

1 **Working Paper**

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7 **Adjusting Statistical Discrepancies of Bilateral Trade Data between China and the U.S.**

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14 **1 Introduction**

15 Trade data between China and the U.S. are available from reputable statistics in both countries^{1,2}
16 which are integrated by United Nations Statistics Division (UNSD)³. However, there are obvious
17 discrepancies between statistics in China and the U.S., as showed in Table 1. These discrepancies are due to
18 differences in statistical rules. Without careful adjustment, choosing statistical trade data from either
19 country will generate huge uncertainties.

20 Table 1 Bilateral trade statistics reported by China and the U.S. in billion U.S. dollars³.

Year	Exports from China to the U.S.		Exports from the U.S. to China	
	Chinese data	U.S. data	Chinese data	U.S. data
2002	70.1	133.5	28.2	20.6
2003	92.6	163.3	33.9	28.4
2004	125.2	210.5	44.7	34.7
2005	163.2	259.8	48.7	41.8
2006	203.8	305.8	59.3	55.2
2007	233.1	340.1	69.5	65.2

21 Scholars have studied the statistical discrepancies in bilateral trade between the two countries and
22 disclosed the underlying reasons. First, for exports from China to the U.S., the amounts from the U.S.
23 statistics are much higher than the amounts from the Chinese statistics. This is mainly due to the re-exports
24 through intermediate third destinations^{4,5}. In particular, a great deal of Chinese goods is not directly
25 exported to the U.S. from China ports, but first shipped to third destinations, primarily Hong Kong^{6,7}, and
26 re-exported to the U.S. In the Chinese statistics, those re-exports are not recorded as exports to the U.S. but
27 to Hong Kong. However, in the U.S. statistics, imports are recorded on a 'country of origin' basis which
28 attributes the imports to the ultimate original country of production. Therefore, the re-exports through Hong
29 Kong should be taken into account when studying pollution embodied in trade given that those re-exports
30 are manufactured in China and finally consumed in the U.S. Although the statistics on re-exports through
31 Hong Kong are available, scholars are still studying how to accurately estimate the markup of goods in
32 terms of economic values⁸. In this study, however, we proposed a new approach to estimate the actual value

33 of total exports from China to the U.S. by considering the quantity of goods. Despite there are markups for
34 goods re-exported through Hong Kong, statistics in both China and the U.S. also record the quantities of
35 goods in detail. Therefore, it is reasonable and straightforward to estimate the actual value of both direct
36 and indirect exports by multiplying the quantity recorded in the U.S. and the unit value recorded in China.

37 Second, there are also statistical discrepancies for exports from the U.S. to China, although much
38 smaller than those for exports from China to the U.S. Although China also compiles imports on the
39 "country of origin" basis after 1993, studies pointed out that the tracing of ultimate origins by China
40 customs may not entirely successful^{4,8,9}. Therefore, it is necessary to adjust the U.S. exports to China for
41 Hong Kong re-exports and markups. Moreover, the U.S. records export data on a "freight alongside ship
42 (FAS)" basis, while China records import data on a "cost, insurance, and freight (CIF)" basis. This has
43 instigated studies to estimate the cost of insurance and freight, primarily at an aggregated level. There are
44 profound studies estimating the U.S. re-exports and markups to China via Hong Kong, which can be used
45 to adjust the statistical discrepancies.

46 **2 Balance Trade Statistics between China and the U.S.**

47 2.1 Exports from China to the U.S.

48 Exports from China to the U.S. are recorded by both countries, respectively, in a "free on board
49 (FOB)" basis, officially known as "custom value" in the U.S., which excludes import duties, freight,
50 insurance, and other charges beyond loading onto the cargo vessel. However, there are still huge
51 differences between data reported by China and the U.S. The main reason is that data reported by China
52 exclude the re-exports through Hong Kong while the U.S. records imports on the country of origin basis.
53 Therefore, the differences between data of exports to the U.S. reported by the two countries are the
54 re-exports from China to the U.S. through Hong Kong. This has instigated many studies to adjust official
55 data from both countries by estimating re-export markups in Hong Kong most commonly by surveying
56 Hong Kong middlemen^{4,9,10,11}. Given that the accuracy of survey is hard to guarantee and products are
57 dramatically different from each other, the drawback of surveying middlemen is obvious. In this research, a

58 new approach is applied to adjust and balance the official data for exports from China to the U.S.

59 In fact, this proposed approach is enlightened by material flow analysis (MFA), a method
60 commonly used by industrial ecologists to study sustainability by quantitatively tracing material flows in
61 the economy¹². In our case, it is also possible to adjust and balance data of exports from China to the U.S.
62 by tracing the quantity of products. In particular, the real FOB value of eastbound trade from China to the
63 U.S., expressed by E_R , can be computed by the following equation,

$$64 \quad E_R = \sum_{i=1}^n \left(\frac{V_{Ci}}{Q_{Ci}} Q_{Ui} \right) \quad (1)$$

65 where V_{Ci} and Q_{Ci} represent the value and quantity, respectively, of exported commodity in category i ($i =$
66 $1, 2, \dots, n$) reported by China, and Q_{Ui} indicates the same quantity reported by the U.S. The ratio of V_{Ci} to
67 Q_{Ci} represents the FOB value of unit products in category i . Therefore, the real FOB value of exported
68 commodity in this category can be computed by multiplying this ratio by Q_{Ui} , the quantity reported by the
69 U.S. on the country of origin basis which includes both direct exports from China and re-exports through
70 Hong Kong. Data for V_{Ci} , Q_{Ci} , and Q_{Ui} are available from both countries' government statistics^{1,3}. Moreover,
71 the commodity classification systems used by China and the U.S. are both based on the Harmonized
72 Commodity Description and Coding Systems (the Harmonized System or HS)¹³. Therefore there is no need
73 to adjust commodity categories between databases from China and the U.S.

74 Although this novel method is straightforward in theory, there are several practical difficulties to
75 be overcome. First, some commodities are not reported by the U.S. but reported by China. The reason is
76 likely that those commodities are likely recorded into other categories by the U.S. Therefore, it is necessary
77 to keep those commodities blank in the adjustment to avoid repetitive records. Second, there are also some
78 commodities reported by the U.S. but not by China. Those are re-exports via Hong Kong and can be
79 adjusted based on the U.S. data by estimated proportion of re-exported markups⁹. Third, for some
80 commodities, trade values reported by the U.S. are less than those reported by China. This means such
81 commodities are partially recorded by the U.S. into other categories. Therefore, the U.S. data are part of

82 direct exports from China which can be directly used in the adjustment. Fourth, quantities of some
 83 commodities are not available from data reported by either China or the U.S. It is appropriate to use data
 84 reported by China in the adjustment because only few commodities fall into such case. Finally, all other
 85 commodities' adjusted trade values can be computed by the equation (1).

86 In this research, exports from China to the U.S. are adjusted based on the UNSD database at the
 87 level of HS 6 digits for year 2002 through 2007 using the method described above. Table 2 compares the
 88 adjustment result with official statistical data and other studies. The adjustment results of this research are
 89 between official statistical data reported by China and the U.S. and closer to the U.S. data. Compared with
 90 other top-down estimations, our results are slightly higher or close to their upper bound. It is hard to
 91 determine which estimation approximates the reality better. However, the adjustment in this research
 92 investigates the bilateral trade between China and the U.S. from a bottom-up perspective which is closer to
 93 the actual trade activities. Moreover, the adjustment in this research does not only contain the total trade
 94 data, but also the sectoral data as disaggregated as the HS 6 digits level which is essential for IOA related
 95 studies.

96 Table 2 Adjustment of Chinese exports to the U.S. and comparison in billion U.S. dollars.

Year	Official Chinese data ³	Official U.S. data ³	Adjustment of this research	Fung <i>et al.</i> ⁹	Schindler and Beckett ⁵
2002	70.1	133.5	113.0	94.5~109.5	95.3
2003	92.6	163.3	146.3	116.5~135.6	117.8
2004	125.2	210.5	172.3	149.9~175.4	N/A
2005	163.2	259.8	207.0	189.7~219.5	N/A
2006	203.8	305.8	282.9	N/A	N/A
2007	233.1	340.1	289.9	N/A	N/A

97 2.2 Exports from the U.S. to China

98 There are two steps to adjust statistical data for exports from the U.S. to China. First, the export
 99 data to China reported by the U.S. are on an FAS basis which excludes the costs of loading the goods onto
 100 the cargo vessels at the origination ports. Therefore, it is necessary to make data comparable by converting

101 them into the same basis. Because loading goods for export is part of the domestic economic activities, it is
 102 reasonable to include such costs into the values of goods as FOB value does, especially when investigating
 103 the economy's input-output structure. In order to convert into the FOB values, the U.S. reported export data
 104 on the FAS basis are adjusted by adding 1%, which has been proposed by researchers at various
 105 international organizations, including the World Bank⁹. On the other hand, China reports import data on the
 106 basis of CIF which includes insurance and freight costs. To adjust into FOB values, CIF values are
 107 multiplied by factors provided by Ferrantino and Wang⁸. Table 3 shows the adjusted total exports data
 108 reported by the U.S. in FOB value. Detailed data in commodity level are also available.

109 Table 3 Adjustment for the data of U.S. exports to China into FOB values in billion U.S. dollars.

Year	Chinese Data (in CIF value)	FOB/CIF ⁸	Adjusted Chinese Data (in FOB value)	U.S. Data (in FAS value)	Adjusted U.S. Data (in FOB value)
2002	28.2	0.962	26.3	20.6	20.8
2003	33.9	0.959	32.5	26.7	27.0
2004	44.7	0.960	42.9	32.6	32.9
2005	48.7	0.961	46.8	38.7	39.2
2006	59.3	0.961	57.0	51.6	52.1
2007	69.5	0.961 ^a	66.8	60.3	60.9

110 a: Ratio for 2007 is not available. Here use 0.961 the same as the ratios for 2005 and 2006.

111 Second, further adjustment is required by taking the U.S. re-exports to China through Hong Kong
 112 into account. Although China has been recording their imports on the "country of origin" basis since 1993,
 113 studies indicated that China's tracing of ultimate origins may not entirely successful^{4,8,9}. Therefore, the
 114 method developed in this research cannot be applied here to identify Hong Kong re-exports for the U.S.
 115 exports to China. Due to lack of data, it is also hard to directly trace Hong Kong re-exports by
 116 distinguishing both origins and destinations in commodity level. Given that Hong Kong re-exports only
 117 take about 20% of the U.S. direct exports to China since 2002 and the proportions of re-exports have been
 118 decreasing steadily^{8,9}, it is appropriate to adjust the U.S. exports to China data in commodity level by
 119 adding the share of Hong Kong re-exports and markups. In particular, the real westbound trade from the
 120 U.S. to China, expressed by W_R , can be computed by the following equation,

121
$$W_R = \sum_{i=1}^n (V_{Ui} + \frac{V_{Ui} p_r}{1 + p_m}) \tag{2}$$

122 where V_{Ui} represents the U.S. reported FOB value of exported commodity in category i ($i = 1, 2, \dots, n$), p_r
 123 is percentage of Hong Kong re-exports of V_{Ui} , and p_m indicates the percentage of markups of Hong Kong
 124 re-exports. Table 4 represents the adjustment of Hong Kong re-exports and markups based on the U.S. data
 125 in FOB value. Detailed data in commodity level are also available. Given that the adjustment based on the
 126 U.S. data is straightforward and represents the real exports to China, it is proper to be used as the
 127 approximation of the real U.S. exports to China in FOB value.

128 Table 4 Adjustment for the data of U.S. exports to China in FOB value by taking Hong Kong re-exports
 129 and markups into account, in billion U.S. dollars.

Year	Adjusted Chinese Data in FOB value	Adjusted U.S. Data in FOB value	Percentage of Hong Kong re-exports as direct U.S. exports to China (%) ⁸	Percentage of Hong Kong re-export markups (%) ⁹	Adjusted U.S. data including Hong Kong re-exports
2002	26.3	20.8	22.8	12.8	24.9
2003	32.5	26.7	18.4	11.2	31.4
2004	42.9	32.9	13.0	10.1	36.8
2005	46.8	39.2	12.4	10.1	43.6
2006	57.0	52.1	12.4	10.1 ^b	58.0
2007	66.8	60.9	12.4 ^a	10.1 ^b	67.7

130 a: Percentage for 2007 is not available. Here use 12.4% the same as the ratios for 2005 and 2006;

131 b: Percentage for 2006 and 2007 are not available. Here use 10.1% the same as the ratio for 2005.

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