20.9	15.3	25.5	37.8	28.4	29.1
Australia	0.7	4.6	0.7	1.5	7.1	11.3	9.3	13.4	14.4	18.0
Brazil	-44.1	-14.1	-17.5	-19.4	-9.4	-6.8	-5.3	-1.7	-3.3	-1.1
Canada	8.8	11.5	18.3	21.3	26.2	28.8	32.0	33.6	39.2	41.4
Chile	-102.6	-66.4	-63.7	-53.3	-51.7	-37.7	-20.6	-18.4	-20.6	-4.0
EU15	4.1	8.5	9.2	10.6	15.4	14.4	14.6	19.0	18.6	21.5
EU10	-17.4	5.8	10.4	21.4	23.2	16.7	23.5	32.1	36.0	34.5
India	4.3	0.1	6.7	8.8	20.7	9.1	14.8	13.1	22.7	18.8
Indonesia	-27.1	-20.3	-39.5	-35.4	-64.3	-63.6	-68.8	-54.9	-66.5	-64.2
Israel	11.7	17.8	16.9	23.3	25.5	28.5	25.0	35.0	15.5	20.9
Japan	2.1	2.9	3.9	1.5	7.9	8.2	6.1	7.1	7.6	9.9
Korea	3.4	7.3	5.2	-5.7	6.5	7.0	1.8	8.5	8.9	6.2
Malaysia	23.5	24.4	19.0	19.2	23.9	25.8	19.6	21.5	16.7	23.0
Mexico	14.7	37.9	40.1	29.5	31.3	24.8	35.0	36.7	57.9	59.2
New Zealand	20.5	24.0	25.6	19.6	28.2	26.7	31.7	33.4	36.6	36.7
Norway	28.1	15.3	-0.6	30.0	34.4	26.2	36.9	58.7	36.7	47.4
Panama	-6176.4	-4514.4	-7333.6	-4495.3	-4358.4	-4813.5	-4644.1	-3105.5	-2920.3	
Saudi Arabia	-45.2	-38.8		-33.9	-34.4	-25.0	-13.5	-10.6	-4.8	
Singapore	12.2	13.5	16.6	9.3	14.5	12.3	14.8	16.1	13.7	15.6
South Africa	-43.9	-38.4	-32.2	-36.5	-24.2	-23.2	-12.4	-4.7	3.1	11.3
Switzerland	15.7	11.7	6.3	10.9	9.2	15.4	18.9	30.4	29.7	17.5
Thailand	2.4	13.0	11.8	17.5	20.8	17.1	16.8		22.0	18.3
United States	-3.2	1.3	5.6	10.3	16.9	18.7	20.3	22.2	22.9	23.8
Venezuela	-188.5	-154.9	-268.4	-163.8	-25.4	-27.6	-31.9	-43.8	-14.5	-38.2
Philippines		-2.7	-3.5	0.4	-6.3	-31.4	-26.2	-33.7	-31.9	-41.7
Russian Federation		-105.5	-97.0	-79.6	-78.7	-149.8	-77.6	-54.6	-90.0	-99.6
Other reporting countries	-22.5	-26.7	-18.9	-12.7	-12.3	-13.9	-3.7	-8.9	-15.7	-5.3
All reporting partners	-0.8	2.4	4.1	6.0	11.9	11.7	12.6	15.6	15.8	18.2
Statistical Discrepancy as % of mean of Partner, China & Hong Kong reported data, consistency indicators (total)^b										
Argentina	8.9	5.1	15.6	22.2	23.4	16.6	29.2	46.6	33.1	34.0
Australia	0.7	4.7	0.7	1.5	7.3	12.0	9.8	14.3	15.6	19.8
Brazil	-36.1	-13.2	-16.1	-17.7	-8.9	-6.6	-5.2	-1.7	-3.3	-1.1
Canada	9.2	12.2	20.1	23.9	30.1	33.7	38.1	40.4	48.7	52.2
Chile	-67.8	-49.9	-48.3	-42.1	-41.1	-31.7	-18.7	-16.9	-18.7	-3.9
EU15	4.2	8.9	9.6	11.2	16.7	15.6	15.8	20.9	20.5	24.1
EU10	-16.0	5.9	11.0	24.0	26.3	18.3	26.6	38.3	43.9	41.7
India	4.4	0.1	6.9	9.2	23.1	9.6	16.0	14.0	25.7	20.8
Indonesia	-23.9	-18.5	-33.0	-30.1	-48.7	-48.3	-51.2	-43.1	-49.9	-48.6
Israel	12.4	19.6	18.5	26.4	29.2	33.2	28.6	42.5	16.9	23.3
Japan	2.1	3.0	3.9	1.6	8.3	8.6	6.2	7.4	7.9	10.4
Korea	3.4	7.6	5.4	-5.5	6.7	7.2	1.8	8.9	9.3	6.4
Malaysia	26.7	27.7	21.1	21.2	27.2	29.6	21.7	24.1	18.2	26.0
Mexico	15.9	46.8	50.1	34.6	37.1	28.3	42.4	44.9	81.5	84.1
New Zealand	22.9	27.3	29.4	21.7	32.8	30.8	37.6	40.1	44.8	44.9
Norway	32.7	16.6	-0.6	35.2	41.5	30.2	45.3	83.1	44.9	62.0
Panama	-193.7	-191.5	-194.7	-191.5	-191.2	-192.0	-191.7	-187.9	-187.2	
Saudi Arabia	-36.9	-32.5		-29.0	-29.4	-22.2	-12.6	-10.1	-4.7	
Singapore	13.0	14.5	18.1	9.7	15.6	13.1	16.0	17.5	14.7	17.0
South Africa	-36.0	-32.2	-27.7	-30.9	-21.6	-20.8	-11.7	-4.6	3.1	11.9
Switzerland	17.1	12.4	6.5	11.5	9.7	16.7	20.8	35.8	34.9	19.2
Thailand	2.4	13.9	12.6	19.2	23.3	18.7	18.4		24.8	20.1
United States	-3.2	1.3	5.8	10.9	18.5	20.6	22.5	25.0	25.9	27.0
Venezuela	-97.0	-87.3	-114.6	-90.0	-22.5	-24.3	-27.5	-35.9	-13.5	-32.0
Philippines		-2.7	-3.4	0.4	-6.1	-27.1	-23.2	-28.8	-27.5	-34.5
Russian Federation		-69.1	-65.3	-57.0	-56.5	-85.7	-55.9	-42.9	-62.1	-66.5
Other reporting countries	-20.2	-23.6	-17.2	-11.9	-11.6	-13.0	-3.6	-8.5	-14.5	-5.1
All reporting partners	-0.8	2.4	4.1	6.1	12.7	12.4	13.4	16.9	17.1	20.0

Table 5, continued

Discrepancy Indexes of Trade Statistics Reported by China, Hong Kong and their Major Partners, 1995-2004
(export to partner countries, in percent) cont.

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Consistency indicators (absolute average)^c										
Argentina	20.5	25.3	32.1	36.6	34.9	29.9	38.4	56.6	42.7	39.5
Australia	14.8	14.3	14.3	15.0	16.8	20.0	19.2	20.5	21.1	24.7
Brazil	45.2	30.4	34.3	34.9	30.0	33.8	20.8	23.0	20.9	21.9
Canada	15.4	20.3	27.6	30.8	33.5	37.0	41.1	42.6	49.1	52.5
Chile	70.7	52.8	51.2	46.0	45.9	36.3	26.4	22.4	24.6	21.4
EU15	14.2	13.7	14.5	16.4	20.4	20.2	20.2	24.5	24.1	28.4
EU10	65.7	64.2	77.2	78.7	72.8	70.8	69.3	70.3	69.0	49.7
India	41.8	44.6	31.7	43.5	48.7	39.1	34.2	35.5	36.9	35.3
Indonesia	40.4	42.7	47.5	62.2	71.5	63.1	63.7	53.2	55.8	54.6
Israel	32.1	30.4	27.5	33.5	40.6	43.0	40.9	53.0	30.2	36.5
Japan	14.3	13.1	12.8	12.0	12.8	12.4	10.5	12.0	11.9	12.3
Korea	20.5	23.8	16.8	21.6	19.6	19.9	17.1	21.6	22.7	18.1
Malaysia	37.3	35.7	34.5	34.8	39.2	39.7	34.0	33.3	33.7	39.7
Mexico	52.6	55.8	60.4	45.4	52.5	48.5	65.8	71.6	97.9	101.1
New Zealand	27.1	29.4	33.0	36.3	36.0	32.8	39.6	45.9	47.2	47.1
Norway	44.7	48.6	61.9	46.6	52.0	57.2	52.8	84.4	74.7	71.2
Panama	194.1	191.8	194.8	192.1	191.4	192.1	191.9	188.0	187.3	
Saudi Arabia	43.5	43.7		33.0	38.4	32.6	35.8	35.3	41.2	
Singapore	19.4	23.8	24.0	19.3	23.6	20.3	23.6	28.6	28.7	29.0
South Africa	50.4	46.5	40.3	42.5	40.8	35.0	28.4	31.8	31.1	32.7
Switzerland	39.1	43.0	47.0	46.2	44.7	41.3	37.3	45.2	49.0	59.5
Thailand	31.7	27.6	29.5	33.6	35.7	31.6	32.0		30.3	25.5
United States	11.8	11.2	12.1	14.8	20.6	22.8	24.4	26.6	28.1	29.0
Venezuela	100.4	87.9	117.7	90.9	35.3	32.3	33.8	44.5	47.6	44.3
Philippines		43.8	32.0	24.2	24.0	38.8	33.4	37.9	38.1	39.0
Russian Federation		85.2	99.4	101.3	107.1	113.1	85.3	64.1	75.0	83.3
Other reporting countries	36.0	38.4	42.8	35.5	25.7	28.4	19.1	24.1	28.6	30.6
All reporting partners	7.1	8.2	10.2	11.8	17.3	17.9	17.5	21.0	22.2	23.5

Data Source: Calculated by the authors from COMTRADE data of UNSD, all reported exports measured at fob price, imports reported at cif price.

a. Defined in equation (1) of the paper.

b. Defined in equation (2) of the paper, which is modified from similar index developed by International Trade Center at UNCTAD/WTO in Geneva

c. Defined in equation (3) of the paper, which is modified from similar index developed by International Trade Center at UNCTAD/WTO in Geneva

Table 6 Trade Statistics Reported by China, Hong Kong and the United States and Statistical Discrepancies, 1995-2006 (from the US, in Million US dollars)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
US reported exports to China (fas) +	11,748	11,978	12,805	14,258	13,118	16,253	19,235	22,053	28,418	34,721	41,837	55,224
US reported exports to Hong Kong (fas) +	14,220	13,956	15,115	12,923	12,647	14,625	14,072	12,612	13,542	15,809	16,323	17,779
Geographical coverage adjustment for US reported data												
To China -	13	3	4	12	6	15	32	52	77	74	76	103
To Hong Kong -	14	10	17	11	15	16	18	18	27	31	54	57
US reported exports to China & Hong Kong (fas)	25,942	25,921	27,899	27,158	25,743	30,847	33,257	34,594	41,856	50,425	58,029	72,843
Statistical Discrepancy (Million US dollars) -	-725	-660	-2,032	-2,381	153	-1,203	-1,209	-2,966	-3,054	852	-2,066	-6,722
cif to fob adjustment for China and Hong Kong reported data	25,217	25,260	25,867	24,777	25,896	29,644	32,048	31,628	38,802	51,276	55,963	66,121
China -	419	339	315	378	595	705	790	807	1,134	1,574	1,656	2,044
Hong Kong -	381	367	350	304	330	385	346	327	365	421	412	427
Hong Kong reported re-exports to China for US originated goods -	4,982	5,866	5,965	5,294	5,373	6,109	6,466	6,197	6,238	5,787	6,029	6,524
China & Hong Kong reported imports from US (cif)	30,999	31,831	32,496	30,753	32,194	36,843	39,650	38,959	46,540	59,059	64,060	75,116
China reported imports from US (cif) +	16,124	16,179	16,301	16,997	19,488	22,365	26,195	27,230	33,861	44,679	48,726	59,209
Hong Kong reported imports from US (cif) +	14,876	15,653	16,195	13,756	12,706	14,478	13,456	11,729	12,679	14,380	15,334	15,907
Statistical Discrepancy as % of China & Hong Kong reported imports	-2.87	-2.61	-7.86	-9.61	0.59	-4.06	-3.77	-9.38	-7.87	1.66	-3.69	-10.17
Statistical Discrepancy as % of sum of US, China & Hong Kong reported data, ITC consistency indicators (total)	-1.42	-1.29	-3.78	-4.58	0.30	-1.99	-1.85	-4.48	-3.79	0.84	-1.81	-4.84
Hong Kong re-export as % of China total imports from US	30.9	36.3	36.6	31.1	27.6	27.3	24.7	22.8	18.4	13.0	12.4	12.4
Hong Kong re-export for US as % of Hong Kong total re-export to China	10.0	10.9	10.4	10.1	10.4	9.7	10.2	8.5	6.9	5.3	4.8	4.8
US-China fob/cif	0.962	0.967	0.970	0.968	0.958	0.957	0.960	0.962	0.959	0.960	0.961	0.961
US-Hong Kong fob/cif	0.974	0.977	0.978	0.978	0.974	0.973	0.974	0.972	0.971	0.971	0.973	0.973

Data source: All China reported data are from China Customs Authority; all Hong Kong reported data are from Hong Kong Census and Statistics Department; all United State reported data are from International Trade Commission Oracle database. The data include HS Chapter 1 to 99.

Note: Geographical adjustments are based on U.S. reported data. China & Hong Kong reported data do not include Virgin Island and Puerto Rico.

Table 7. Discrepancy Indexes of Trade Statistics Reported by China, Hong Kong and United States in Major HS sections, 1995-2006 (export to China and Hong Kong in percent)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Live Animals And Animal Products	-29.1	-63.2	-68.2	-76.3	-21.1	-17.3	-5.7	19.0	18.2	4.0	-1.3	-12.6
Vegetable Products	19.8	3.5	29.8	19.0	20.1	6.2	7.7	-0.8	-28.7	23.1	20.4	0.5
Animal And Vegetable Fats And Oils	9.5	-76.5	-12.2	-14.6	52.4	41.9	26.4	12.2	-31.1	-124.9	-75.3	-134.8
Prepared Foodstuffs, Beverages and Tobacco	13.9	2.4	6.0	5.8	13.7	12.8	17.6	19.4	13.6	13.7	0.7	6.2
Mineral Products	3.2	-16.0	-27.6	1.3	10.6	-6.1	-28.9	26.2	10.3	24.4	21.4	6.1
Products Of The Chemical Or Allied Industries	4.1	12.1	-4.1	12.2	17.3	9.7	13.3	18.0	25.1	25.2	21.6	19.4
Plastics And Rubber	-7.5	-1.3	-1.4	-3.4	1.8	-13.3	-10.5	-25.0	-23.5	-13.1	-13.2	-17.0
Raw Hides And Skins, Leather, Fur skins	-1.8	9.6	-4.3	2.2	6.9	-31.0	-34.6	-31.8	-36.9	-22.9	-17.0	-19.0
Wood And Cork Articles	-0.7	-3.9	7.9	-6.7	-23.0	-50.2	-67.8	-47.0	-41.0	-49.9	-36.8	-30.3
Wood Pulp, Paper And Paperboard Articles	9.4	10.8	13.1	5.3	15.5	21.9	13.3	12.0	19.3	21.5	20.4	6.4
Textiles	2.3	0.4	5.4	-6.1	-9.3	-16.6	-14.4	-35.8	-22.6	6.0	-5.0	-1.4
Footwear, Headgear And Umbrellas	-7.3	-21.6	-4.6	-28.1	-17.2	-27.2	-48.3	-52.2	-18.8	-3.3	-8.9	-8.4
Articles Of Stone, Plaster, Cement, Ceramic And Glass	-6.3	-12.6	-17.9	-19.7	-17.9	-55.1	-33.8	-52.5	-26.6	-21.6	-13.1	-20.2
Pearls, Precious Stones And Metals	-85.3	-50.5	-52.4	-25.5	-26.5	-20.4	-29.3	-13.4	-26.0	-39.7	-48.0	-53.0
Base Metals	-6.5	6.7	3.5	-7.4	2.6	-9.5	-23.6	-34.7	-32.5	-27.6	-55.1	-115.7
Machinery And Mechanical Appliances	0.9	10.7	-7.0	-1.2	12.9	-2.1	0.4	-0.2	1.1	5.3	7.3	5.9
Electrical Machinery And Equipment	-0.3	-5.6	-4.4	4.2	-3.6	-4.6	2.6	-11.9	-23.3	-9.4	-4.7	-7.0
Vehicles, Aircraft, Vessels And Other Transport Equipment	-17.7	-22.3	-37.3	-84.7	-35.1	-18.9	-26.2	-56.4	-11.7	5.9	-31.8	-16.9
Medical Instruments, Musical Instruments, Clocks and Watches	7.5	13.7	2.1	0.9	7.4	16.0	8.8	8.5	13.4	15.5	14.1	8.7
Arms And Ammunition	-309.5	-135.3	-150.1	-100.9	-749.9	-1327	-147.1	-229.4	-223.7	-1015.	-1487.	-332.8
Miscellaneous Manufactured Articles	-15.3	-20.8	-44.2	-47.1	-44.4	-55.9	-62.4	-84.4	-65.6	-61.2	-59.9	-54.2
Works Of Art, Collectors' Pieces and Antiques	-102.4	-94.0	-207.8	-29.6	-53.6	2.5	-26.9	-22.1	36.3	-36.4	10.1	-25.2
Total ^c	-1.1	-0.9	-6.5	-7.9	2.2	-2.6	-2.5	-8.4	-6.9	2.8	-2.6	-8.8
Live Animals And Animal Products	-25.4	-48.0	-50.9	-55.2	-19.1	-15.9	-5.6	21.0	20.0	4.1	-1.3	-11.9
Vegetable Products	22.0	3.6	35.0	21.0	22.3	6.4	8.1	-0.8	-25.1	26.2	22.8	0.5
Animal And Vegetable Fats And Oils	10.0	-55.3	-11.5	-13.6	71.1	53.1	30.5	13.0	-26.9	-76.9	-54.7	-80.5
Prepared Foodstuffs, Beverages and Tobacco	14.9	2.5	6.2	6.0	14.7	13.7	19.3	21.5	14.6	14.7	0.7	6.4
Mineral Products	3.3	-14.8	-24.2	1.3	11.2	-5.9	-25.2	30.2	10.9	27.8	23.9	6.2
Products Of The Chemical Or Allied Industries	4.2	12.8	-4.0	12.9	18.9	10.2	14.3	19.8	28.6	28.8	24.3	21.4
Plastics And Rubber	-7.3	-1.3	-1.4	-3.3	1.8	-12.5	-9.9	-22.2	-21.0	-12.3	-12.4	-15.7
Raw Hides And Skins, Leather, Fur skins	-1.8	10.1	-4.2	2.2	7.1	-26.8	-29.5	-27.4	-31.2	-20.5	-15.6	-17.4
Wood And Cork Articles	-0.7	-3.8	8.2	-6.5	-20.6	-40.1	-50.6	-38.1	-34.0	-39.9	-31.1	-26.3
Wood Pulp, Paper And Paperboard Articles	9.8	11.4	14.0	5.5	16.8	24.6	14.3	12.8	21.4	24.1	22.7	6.6
Textiles	2.4	0.4	5.6	-5.9	-8.9	-15.3	-13.5	-30.4	-20.3	6.2	-4.9	-1.4
Footwear, Headgear And Umbrellas	-7.0	-19.5	-4.5	-24.7	-15.8	-24.0	-38.9	-41.4	-17.2	-3.3	-8.6	-8.1
Articles Of Stone, Plaster, Cement, Ceramic And Glass	-6.1	-11.9	-16.4	-17.9	-16.4	-43.2	-28.9	-41.6	-23.5	-19.5	-12.3	-18.4
Pearls, Precious Stones And Metals	-59.8	-40.3	-41.5	-22.6	-23.4	-18.5	-25.5	-12.6	-23.0	-33.1	-38.7	-41.9
Base Metals	-6.2	7.0	3.6	-7.1	2.6	-9.1	-21.1	-29.6	-27.9	-24.3	-43.2	-73.3
Machinery And Mechanical Appliances	0.9	11.3	-6.7	-1.2	13.8	-2.0	0.4	-0.2	1.1	5.5	7.5	6.1
Electrical Machinery And Equipment	-0.3	-5.5	-4.3	4.3	-3.5	-4.5	2.7	-11.2	-20.8	-9.0	-4.6	-6.8
Vehicles, Aircraft, Vessels And Other Transport Equipment	-16.2	-20.1	-31.4	-59.5	-29.8	-17.3	-23.2	-44.0	-11.1	6.1	-27.4	-15.6
Medical Instruments, Musical Instruments, Clocks and Watches	7.8	14.7	2.1	0.9	7.7	17.4	9.2	8.9	14.3	16.8	15.1	9.1
Arms And Ammunition	-121.5	-80.7	-85.7	-67.1	-157.9	-173.8	-84.8	-106.8	-105.6	-167.1	-176.3	-124.9
Miscellaneous Manufactured Articles	-14.2	-18.9	-36.2	-38.1	-36.4	-43.7	-47.5	-59.4	-49.4	-46.9	-46.1	-42.6
Works Of Art, Collectors' Pieces and Antiques	-67.7	-63.9	-101.9	-25.8	-42.3	2.6	-23.7	-19.9	44.4	-30.8	10.6	-22.4
Total ^c	-1.1	-0.9	-6.3	-7.6	2.3	-2.5	-2.4	-8.0	-6.7	2.8	-2.6	-8.4

Data source: All China reported data are from China Customs Authority; all Hong Kong reported data are from Hong Kong Census and Statistics Department; all United State reported data are from International Trade Commission Oracle database, both exports and imports are measured on fob price.

a. Defined in equation (1) of the paper.

b. Defined in equation (2) of the paper, which is modified from similar index developed by International Trade Center at UNCTAD/WTO in Geneva.

c. It includes HS Chapter 1-97.

Table 8. Discrepancy Indexes of Trade Statistics Reported by China, Hong Kong and their Major Partners, 1995-2004 (export to China and Hong Kong, in percent)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Statistical Discrepancy as % of China & Hong Kong reported imports^a										
Argentina	-4.3	-25.1	-20.9	5.8	9.9	8.9	8.3	8.1	7.2	17.7
Australia	2.9	10.8	-6.2	-2.8	3.2	13.3	14.6	16.4	23.6	35.7
Brazil	-5.7	14.8	14.6	9.6	9.1	19.9	10.7	8.6	15.3	32.5
Canada	-6.3	5.5	3.7	15.6	17.8	29.1	25.4	21.0	16.4	23.2
Chile	-19.5	17.1	11.0	1.1	37.8	35.9	21.9	24.7	21.7	11.1
EU15	-0.9	-6.7	-10.8	-6.5	4.5	8.3	9.2	2.8	3.2	3.2
EU10	-0.1	26.3	-10.6	-37.2	2.7	-4.4	-0.6	25.8	22.0	10.2
India	-6.3	-6.6	-3.7	2.2	-16.1	-0.8	5.7	-5.9	11.2	17.4
Indonesia	-10.3	-11.6	-0.1	3.9	13.9	16.1	23.8	20.4	23.0	26.2
Israel	-19.8	-35.8	-46.7	-58.2	-56.9	-52.9	-47.5	-42.5	-44.1	-46.2
Japan	-6.1	-4.5	-6.0	-5.3	-2.3	-3.9	1.5	1.0	1.6	2.8
Korea	-22.5	-24.0	-25.3	0.8	-4.8	-1.0	2.1	-1.8	-3.1	0.6
Malaysia	-20.3	-22.2	-4.1	4.2	0.0	10.1	13.4	11.8	18.4	23.1
Mexico	-54.7	6.5	-15.2	-25.1	-7.2	27.4	54.2	43.8	55.2	62.3
New Zealand	-22.7	-10.9	-11.7	1.0	9.4	19.9	10.7	11.2	10.7	8.1
Norway	11.9	21.1	24.5	18.2	-6.9	46.6	-14.0	6.2	6.7	28.2
Saudi Arabia	42.5	67.9		71.8			73.4			
Singapore	-12.3	-25.4	-35.6	-31.6	-19.8	-21.1	-20.9	-18.9	-21.9	-25.6
South Africa	30.7	14.6	32.3	40.4	32.2	39.4	31.6	40.9	33.5	47.6
Switzerland	-12.8	-19.1	-18.4	-6.6	-2.9	5.2	10.4	2.4	2.1	6.0
Thailand	-22.8	-22.5	-17.1	-5.2	0.3	6.2	13.9		10.4	15.2
United States	2.0	1.8	-3.9	-5.1	5.6	1.1	1.0	-2.4	-1.6	7.2
Philippines		1.2	3.5	1.4	-14.2	19.7	26.6	23.7	35.7	73.9
Russian Federation		22.9	15.5	18.3	19.1	19.6	50.3	35.8	19.1	30.3
Other reporting countries	-6.1	12.3	-35.6	4.9	1.9	23.7	41.0	35.4	35.8	40.8
All reporting partners	-6.2	-6.2	-10.5	-3.9	0.4	3.8	8.8	4.4	5.5	9.6
Statistical Discrepancy as % of sum of Partner, China & Hong Kong reported data, ITC consistency indicators (total)^b										
Argentina	-4.2	-22.3	-18.9	5.9	10.5	9.4	8.7	8.4	7.5	19.5
Australia	2.9	11.4	-6.0	-2.8	3.2	14.2	15.8	17.9	26.7	43.5
Brazil	-5.6	16.0	15.7	10.1	9.5	22.2	11.3	9.0	16.6	38.8
Canada	-6.1	5.6	3.7	17.0	19.6	34.1	29.1	23.5	17.8	26.3
Chile	-17.8	18.7	11.6	1.1	46.6	43.7	24.6	28.2	24.3	11.7
EU15	-0.9	-6.5	-10.2	-6.3	4.6	8.6	9.7	2.9	3.3	3.2
EU10	-0.1	30.2	-10.1	-31.4	2.7	-4.3	-0.6	29.6	24.7	10.8
India	-6.1	-6.4	-3.6	2.2	-14.9	-0.8	5.8	-5.7	11.8	19.1
Indonesia	-9.8	-10.9	-0.1	4.0	15.0	17.6	27.0	22.7	26.0	30.1
Israel	-18.0	-30.4	-37.9	-45.1	-44.3	-41.9	-38.4	-35.1	-36.1	-37.5
Japan	-5.9	-4.4	-5.9	-5.2	-2.3	-3.8	1.5	1.0	1.7	2.8
Korea	-20.3	-21.4	-22.5	0.8	-4.7	-1.0	2.1	-1.8	-3.1	0.6
Malaysia	-18.4	-20.0	-4.0	4.3	0.0	10.6	14.4	12.5	20.2	26.2
Mexico	-42.9	6.7	-14.2	-22.3	-6.9	31.8	74.4	56.1	76.2	90.6
New Zealand	-20.4	-10.3	-11.1	1.0	9.8	22.2	11.3	11.9	11.3	8.5
Norway	12.7	23.6	28.0	20.0	-6.7	60.8	-13.1	6.4	6.9	32.8
Saudi Arabia	53.9	102.9		111.9			116.0			
Singapore	-11.6	-22.5	-30.2	-27.3	-18.0	-19.1	-18.9	-17.3	-19.7	-22.7
South Africa	36.3	15.8	38.5	50.6	38.4	49.1	37.5	51.5	40.2	62.5
Switzerland	-12.0	-17.4	-16.9	-6.4	-2.9	5.4	11.0	2.4	2.1	6.2
Thailand	-20.5	-20.3	-15.8	-5.1	0.3	6.4	15.0		11.0	16.4
United States	2.0	1.9	-3.8	-4.9	5.8	1.1	1.0	-2.4	-1.6	7.5
Philippines		1.2	3.6	1.4	-13.2	21.8	30.7	26.9	43.4	117.3
Russian Federation		25.8	16.8	20.2	21.1	21.7	67.2	43.5	21.1	35.7
Other reporting countries	-5.9	13.1	-30.2	5.0	1.9	26.8	51.6	43.1	43.6	51.3
All reporting partners	-6.0	-6.0	-10.0	-3.8	0.4	3.9	9.2	4.5	5.7	10.1

Table 8. Discrepancy Indexes of Trade Statistics Reported by China, Hong Kong and their Major Partners, 1995-2004 (export to China and Hong Kong, in percent)—Continued

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
ITC consistency indicators (absolute average)^c										
Argentina	35.2	36.4	44.7	34.3	27.5	24.4	24.0	22.7	24.3	28.8
Australia	39.5	48.4	43.9	40.6	35.7	32.3	37.9	36.0	40.7	49.3
Brazil	24.2	29.6	28.8	27.0	31.8	34.7	31.9	23.0	28.1	43.8
Canada	25.3	23.0	28.2	34.2	29.1	40.7	37.7	36.0	37.2	36.7
Chile	28.4	22.1	19.0	27.8	56.5	44.8	29.2	29.5	25.6	13.6
EU15	13.9	13.7	15.2	14.8	17.3	19.2	20.0	16.0	13.3	13.2
EU10	70.6	60.7	67.7	68.3	28.3	28.5	23.2	59.5	38.6	27.5
India	19.7	27.7	21.3	32.6	31.1	29.8	23.1	23.6	28.4	26.8
Indonesia	20.0	21.4	30.4	32.5	28.5	25.4	33.2	27.2	31.3	34.3
Israel	26.2	35.7	44.1	49.8	46.3	48.6	56.4	55.0	58.9	47.9
Japan	10.9	12.0	12.5	11.3	9.8	8.5	7.6	6.9	6.6	7.5
Korea	23.7	26.2	26.0	25.5	12.9	14.3	18.1	16.9	28.1	33.0
Malaysia	21.5	24.1	29.1	28.9	14.4	19.6	20.0	19.9	24.8	30.4
Mexico	108.3	30.9	42.2	49.1	63.5	39.0	85.7	81.0	105.3	110.0
New Zealand	27.5	23.6	22.6	21.3	28.3	35.0	25.6	28.6	30.8	30.6
Norway	49.7	59.9	44.0	39.6	39.9	80.7	63.9	20.5	34.1	69.9
Saudi Arabia	75.6	125.6		115.1			123.7			
Singapore	17.2	24.8	31.8	28.2	18.5	19.7	19.4	18.7	21.1	23.4
South Africa	65.1	38.5	62.3	73.0	51.6	64.4	45.5	57.9	48.5	66.8
Switzerland	16.9	23.7	23.9	14.7	10.9	13.4	16.8	13.4	14.1	18.5
Thailand	25.4	25.4	22.8	27.4	22.8	18.3	20.7		17.4	21.4
United States	14.9	17.6	15.6	18.6	17.1	12.6	12.7	20.5	21.1	19.1
Philippines		27.5	29.2	33.1	50.3	31.4	36.4	32.1	47.9	119.5
Russian Federation		63.4	58.7	51.9	56.8	56.8	74.3	54.6	44.3	48.5
Other reporting countries	32.5	56.8	39.6	56.6	48.0	43.0	68.3	73.8	61.4	69.2
All reporting partners	7.6	10.6	11.7	7.5	6.4	8.9	12.0	8.4	9.6	13.3

Data Source: Calculated by the authors from COMTRADE data of UNSD, all reported exports measured at fob price, imports reported at cif price.

a. Defined in equation (1) of the paper.

b. Defined in equation (2) of the paper, which is modified from similar index developed by International Trade Center at UNCTAD/WTO in Geneva.

c. Defined in equation (3) of the paper, which is modified from similar index developed by International Trade Center at UNCTAD/WTO in Geneva.

Table 9 Decomposition of Discrepancy in Eastbound Trade, 1995 -2005, Millions of U.S. Dollars

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
<i>China reported trade statistics</i>											
Direct exports to U.S. (C1)	9,842	14,057	18,401	22,043	27,087	37,042	39,986	54,104	75,424	105,495	141,943
Exports to U.S. via Hong Kong (C2)	14,260	12,455	14,106	15,766	14,692	14,632	13,893	15,346	16,296	19,006	20,410
Exports to U.S. via third countries (C3)	611	196	209	156	236	453	388	494	745	410	459
<i>Hong Kong reported trade statistics</i>											
Domestic exports to U.S. (C4)	7,884	6,925	7,082	7,064	6,611	6,984	6,099	5,368	5,020	4,955	4,850
Re-exports to U.S. for China (C5)	27,568	29,172	31,236	30,853	31,962	36,416	33,246	34,303	33,392	35,504	38,268
Sum of Hong Kong Based flows(C2+C4+C5)	49,712	48,552	52,424	53,684	53,266	58,032	53,237	55,017	54,708	59,464	63,528
<i>U.S. shipping data for imports from China</i>											
Direct imports from Chinese ports (U1)	11,573	15,119	21,613	28,124	36,290	48,844	53,502	73,343	99,996	138,387	178,426
Re-exports to U.S. via Hong Kong (U5)	24,802	27,287	31,035	32,155	34,051	39,010	35,554	37,503	35,611	38,612	42,770
Transshipment via Hong Kong (U2)	7,800	7,647	8,033	8,543	8,676	10,702	10,295	10,262	11,045	11,920	12,294
Indirect imports via third countries (U3)	1,678	1,772	2,334	2,775	3,029	3,391	3,511	4,727	6,289	8,620	11,099
Total imports from China	45,853	51,824	63,015	71,597	82,047	101,947	102,861	125,835	152,942	197,538	244,589
<i>U.S. reported trade statistics</i>											
Imports from Hong Kong (U4)	9,801	9,375	9,712	10,001	9,898	10,697	9,025	8,708	8,248	8,682	8,128
U.S. geographical adjustment for China (U6)	106	132	145	151	195	216	256	299	369	414	510
U.S. geographical adjustment for Hong Kong (U7)	36	67	50	60	43	35	24	18	24	24	27
Sum of Hong Kong Based flows(U2+U4+U5-U7)	42,367	44,241	48,730	50,639	52,582	60,374	54,850	56,456	54,881	59,189	63,165
Discrepancies in direct trade (C1-U1)	1,731	1,062	3,212	6,082	9,203	11,802	13,516	19,240	24,572	32,891	36,484
Discrepancies in re-exports (C5-U5)	-2,766	-1,886	-201	1,301	2,089	2,594	2,308	3,200	2,219	3,109	4,501
Discrepancies in transshipment (C2-U2)	-6,460	-4,808	-6,073	-7,223	-6,016	-3,930	-3,598	-5,084	-5,252	-7,086	-8,116
Discrepancies in H.K. domestic exports (C4-U4)	1,917	2,450	2,630	2,937	3,287	3,713	2,927	3,340	3,229	3,727	3,279
Discrepancies in trade via third Countries (C3-U3)	1,067	1,575	2,125	2,619	2,793	2,937	3,123	4,233	5,544	8,210	10,640
Discrepancies in sum of Hong Kong based flows	-7,346	-4,311	-3,694	-3,045	-683	2,343	1,613	1,438	172	-275	-362
China & Hong Kong reported exports to U.S.	60,165	62,805	71,034	75,882	80,589	95,527	93,611	109,615	130,878	165,369	205,929
U.S. reported imports from China & Hong Kong	55,511	61,000	72,532	81,387	91,707	112,393	111,607	134,227	160,797	205,781	252,181
Total discrepancy ^a	-4,654	-1,805	1,498	5,504	11,118	16,866	17,997	24,612	29,920	40,412	46,252
<i>Statistical Discrepancy as % of U.S. reported imports</i>											
Total	-8.38	-2.96	2.07	6.76	12.12	15.01	16.12	18.34	18.61	19.64	18.34
Direct trade	14.96	7.03	14.86	21.62	25.36	24.16	25.26	26.23	24.57	23.77	20.45
Hong Kong re-exports	-11.15	-6.91	-0.65	4.05	6.14	6.65	6.49	8.53	6.23	8.05	10.52
Hong Kong transshipment	-82.82	-62.88	-75.60	-84.56	-69.35	-36.73	-34.95	-49.54	-47.55	-59.45	-66.01
Hong Kong domestic exports	19.56	26.13	27.08	29.37	33.21	34.71	32.43	38.35	39.14	42.93	40.34
Sum of Hong Kong Based flows	-17.34	-9.74	-7.58	-6.01	-1.30	3.88	2.94	2.55	0.31	-0.46	-0.57
<i>Statistical Discrepancy as % of average of U.S., China & Hong Kong reported data</i>											
Total	-8.05	-2.92	2.09	7.00	12.91	16.22	17.54	20.19	20.52	21.78	20.19
Direct trade	16.17	7.28	16.05	24.25	29.04	27.48	28.92	30.19	28.02	26.97	22.78
Hong Kong re-exports	-10.56	-6.68	-0.65	4.13	6.33	6.88	6.71	8.91	6.43	8.39	11.11
Hong Kong transshipment	-58.57	-47.84	-54.86	-59.43	-51.49	-31.03	-29.75	-39.71	-38.42	-45.83	-49.63
Hong Kong domestic exports	21.68	30.06	31.32	34.42	39.82	42.00	38.70	47.45	48.67	54.66	50.53
Sum of Hong Kong Based flows	-15.95	-9.29	-7.30	-5.84	-1.29	3.96	2.98	2.58	0.31	-0.46	-0.57

Source: US Census Bureau. a. The total discrepancy is the difference between the two rows above. "China and Hong Kong reported exports to U.S." is the sum of C1-C5. "U.S. reported imports from China and Hong Kong" is the sum of U1-U5 minus the two geographical adjustments, U6 and U7. These reflect U.S. imports in the customs districts of Puerto Rico and the Virgin Islands, which are treated as destinations separate from the United States in China and Hong Kong data. The data exclude HS Chapter 98 and 99.

Table 10 Percentage of Each Component in Total Reported East Bound Trade, 1995-2005

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
<i>Share in adjusted China and Hong Kong reported total^a</i>											
Direct exports to U.S.	16.07	21.83	25.15	28.08	32.49	37.62	41.34	47.52	55.29	60.78	65.54
Re-exports to U.S. for China	45.02	45.31	42.70	39.30	38.33	36.98	34.37	30.13	24.48	20.45	17.67
Exports to U.S. via Hong Kong	23.29	19.35	19.28	20.08	17.62	14.86	14.36	13.48	11.95	10.95	9.42
Domestic exports to U.S.	12.88	10.76	9.68	9.00	7.93	7.09	6.30	4.72	3.68	2.85	2.24
Exports to U.S. via third countries	2.74	2.75	3.19	3.53	3.63	3.44	3.63	4.15	4.61	4.97	5.13
<i>Share in U.S. reported total</i>											
Direct imports from ports within China	20.79	24.71	29.72	34.47	39.47	43.36	47.82	54.51	62.04	67.11	70.60
Re-exports to U.S. via Hong Kong	44.56	44.59	42.67	39.41	37.03	34.63	31.78	27.87	22.09	18.72	16.92
Transshipment to U.S. Via Hong Kong	14.02	12.49	11.04	10.47	9.44	9.50	9.20	7.63	6.85	5.78	4.86
Imports from Hong Kong (fob)	17.61	15.32	13.35	12.26	10.77	9.50	8.07	6.47	5.12	4.21	3.22
Indirect imports via third countries	3.01	2.89	3.21	3.40	3.29	3.01	3.14	3.51	3.90	4.18	4.39
<i>Hong Kong re-export plus transshipment share</i>											
As % of China and Hong Kong total exports to U.S.	73.69	67.48	62.93	58.33	54.13	49.57	45.40	38.80	30.69	25.18	21.24
As % in U.S. shipping data	54.22	52.79	49.36	45.01	41.60	38.35	34.65	29.87	23.34	19.59	17.52

a. The adjustment here made is to replace China's reported exports through third countries with U.S.-reported data, as the extent of the underreporting is so severe.

Table 11. Descriptive Statistics

	<i>Mean</i>	<i>Standard Deviation</i>	<i>Minimum</i>	<i>Maximum</i>
Dependent variable				
Discrepancy (ER)	7.71	24.14	-90.94	97.60
Independent variable				
Processing trade export share	37.44	31.69	0	99.98
State-owned enterprise export share	53.48	25.74	2.41	100.00
Hong Kong re-export share	21.61	21.94	0	89.56
Hong Kong domestic export share	4.84	12.23	0	89.30
U.S. import share passing through third Countries	5.94	8.90	0	82.46
U.S. re-export as a share of U.S. imports	3.99	4.80	0	44.78
Time (years since 1995)	3.50	2.87	1	10
Valuation (share of goods with no unit values)	9.83	19.71	0	99.99
Homogeneity index	11.64	11.12	1.02	63.51
U.S. tariff, ad valorem percent	3.75	3.85	0	32.07

Memo: Mean for normal trade = 61.22 Mean for foreign-invested enterprises = 37.12

Table 12 Regression results – OLS specifications**Dependent variable – Discrepancy index(ER)****N = 960 (910 without outliers)**

	(1)	(2)	(3)	(4)
Processing trade export share	-.673*** (.052)	-.028 (.049)	-.565*** (.051)	.140*** (.040)
State-owned enterprise export share	.192** (.075)	-.050 (.068)	-.040 (.072)	-.077*** (.054)
Hong Kong Re-export share	.534*** (.078)	.041 (.057)	.303*** (.078)	-.359*** (.048)
Hong Kong domestic export share	-.008 (.122)	.130 (.086)	.115 (.114)	.288*** (.069)
U.S. import share passing through third countries	.331** (.166)	-.007 (.251)	.359 (.163)	-.798*** (.222)
U.S. re-exports as share of U.S. imports	-.610* (.333)	-.730*** (.203)	-1.419*** (.404)	-.812*** (.168)
Time	2.857*** (.589)	1.861*** (.358)	2.056*** (.567)	1.241*** (.288)
Valuation problems	.279*** (.083)	.200*** (.037)	.655*** (.103)	.331*** (.032)
Homogeneity	-.087 (.139)	-.228 (.153)	.162 (.140)	.593*** (.153)
U.S. import tariffs	-2.376*** (.403)	-1.195*** (.261)	-2.355** (.412)	-0.673*** (.220)
R ²	.2576	.2185	.2344	.3951
Data weighted?	No	Yes	No	Yes
Outliers?	Included	Included	Excluded	Excluded

Standard errors in parentheses *** significant at .01, ** at .05 and * at .10. Intercept not reported.

Table 13 Regression results- Fixed effects**Dependent variable – Discrepancy index (ER)****N = 960 (910 without outliers)**

	(1)	(2)
Processing trade export share	-.304*** (.074)	-.320*** (.075)
State-owned enterprise export share	-.003 (.065)	.023 (.075)
Hong Kong re-export share	.348*** (.106)	.321*** (.110)
Hong Kong domestic export share	.423*** (.140)	.419*** (.140)
U.S. import share passing through third countries	.606*** (.140)	.584*** (.142)
U.S. re-exports as share of U.S. imports	-.835* (.444)	-.326 (.582)
Time	2.755*** (.453)	2.441*** (.474)
Valuation problems	.377 (.309)	.705* (.374)
Homogeneity	-.044 (.370)	.091 (.388)
U.S. import tariffs	.118 (.796)	-1.233 (.1.140)
R ²	.7710	.7255
Data weighted?	No	No
Outliers?	Included	Excluded
HS fixed effects?	Yes	No

Standard errors in parentheses *** significant at .01 ** significant at .05

* significant at .10.

Appendix Table: Concordance between Major HS section and HS Chapters

HS Section Code	HS Section Code Description	Corresponding HS Chapters and Descriptions
01	Live animals and animal products	01 live animals 02 meat and edible meat offal 03 fish and crustaceans, mollusks and other aquatic invertebrates 04 dairy produce, birds' eggs, natural honey and edible products of animal origin not elsewhere specified or included 05 products of animal origin not elsewhere specified or included
02	Vegetable products	06 live trees and other plants, bulbs and roots, cut flowers and ornamental foliage 07 edible vegetables and certain roots and tubers 08 edible fruit and nuts, peel of citrus fruit or melons 09 coffee, tea, mate and spices 10 cereals 11 milling industry products, malt, starches, insulin and wheat gluten 12 oil seeds and oleaginous. fruits, miscellaneous grains, seeds and fruits, industrial or medicinal plants, straw and fodder 13 lac, gums, resins and other vegetable saps and extracts 14 vegetable plaiting materials and vegetable products, not elsewhere specified or included
03	Animal and vegetable fats and oils, cleavage products and waxes	15 animal or vegetable fats and oils and their cleavage products, prepared edible fats, animal or vegetable waxes
04	Prepared foodstuffs, beverages, spirits, vinegar, and tobacco	16 edible preparations of meat, fish, crustaceans, mollusks or other aquatic invertebrates 17 sugars and sugar confectionery 18 cocoa and cocoa preparations 19 preparations of cereals, flour, starch or milk, bakers' wares 20 preparations of vegetables, fruit, nuts, or other parts of plants 21 miscellaneous edible preparations 22 beverages, spirits and vinegar 23 residues and waste from the food industries, prepared animal feed 24 tobacco and manufactured tobacco substitutes
05	Mineral products	25 salt, sulfur, earths and stone, plastering materials, lime and cement 26 ores, slag and ash 27 mineral fuels, mineral oils and products of their distillation, bituminous substances, mineral waxes
06	Products of the chemical or allied industries	28 inorganic chemicals, organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes 29 organic chemicals 30 pharmaceutical products 31 fertilizers 32 tanning or dyeing extracts, tannins and derivatives, dyes, pigments and other coloring matter, paints and varnishes, putty and other mastics, inks 33 essential oils and resinoids, perfumery, cosmetic or toilet preparations 34 soap etc., lubricating products, waxes, polishing or scouring products, candles etc., modeling pastes, dental waxes and dental plaster preparations

HS Section Code	HS Section Code Description	Corresponding HS Chapters and Descriptions
06— <i>cont.</i>	Products of the chemical or allied industries	35 albuminoidal substances, modified starches, glues, enzymes 36 explosives, pyrotechnic products, matches, pyrophoric alloys, certain combustible preparations 37 photographic or cinematographic goods 38 miscellaneous chemical products
07	Plastics and rubber	39 plastics and articles thereof 40 rubber and articles thereof
08	Raw hides and skins, leather, fur skins , saddlery and handbags	41 raw hides and skins (other than fur skins) and leather 42 articles of leather, saddlery and harness, travel goods, handbags and similar containers, articles of gut (other than silkworm gut) 43 fur skins and artificial fur, manufactures thereof
09	Wood and cork articles	44 wood and articles of wood, wood charcoal 45 cork and articles of cork 46 manufactures of straw, esparto or other plaiting materials, basketware and wickerwork
10	Wood pulp, paper and paperboard articles	47 pulp of wood or other fibrous cellulosic material, recovered (waste and scrap) paper and paperboard 48 paper and paperboard, articles of paper pulp, paper or paperboard 49 printed books, newspapers, pictures and other printed products, manuscripts, typescripts and plans
11	Textiles	50 silk, including yarns and woven fabrics thereof 51 wool and fine or coarse animal hair, including yarns and woven fabrics thereof, horsehair yarn and woven fabric 52 cotton, including yarns and woven fabrics thereof 53 vegetable textile fibers not elsewhere specified or included, yarns and woven fabrics of vegetable textile fibers not elsewhere specified or included and paper 54 manmade filaments, including yarns and woven fabrics thereof 55 manmade staple fibers, including yarns and woven fabrics thereof 56 wadding, felt and nonwovens, special yarns, twine, cordage, ropes and cables and articles thereof 57 carpets and other textile floor coverings 58 special woven fabrics, tufted textile fabrics, lace, tapestries, trimmings, embroidery 59 impregnated, coated, covered or laminated textile fabrics, textile articles suitable for industrial use 60 knitted or crocheted fabrics 61 articles of apparel and clothing accessories, knitted or crocheted 62 articles of apparel and clothing accessories, not knitted or crocheted 63 made-up textile articles not elsewhere specified or included, needlecraft sets, worn clothing and worn textile articles, rags
12	Footwear, headgear, umbrellas, walking sticks, whips, feathers, artificial flowers	64 footwear, gaiters and the like, parts of such articles 65 headgear and parts thereof 66 umbrellas, sun umbrellas, walking-sticks, seat-sticks, whips, riding-crops and parts thereof 67 prepared feathers and down and articles thereof, artificial flowers, articles of human hair
13	Articles of stone, plaster, cement, asbestos, mica, ceramic, and glass	68 articles of stone, plaster, cement, asbestos, mica or similar materials 69 ceramic products 70 glass and glassware
HS Section	HS Section Code Description	Corresponding HS Chapters and Descriptions

Code		
14	Natural and cultured pearls, precious and semiprecious stones, precious metals and coin	71 natural or cultured pearls, precious or semiprecious stones, precious metals, precious metal clad metals, articles thereof, imitation jewelry, coin
15	Base metals	72 iron and steel 73 articles of iron or steel 74 copper and articles thereof 75 nickel and articles thereof 76 aluminum and articles thereof 78 lead and articles thereof 79 zinc and articles thereof 80 tin and articles thereof 81 base metals not elsewhere specified or included, cermets, articles thereof 82 tools, implements, cutlery, spoons and forks, of base metal, parts thereof of base metal 83 miscellaneous articles of base metal
16	Machinery And Mechanical Appliances, Nuclear Reactors And Boilers	84 Nuclear Reactors, Boilers, Machinery And Mechanical Appliances, Parts Thereof
17	Electrical machinery and equipment, sound recorders, television image recorders	85 electrical machinery and equipment and parts thereof, sound recorders and reproducers, television recorders and reproducers, parts and accessories
18	Vehicles, aircraft, vessels and transport equipment	86 railway or tramway locomotives, rolling stock, track fixtures and fittings, and parts thereof, mechanical etc. Traffic signal equipment of all kinds 87 vehicles, other than railway or tramway rolling stock, and parts and accessories thereof 88 aircraft, spacecraft, and parts thereof 89 ships, boats and floating structures
19	Optical, cinematographic, measuring, precision, medical instruments, clocks and watches, musical instruments	90 optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus, parts and accessories thereof 91 clocks and watches and parts thereof 92 musical instruments, parts and accessories thereof
20	Arms and ammunition	93 arms and ammunition, parts and accessories thereof
21	Miscellaneous manufactured articles	94 furniture, bedding, cushions etc., lamps and lighting fittings not elsewhere specified or included, illuminated signs, nameplates and the like, prefabricated buildings 95 toys, games and sports equipment, parts and accessories thereof 96 miscellaneous manufactured articles
22	Works of art, collectors' pieces and antiques	97 works of art, collectors' pieces and antiques