On the Accuracy of Foreign Trade Statistics (1909–1935): Morgenstern Revisited*

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This work questions Morgenstern's pessimistic results on the reliability of aggregate international foreign trade statistics: His comparisons using pairs of countries can only test the misclassification of a country's trade flow. Aggregation, by contrast, eliminates this problem. Therefore, testing the total value of imports and exports with the sum of the same trade flows as registered by their partner countries' statistics, leads to more encouraging conclusions on the aggregate data. Our results strengthen considerably one's trust in the reliability of pre-World War II foreign trade statistics. Diversity in individual countries' accuracy indexes can be partially explained by differences in freight factors and also by minor differences in compilation. © 1991 Academic Press, Inc.

INTRODUCTION

Foreign trade statistics are one of the oldest and most complete economic series. Economic historians have used them extensively to account for differences in economic performance between countries and even to reconstruct domestic price and production series when unavailable.[1] This does not imply that their reliability has not (or can not) be questioned. Literature on the issue is fairly extensive. It includes "theoretical" works, which analyze comparability of statistics or the optimal criteria of com-

[1] See the classical works of Lewis (1952), Kindleberguer (1956), Nurkse (1959), Yates (1959), Maddison (1962), Maizels (1963), Kuznets (1967), Kravis (1970), and Bairoch (1976).

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pilation, as well as more "empirical" studies focused upon the accuracy or reliability of the data.[2] The few works that have tested the reliability of trade statistics are based on pairwise comparisons between records of the same flows in the statistics of partner countries. Results have usually been disappointing and have shown important differences even in the most recent data.[3] Many authors have considered this as a proof of the unreliability of the whole set of statistics. "It will be seen," Morgenstern stated in 1963, "that for pairs of individual countries correspondences are as a rule very poor, so it remains a puzzle how the aggregate could be better." He concluded:

> Writers on all phases of foreign trade will have to assume the burden of proof that the figures on commodity movements are good enough to warrant the manipulation and the reasoning to which they are customarily subject.[4]

In this work we argue that Morgenstern's inference is not necessarily correct because this method tests only the accuracy of the geographical assignment. Misclassification of a particular trade flow, either by commodity or by country, causes a parallel misclassification of opposite sign in another category. Aggregation, in principle, eliminates this problem.

A better test for the reliability of the aggregate data is the comparison between the total value of each country's trade (according to its own statistics) and the sum of these flows as registered by its partner countries' statistics.[5] The results of such a test for pre-World War II international foreign trade statistics strengthen considerably one's trust in the reliability of data: values of our index are already acceptable for the 1909–1913 data and show a significant improvement after the war. The test also suggests a certain continuity in the reliability of data and that an important part of the dispersion is due to c.i.f.–f.o.b. differences due to the composition of the trade flows.

[2] For a good discussion on theoretical issues see Allen and Ely (1953). On the reliability of statistics no comprehensive study has been published. The list of authors dealing with the subject goes from Bourn (1872) and Giffen (1882) to the restricted treatments given by some economic historians (see Kindleberger, 1956; Yates, 1959; Lewis, 1981).

[3] See Morgenstern (1963), Don (1968), Ely (1961), and, for analyses of more recent data, see Yeats (1978), Blades and Ivanov (1985), Kostecki and Tymowsky (1984).

[4] Morgenstern (1963, pp. 164 and 180). He tests foreign trade statistics using pairwise comparisons between countries $(M_i = (M_{ij} - X_{ji}/M_{ij}) \times 100$ and $X_i = (X_{ij} - M_{ji}/X_{ij}) \times 100$. A systematic reproduction of his test (using indexes instead of percentages) on a sample of countries shows a great variation between indexes. Coefficients of variation of the simple averages are around 50-60% and the range is extremely wide. For instance, 1909–1913 export indexes would go from 5 to 297 in the United States, from 34 to 133 in the United Kingdom, from 13 to 208 in France and from 35 to 218 in Germany.

[5] This method is discussed in Tena 1989, and it has been used to criticize or correct series of some countries with defective data such as Belgium (Degreve, 1982), Spain (Tena, 1985; Prados de la Escosura, 1986), and the Ottoman Empire (Pamuk, 1987).

In the first section of this essay we briefly consider the causes of divergence and review both the differences in compilation criteria and the actual errors. While the latter make data records diverge from real flows, the former may affect the comparability of data, but not their reliability. In principle, a statistic is reliable if it is consistent with the established national criteria, but it may not be comparable with the partner records. For instance, until 1904, the United Kingdom assigned trade by country according to the so-called "consignment method" which made comparison with other country's statistics hardly feasible.[6] As will be shown later, many of these "structural" differences in compilation can be eliminated by standardization of national criteria.

1. THE "THEORETICAL" PROBLEM

There are many reasons for divergence in the data relating to the same trade flow in the statistics of partner countries. The reasons can be grouped under three headings:

(a) "Unavoidable" differences arising between nonbordering countries because of the time and cost of transportation: The latter should be equal to the difference between the f.o.b. value of exports and the c.i.f. value of imports.

(b) "Structural" differences in compilation criteria, which could be eliminated by standardization: They concern mainly trade coverage, classification of goods by items, recording of values, and indication of trading partners. There are two alternative models. The first one was adopted by Britain and the U.S. (the "Anglo–Saxon model") and the second by most European countries (the "Continental model").[7] Even if the most important differences are those among countries, significant divergences can also be detected within time series relating to the same country. More or less sizeable changes in compilation criteria and definitions were in fact rather frequent. They produced discrepancies which in most cases cannot be corrected, but must nevertheless be borne in mind when reconstructing historical series;

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[6] It registered the flows according to the first port of departure or arrival of the goods as indicated on the shipping documents. Consequently it overestimated the flows to and from the countries with "entreport trade" and there was almost no trade with land-locked countries like Switzerland, Bolivia, and Paraguay.

[7] Countries using the "Anglo–Saxon" model considered only one generic category of trade, excluding "transit" (only British exports distinguished British products from reexported foreign ones). In theory, this ought to have been the same as "special trade" on the "Continental" criterion, including improvement trade and stock changes in bonded warehouse. The other main difference between the two models was in the record of values. Prices could either be declared by the shipper ("declared values")—as in the Anglo–Saxon model—or estimated as unitary values by an official commission ("official values"). After the First World War "declared values" were progressively adopted by almost every country.

(c) Finally, there were actual errors, i.e., cases where recorded data differed from the real flow. They can be classified as follows:

(1) Failure to record because of smuggling: Smuggling usually affects imported commodities with high duties. This causes an underestimation of trade in the importing country but not necessarily in the exporting one.[8]

(2) Inaccurate recordings following wrong declarations because of negligence or fraud: These errors might concern either parameters of individual transactions (weight, value, etc.) or their classification. The most important case seems to be entering consignments in transit as special trade (according to the "Continental" definition)—especially duty-free goods. It resulted in an overvaluation of the trade of the country, as well as of world trade, and caused a divergence from the statistics of other states.[9] Furthermore, in the case of *ad valorem* duties, traders had an obvious interest in declaring values below the real ones.

(3) Errors by statistical offices: These errors were related mainly to the estimation of official values. The most serious case was of course the failure to update them yearly. It caused an overvaluation in times of falling prices and undervaluation in times of rising ones. Errors in the estimation of values were also due to the use of domestic instead of international prices or to the failure to weigh values according to quality or place of origin. There could also be deliberate distortions: raising the unit price of imports, for instance, would give a false impression of lower nominal protection. Finally, official conversion of export values into the importing country's currency should be done at the exchange rate current at the time the payment is made. The use of other rates (as those prevailing at earlier or later dates) would introduce systematic distortions into a country's import statistics.[10]

The percentage of errors was higher in records by country, undoubtedly the worst part of all trade statistics. Declarations of traders about the origin and destination of goods were not reliable, and customs were interested in checking them only if differentiated tariffs by country were

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[8] Therefore, generally speaking, the sum of bilateral trade statistics may be a good indicator of smuggling. This would not be the case when duties are imposed upon exported goods or when the transaction is illegal.

[9] Netherlands is the most evident case of inclusion of transit trade in the special trade accounts (see text).

[10] In periods of considerable fluctuation in exchanges rates during the year (as in war or postwar inflation periods), under floating exchange rates, this can produce a high number of errors. A related problem arises, for both export and import, when economic historians use incorrect exchange rates. For instance, in 1937 German foreign trade was conducted by the use of a complex system of multiple exchange rates and it is well known that the official rate of 40 U.S. cents per Reichsmark considerably overvalued the German currency. See Maizels (1963, p. 542).

applied (hence it is likely that accuracy was greater on the import side). In general there was a tendency to overestimate the trade with neighboring or transit countries and underestimate, to the same extent, that with distant ones; this bias was particularly serious for land transport.

2. THE TEST

Only a few studies have tested systematically the reliability of trade statistics, and, with one exception, they all used the method of pairwise comparison (as in Lippert, 1903). The most comprehensive survey (37 countries for 1909–1913), which elaborated on the basis of this procedure, was carried out by Zuckermann (1921). By then an alternative method of testing had been used by Ricci (1914) in the reconstruction of the whole matrix of world wheat trade in 1909. Ricci succeeded in explaining almost all the initial differences due to type (A) and (B) errors. His results pointed to a less pessimistic view of the quality of the data but unfortunately his method can be applied only to homogenous commodities. Yehuda Don's well-known study, while suggestive, was almost exclusively devoted to the comparability of U.K. and Austria–Hungary statistics. While he adopts the same method as Morgenstern he is not as pessimistic and tends to consider more carefully the problems of comparability.

Our test is designed to overcome errors due to geographical assignment. Our index is the ratio of the total trade of the ith country according to its statistics with the sum of the same flows according to the statistics of its partner's (jth country):[11]

$$M_i = \frac{\sum_{i=1}^{N} M_{ij}}{\sum_{j=1}^{N} X_{ji}} \qquad X_i = \frac{\sum_{i=1}^{N} X_{ij}}{\sum_{j=1}^{N} M_{ji}}.$$

This ratio includes a transporation cost component, i.e., the difference between the c.i.f. valuation of imports and the f.o.b. valuation of exports. Differences between countries in the percentage of transportation costs (the so-called "freight factor") depend more on the commodity composition of trade than on its geographical distribution. The higher the freight factor, the larger the share of bulky commodities in total trade flows.[12] The international factor estimated here is the weighted average of the

[11] The summations of geographical assignment errors in the numerator cancel each other out by definition. The denominator is the sum of independent items taken from different countries' statistics. Therefore there is not a mathematical compensation as in the numerator. However, if errors are casual, they tend to be balanced; the higher the number of countries, the lower their concentration of trade.

[12] "It follows that the differentiation between freight factors of imports of the same commodity from different countries is significant only when low-valued commodities are considered" Moneta (1959, p. 51). Similar results are obtained for the United States case by Yeats (1978).

available data. Freight factors have been taken only for eight countries: an estimation for all others would require too much information and calculation to be feasible here. Despite the small number of countries, the sample is representative enough, accounting for more than 50% of world trade.[13] This factor is used to compute indexes of a perfect "average" statistic (henceforth called "the norm"). However, given the wide differences among countries ("freight factors" go from 2 to 21%), one could accept a larger interval of confidence (80–100 for exports and 100–120 for imports).

In the test we employ Zuckermann's data covering 19 European and 14 non-European countries for the years 1909–1913.[14] This source gives for each country a network of trade (in francs at the gold parity) representing at least 90% of their flows. For the years 1928 and 1935 the data are taken from the world trade matrix in League of Nations (1942). This work reports 173 national records of export and import flows by country of origin and destination (the representativity for each country being aroung 100%) in dollars at 1934 parity. To maintain the homogeneity of the sample we have selected in both cases the same countries (using Yugoslavia as Serbia and Austria as Austria–Hungary). This sample covers around 95% of world trade in 1909–1913 and 90% after the war.

3. RESULTS

Aggregate results reported in Table 1 are better than we expected: averages for the whole sample[15] are—for imports and exports—stable in time and close to the norms. The hypothesis of significant differences among values at the three benchmark years can always be rejected.[16] It is also possible to reject the hypothesis that the averages significantly differ from the "norm" at 5% in five of the six cases (only imports in 1909–1913 seem significantly overvalued). The division of the sample between industrial and nonindustrial countries is designed to test whether a higher level of economic development might determine a better quality of bureaucracy and therefore better statistics. This hypothesis seems to hold only for 1909–1913 exports: in other cases differences are not relevant.

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[13] An Appendix with the estimation of freight factors is available upon request.

[14] Zuckermann (1921). For the list of countries and the division between industrial and nonindustrial countries (according to the League of Nations classification) see the Appendix. The 5-year average used for 1909–1913 is very close to (and never significantly different from) the average annual data.

[15] The Netherlands is always excluded because its indexes in 1909–1913 are extremely overvalued (see below). We have computed indexes for other countries excluding altogether trade with the Netherlands from the matrix. Aggregate results (available on request) are very similar.

[16] The heteroscedasticity of the average reinforces this conclusion.

TABLE 1

Statistical Foreign Trade Accuracy Indexes by Groups of Countries

	1909–1913		1928		1935	
	$\bar{X}$	CV	$\bar{X}$	CV	$\bar{X}$	CV
A. Exports						
Industrial countries[a]	97.6	0.152	92.7	0.070	96.1	0.059
Nonindustrial countries	82.5	0.256**	93.8	0.161	90.4	0.195
World[a]	86.6	0.237	93.5	0.141	92.0	0.168
B. Imports						
Industrial countries[a]	117.1	0.170	108.3	0.115	112.7	0.095
Nonindustrial countries	113.0	0.144	109.9	0.133	112.3	0.107
World[a]	114.1	0.150*	109.5	0.127	112.3	0.102

Note. $\bar{X}$, arithmetic average; CV, coefficient of variation. Sources, See text and Appendix.

[a] Netherlands excluded (see text).

* Significantly different from the "norm" at 5%.

** Significantly different from the "norm" at 10%.

Country indexes are rather scattered in 1909–1913, as shown by the variation coefficient in Table 1: after the war the dispersion is clearly lower—the reduction of variance is significant.[17] This trend can be visualized in the reduction of the number of outliers (cases outside our interval of good accuracy) in Fig. 1: it declines from 22 for exports and 24 for imports to 9 and 13, respectively, in 1928.

Table 2 shows some relevant correlation coefficients by country. To the left there are those between the same flow (imports or exports) in different years: the fairly high (and highly significant) values show the existence of intertemporal stability. This rules out the possibility that good and stable sample averages are the causal result of erratic movements of country indexes. We report the coefficients between different flows in the same year in the right column of Table 2. Low and insignificant values seem to exclude the existence of systematic biases (i.e., an overvaluation or an undervaluation).

Previous discussion has suggested two possible causes of the dispersion of indices—besides errors—i.e., different compilation criteria and the freight factor. The latter's influence can be tested because it depends, as already said, on the share of bulky commodities on total trade. The higher the freight factor, the larger the difference between c.i.f. and f.o.b. valuations and therefore the more distant the index from 100. This idea can be tested with the regression

[17] The null hypothesis of homoscedasticity is rejected at 2% for exports and 5% for imports.
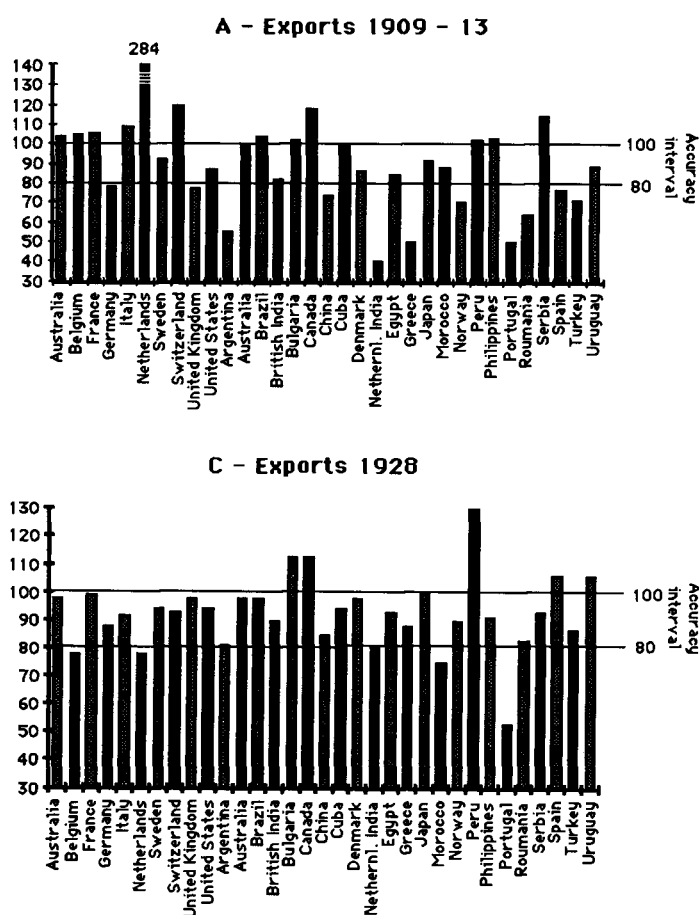
FIGURE 1

$$INDEX = a + b \, BULKY + e, \tag{1}$$

in which INDEX is our index of accuracy and BULKY is the share of bulky commodities, with a predicted coefficient negative and positive for exports and imports, respectively (see Table 3). We have tested it with export indexes for 1909–1913, the year and the flow with the highest dispersion. Data of BULKY have been computed as a weighted sum of shares on total exports of the six commodities with the highest transportation costs.[18] The weighting corresponds to the freight factors (as a per-

[18] Data on countries bulky commodity exports composition in 1913 are taken from Yates (1959), League of Nations (1927); for Portugal see Lains (1986).

B - Imports 1909 - 13
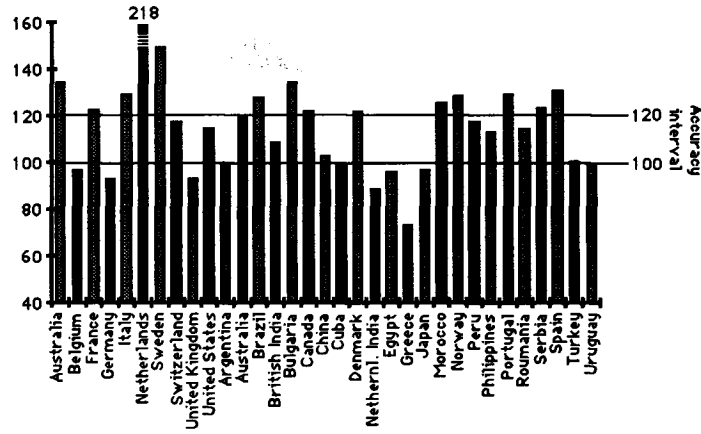
D - Imports 1928
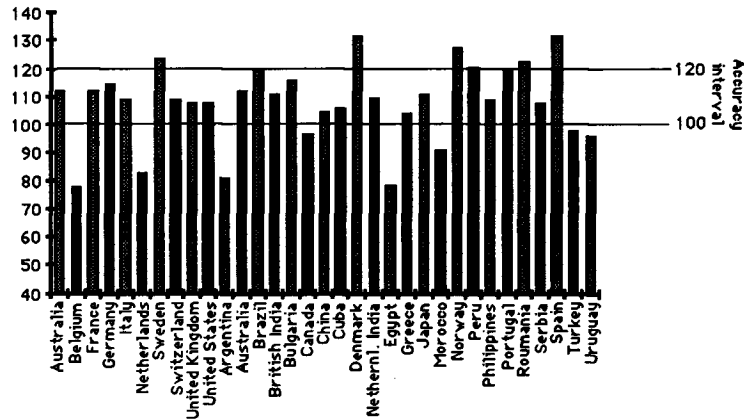
FIG. 1—*Continued*

TABLE 2
Correlation Coefficients

EX13-EX28: 0.570*		EX13-IM13: 0.272
EX13-EX35: 0.576*		EX28-IM28: 0.214
EX28-EX35: 0.732*		EX35-IM35: 0.074
IM13-IM28: 0.524*		
IM13-IM35: 0.286		
IM28-IM35: 0.514*		

* Significant at 1%.

TABLE 3
Bulky Commodities Regression Functions: Exports 1909–1913

(A)

(1) INDEX = 96.99 − 4.56* BULKY $R^2 = 0.11 \backslash\ F = 5.04$
   $n = 33$ (16.99)   (2.25)   SEE = 19.33

(2) INDEX = 100.01 − 7.07** BULKY $R^2 = 0.38 \backslash\ F = 16.57$
   $n = 29$ (21.80)   (4.07)   SEE = 15.28

(B)

(1) INDEX = 92.24 − 3.95% BULKY + 12.29 GROUP; $R^2 = 0.16 \backslash\ F = 4.01$
   $n = 29$ (14.73)   (1.98)   (1.64)   SEE = 18.82

(2) INDEX = 94.36 − 6.52**BULKY + 14.71*GROUP; $R^2 = 0.47 \backslash\ F = 13.58$
   $n = 29$ (20.14) (4.11)   (2.64)   SEE = 13.78

Note. *t*-Statistics in parenthesis.
* Significant at 5%.
** Significant at 1%.

centage of the commodities value) as reported by Moneta for German imports in 1951.[19]

The model is further tested through the introduction of a dummy (GROUP) for the level of industrialization, a variable that has proved to be a relevant factor of differentiation at least within this sample. It can be considered a proxy for different qualities of the statistical service.

Results of the regression from the whole sample confirm the freight factor as an explanatory variable: BULKY is always negative and significant at 5%, but in the simpler model (regression A.1) the R^2 is rather low. The introduction of GROUP (B.1) raises it slightly. However, it is possible to single out from an analysis of the residuals a small group of "outlying" indexes, which could be explained by country-specific considerations.[20] Excluding only four countries (Canada, Portugal, Peru, and Serbia) the level of significance rises to 1% and the R^2 to 0.38 (regression A.2). The introduction of the dummy (B.2) raises the explained variance

[19] Moneta (1959). The commodities are (freight factor in parentheses) petroleum (64.3%), coal (53.2%), minerals (37.6%), wood and timber (24.8%), cereals (16.8%), fruit and vegetables (15.8%). We assume that proportion among freight factors of bulky commodities of German import in 1951 are similar to those of the international trade in 1913.

[20] The apparent overvaluation of Canada's export could be the consequence of a geographical misclassification by European importing countries. If a high proportion of Canadian commodity exports to Europe passed through United States harbors, they could have been recorded as imports from the U.S. rather than from Canada. In this way our Canadian export index would be undervalued in the denominator. The Portuguese undervalued index came from a British misclassification. Portugal only recorded domestic export while its main import partner, Great Britain, recorded also the goods coming from Portugal's colonies. For Peru and Serbia, with a very small value of trade, time lags and misclassifications have a disproportionate impact on the trade differences.

to 0.47 and the dummy itself is also significant. This result suggests that differences in the quality of statistical services could be a relevant explanatory variable.

Outcomes can probably be improved by refining the freight factor index. However, they strongly suggest we should complete the aggregate analysis with case studies. Only at a country level is it possible to pinpoint peculiarities in compilation criteria and/or defects in statistics that can explain the actual values of indexes. The following cases can serve as examples.

In 1909–1913 the Netherlands is characterized by an extreme overvaluation (284 for exports and 218 for imports), caused by the inclusion of both transit and transhipment trade in the special trade accounts and to the use of old fixed values (most of them not revised since 1846). In 1917 transit trade was excluded (through the imposition of a general *ad valorem* duty on imports that excluded transit good) and declared values were adopted.[21] These changes were effective: Dutch indexes in the interwar years are quite good, even slightly undervalued.

Greek indexes are clearly undervalued in 1909–1913. This seems due to the out-of-date revision of the official values before 1918.[22] From then on they were revised yearly until declared values were introduced, at first partially in 1921 and as a general system in 1926. This change seems to be responsible for the remarkable improvement in the Greek indexes of 1928 and 1935. It should be added that other nonindustrial countries (such as Argentina, Romania, and Spain) failed to revise annually the official values.[23]

Low values for Germany and Great Britain in 1909–1913 are puzzling, because both countries are usually regarded as paradigms of accuracy, even if they used different methods of compilation.[24] They can be ex-

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[21] League of Nations (1927, pp. 527–535). As is well known, international prices declined during the great depression of 1880 and rose afterwards (Great Britain's export prices index goes from 118 in 1845–1847 to 92 in 1909–1913). This would explain why the lack of a unit value revision was one of the causes of the overvaluation of Dutch statistics.

[22] In this case the bias is opposite because prices rose between the second half of 1890s and 1913 (Britain's import prices index rose from 69 in 1895–1897 to 83 in 1911–1913). This would produce a tendency toward undervaluation in statistics with values not regularly revised.

[23] League of Nations (1927, pp. 374–377). The import overvaluation trend affected both industrial and nonindustrial countries in 1909–1913. This could be explained by the inclusion of transit trade in special trade accounts and—for countries using official values—a tendency to overvaluate unit prices (to give a false impression of a lower nominal protection).

[24] German statistics seem to present problems only for the years prior to 1880. Since then, the accuracy in the distinction of special trade from other trade flows and a meticulous annual estimation of official values differentiated by country and revised annually ranked them among the most accurate in Europe. British statistics followed the Anglo-Saxon method of compilation, but also present an accurate record of reexport and from at least 1871 an accurate system of declared values.

plained at least partially by the distortions introduced into the test by the great overvaluation of Dutch statistics. Both countries had considerable bilateral trade with the Netherlands, especially Germany.[25] In fact, if the Netherlands is left out of their trade matrix, both indexes would improve, but not in the same proportion (the German index rising to 119 for imports and 88 for exports, the British one to 98 and 78, respectively). The smaller improvement in British statistics suggests the existence of other problems, such as differences in trade coverage definition or undervalued declarations by traders. Given the smaller size of bilateral trade with the Netherlands, this problem does not affect other countries.[26]

4. CONCLUSIONS

The results of our test are better than those of previous tests, which were based on unnecessarily stringent requirements (the accuracy of country assignment). The accuracy indexes are already relatively good in the 1909–1913 period, and they show a net improvement after the war. The standardization efforts of the League of Nations improved both the comparability and the accuracy of data. Diversity between individual country indexes can be partially explained by differences in freight factors and also by minor differences in compilation.

Therefore, our verdict on the reliability of foreign trade statistics is—on balance—positive, at least for aggregate data. However, the use of statistics of any single country requires a careful assessment of their values through a study of the methods of compilation and of the efficiency with which they were applied. Even greater caution should be taken when handling data on the geographical distribution of trade, which are usually rather unreliable.

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[25] According to German statistics the share of Dutch exports and imports was 3 and 7%, respectively; according to Dutch records, those percentages would increase to 32 and 18%. For the British case the same percentage would be 3% for both export and import in British records and 9 and 6% in the Dutch ones.

[26] The only exception is Belgium which, with Germany and the United Kingdom, was one of the biggest trade partners of the Netherlands. Belgium's index without the Netherlands improves its import outcomes and increases the overvaluation already detected in exports, a fact that is probably closer to reality.

APPENDIX

Accuracy Index

	1909–1913		1928		1935	
	Export	Import	Export	Import	Export	Import
Industrial countries						
Austria	104	135	98	112	100	117
Belgium	105	97	78	79	97	94
France	106	123	99	112	100	115
Germany	78	93	88	115	96	124
Italy	109	130	92	109	91	107
Netherlands	284	218	78	83	82	92
Sweden	92	150	94	124	88	116
Switzerland	120	118	93	109	107	129
United Kingdom	77	93	98	108	93	108
United States	87	115	94	108	93	104
Nonindustrial countries						
Argentina	55	99	81	81	81	105
Australia	99	121	98	112	88	111
Brazil	104	128	98	120	84	116
British India	82	109	90	111	87	108
Bulgaria	102	135	113	116	111	127
Canada	118	122	113	97	101	99
China	74	103	85	105	70	110
Cuba	100	99	94	106	94	102
Denmark	86	122	98	132	96	122
Netherl.India	40	89	81	110	76	128
Egypt	84	96	93	79	94	89
Greece	50	73	88	104	86	110
Japan	91	97	100	111	91	112
Morocco	88	126	75	91	84	119
Norway	70	129	90	128	85	116
Peru	102	118	130	121	131	121
Philippines	103	113	91	109	79	99
Portugal	50	130	53	120	60	113
Roumania	64	115	83	123	84	99
Serbia	114	124	93	108	84	114
Spain	76	131	106	132	79	109
Turkey	71	101	87	98	94	98
Uruguay	89	99	106	96	143	123

Sources. See text.

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