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Anglo-American trade costs during the first era of globalization: the contribution of a bilateral tariff series*

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Abstract

Previous scholarship has suggested that British trade was generally unaffected by foreign tariffs during the period from 1870-1913. This article focuses specifically on Anglo-American trade, the largest bilateral flow of trade during the first era of globalization, and finds that tariffs were the sole inter-temporal determinant of Anglo-American trade costs. However, the determinacy of tariffs for Anglo-American trade costs only becomes apparent when the tariff variable incorporates a measure of the bilateral American tariff toward Britain, which this article reconstructs. The article concludes by claiming that Anglo-American trade represents a major qualification to any emerging consensus that foreign tariffs were of minor significance to the trade of late nineteenth-century Britain.

Keywords: Britain, United States, nineteenth century, globalization, tariffs, bilateral tariffs, trade, trade costs

JEL codes: F14, N71, N73

In the first era of globalization, the largest bilateral flow of trade was between Britain and the United States. This article examines Anglo-American trade during the period from 1870-1913, the so-called first era of globalization. Specifically, the aim of this article is to identify the determinants of Anglo-American bilateral trade costs, paying special attention to tariffs. Bilateral trade costs are a standardized measure of the difference between the actual and frictionless volumes of bilateral trade. In a recent study, Jacks et al. calculated annual series of bilateral trade costs for a large number of country pairs and then proceeded to estimate the determinants thereof using a gravity model. They found that tariffs were not a statistically significant determinant of the bilateral trade costs of those country pairs that included Britain.[1] This finding is consistent with earlier literature claiming that British trade was generally unaffected by foreign tariffs.[2] But were tariffs a non-determinant of Anglo-American bilateral trade costs in particular? There are two important reasons why this question warrants consideration.

First, as already mentioned, the scale of Anglo-American trade was unsurpassed, comprising 7 per cent of world exports between 1870 and 1913.[3] Britain was consistently the foremost export market of the United States, owing primarily to the trade in cotton. Likewise, the United States was an important export market for Britain, though the share of the United States in the country composition of British exports was, according to Saul, 'volatile'.[4] Especially during the early years of the first era of globalization, periods of expansion in the American economy closely corresponded to increases in British exports to the United States, oftentimes resulting in the United States assuming the largest share in the country composition of British exports.[5] Indeed, Anglo-American trade was of an immense scale. For this reason, if the determinants of Anglo-American trade (or trade costs) were exceptional,

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[1] Jacks et al., 'Trade costs', p. 135.

[2] See Saul, *Overseas trade*, p. 165; Hatton, 'British exports', p. 585.

[3] To arrive at this figure, the values of British exports to the United States (1870-1913) and American exports to Britain (1869/70-1912/3) are deflated and expressed in 1913 prices. The combined volume of British exports to the United States and American exports to Britain is then divided by the volume of world exports in 1913 prices, as estimated in Lewis, 'World trade', pp. 60-5. Nominal values of annual British exports to the United States are reported in the *Annual statements*. Sterling values are converted to dollar values using the exchange rates reported in Mitchell, *British historical statistics*, pp. 702-3. The deflator for British exports is taken from Imlah, *Pax Britannica*, pp. 96-8. Nominal values of annual American exports to Britain are reported in the *Foreign commerce*. The deflator for American exports is taken from Lewis, 'World trade', p. 60, for 1869/70-1878/9, and from Lipsey, *Price and quantity*, p. 413, for 1879/80-1912/3. Unless otherwise noted, all trade values mentioned in this article are from either the *Annual statements* (Britain) or the *Foreign commerce* (United States).

[4] Saul, 'Export economy', p. 6.

[5] Williamson, 'Long swing', pp. 34-40. The United States accounted for the largest share in the country composition of British exports in the years 1870-4, 1880, 1882, 1888, and 1895.

then the general conclusions drawn from gravity models for the first era of globalization are compromised, as these models do not weight the various country pairs.

Second, Anglo-American trade was unique in that it was characterized by quite divergent commercial policies, with Britain notoriously pursuing (practically) free trade and the United States espousing one of the most highly protectionist tariff regimes in the world.[6] Still, American commercial policy, though protectionist by almost any standard, was hardly unchanging throughout the course of the late nineteenth century, most notably during the 1890s when the McKinley Tariff (1890), Wilson-Gorman Tariff (1894), and Dingley Tariff (1897) followed in rapid succession. A substantial literature, addressed shortly, has examined the effect of American tariffs on British exports of certain commodities. Yet, no study has explicitly and econometrically considered the aggregate role of American tariffs in the context of Anglo-American trade.

One deficiency of gravity models is the tariff measurement assigned to each country pair.[7] The tariff measurement is usually some combination (product or sum) of the average tariffs of the two countries, rather than a combination of the bilateral tariffs of the countries toward each other. Taking an average tariff as an approximation of a bilateral tariff is a precarious practice, especially when the composition of bilateral imports differs substantially from the composition of total imports, as in the case of bilateral American imports from Britain. Thus, in order to properly ascertain whether tariffs determined Anglo-American trade costs, this article reconstructs an annual series of the (unidirectional) bilateral American tariff toward Britain for 1870/1-1912/3. The product of the bilateral American tariff toward Britain and the average British tariff—so low that British commercial policy was considered free trade—represents a greatly improved tariff measure for Anglo-American trade.[8] This improved tariff measure is then considered alongside other potential determinants of Anglo-American trade costs.

This article proceeds as follows. Section I situates this article within three recent scholarly debates: trade (and trade costs) during the first era of globalization, the effect of American tariffs on selected British commodity exports, and lastly the measurement and application of bilateral tariffs. Section II reconstructs an annual series of the bilateral

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[6] For a comparison of the average tariff levels of industrial countries for the period from 1875-1914, see table 1 in O'Rourke, 'Tariffs and growth', p. 461. If Russia were included in this comparison, its average tariff may well have exceeded the average tariff of the United States (25%). See Knowles, *Economic development*, pp. 283-5.

[7] For example, see Estevadeordal et al., 'Rise and fall', p. 373.

[8] The extent to which Britain pursued a commercial policy of free trade in the mid nineteenth century has provoked debate. See Nye, 'Free-trade Britain'; Irwin, 'Comment on Nye'.

American tariff toward Britain, relying on a method best described as a current-year weighted average of per-industry *ad valorem* equivalent tariffs. This section also reconstructs an alternative, substitution-adjusted series of the bilateral American tariff toward Britain, relying on a method suggested by Federico and Tena. Section III briefly comments on the course of the bilateral American tariff toward Britain, explaining why it differed from the average American tariff. Section IV estimates the determinants of Anglo-American trade costs in a manner broadly consistent with Jacks et al. Section V offers concluding remarks.

I

Estevadeordal et al. put forward a gravity model of trade for the period from 1870-1939, spanning the first era of globalization and the interwar globalization backlash. They estimated the direct effect of trade barriers on bilateral trade, using data taken from the years 1913, 1928, and 1938. In the most advanced specification of their gravity model, which included country fixed effects, the variables for payments frictions (gold standard adherence), policy frictions (tariffs), and transport frictions (distance) were all statistically significant determinants of the volume of bilateral trade.[9] Statistical significance aside, the actual contributions of these frictions to prewar globalization varied greatly. The pervasion of the gold standard and the decline in transportation costs were major drivers of the volume of world trade and, therefore, globalization.[10] However, as Estevadoerdal et al. argued, tariffs exerted little effect on the volume of world trade between 1870 and 1913, since the trade-weighted world tariff level remained practically unchanged throughout this period, at least judging by the benchmark years of 1870, 1900, and 1913.[11]

Jacks et al. focused on the first era of globalization specifically. Their approach departed from the approach undertaken by Estevadeordal et al. in one crucial respect. While Estevadeordal et al. estimated the *direct* effect of individual barriers on bilateral trade, Jacks et al. estimated the *indirect* effect of individual barriers on bilateral trade, via trade costs. Trade costs are a standardized measure of the difference between the actual volume of bilateral trade and the volume of bilateral trade in the absence of any trade barriers. Although a theoretical discussion of trade costs is beyond the scope of this present article, it should be noted that the calculation—not estimation—of bilateral trade costs for a given country pair is

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[9] Estevadeordal et al., 'Rise and fall', p. 374. Without country fixed effects, however, the coefficient of tariffs was not statistically significant at a conventional level.
[10] Ibid., pp. 394-5.
[11] Ibid., p. 391.

based upon the countries' export volumes (bilateral and total) and real GDPs.[12] Trade costs encompass all barriers to trade, including measurable barriers, such as transportation costs, as well as not so readily measurable barriers, such as the reach of distribution channels. In this way, bilateral trade costs capture the aggregate barriers to bilateral trade. This article follows the example of Jacks et al. in estimating the determinants of bilateral trade costs, rather than of the bilateral trade volume, for the Anglo-American country pair. This strategy permits a better identification of the individual barriers to Anglo-American trade, as separate from the effects of income and relative prices on bilateral trade.

Jacks et al. examined the determinants of bilateral trade costs in both a large and small sample. For the large sample, which contained 48 country pairs, they found that distance, tariffs, adherence to the gold standard, membership in the British Empire, and railway density were all statistically significant determinants.[13] Based upon the standardized coefficients of these variables, distance emerged as the primary determinant of bilateral trade costs, while the other variables were of secondary importance.[14] In recognition of the well-documented decline in ocean freight rates that occurred during the first era of globalization, Jacks et al. sought to estimate the effect of freight rates, rather than (time-invariant) distance *per se*, on bilateral trade costs. They therefore reduced the sample to only those country pairs that included Britain, which were the country pairs for which bilateral ocean freight indices were available. The results were quite different. The most noteworthy difference was that tariffs were not a statistically significant determinant of bilateral British trade costs, of which Anglo-American trade costs were a subset.[15] Ocean freight rates, the variable of interest in the reduced sample, took on a statistically significant coefficient, though it should be observed that the standardized coefficient of this variable was especially small.[16]

Whereas the general literature on the first era of globalization suggests a diminished role for tariffs, the commodity-specific literature on Anglo-American trade during this same period suggests that British exports to the United States were elastic to American tariffs. It should be observed that this literature was primarily intended to assess whether American tariffs fostered certain domestic manufacturing industries. Still, the conclusions reached in this literature may rightly be extended to Anglo-American trade, since the manufactured

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[12] Additionally, it is necessary to assume the elasticity of substitution and the share of tradable goods in economic output. For a theoretical discussion of trade costs, see Novy, 'Gravity redux'.

[13] Jacks et al. 'Trade costs', p. 135.

[14] Ibid., pp. 134-5. It should be noted that membership in the British Empire greatly reduced trade costs for these bilateral pairs, *ceteris paribus*.

[15] Ibid., p. 135.

[16] Ibid.

commodities were previously supplied by Britain, and often to a great extent. While for the antebellum period, the debate was focused on the American cotton textile industry, for the late nineteenth century, the industries of pig iron and tinplate have received the most attention.[17]

Sundararajan was the first to examine econometrically the relationship between American tariffs and domestic pig iron production for the late nineteenth and early twentieth centuries. What distinguished his approach was the calculation of an annual series of the effective tariff for pig iron, that is, the protection extended to the domestic value added in the pig iron industry, after accounting for the share of imported material inputs and the duties imposed upon these inputs.[18] He found that the effective tariff, though not the nominal tariff, was a statistically significant determinant of pig iron production in the seaboard states of New York and New Jersey, where production was not insulated from international competition by the cost of inland transportation.[19] Irwin, proceeding on a better econometric footing, revisited the American pig iron industry and the extent to which it depended upon protection. He found that domestic production and imports were responsive to the (nominal) tariff. In the most extreme of his three counterfactual scenarios, the complete elimination of the duty on pig iron in 1869, the volume of pig iron imports would have risen by 172 per cent in the short run and 489 per cent in the long run, though it should be emphasized that the share of imports in domestic consumption would have remained small.[20] A very recent study by Inwood and Keay explored several potential determinants of British pig iron exports to the United States and Canada during the period from 1870-1913. They found consistent evidence for a negative association between tariffs and pig iron.[21] Based on their estimated coefficient, a 10 per cent decrease in the duty on pig iron, such as occurred under the Tariff Act of 1872, would have corresponded to a 7 per cent increase in British pig iron exports to the United States, *ceteris paribus*.[22]

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[17] For the debate on the dependence of the antebellum cotton textile industry on protection, see Harley, 'International competitiveness'; Irwin and Temin, 'Antebellum tariff'; Harley, 'Different products'.

[18] In his calculations, Sunadararajan had to assume that the factor shares of material inputs remained constant over specified intervals.

[19] Sundararajan, 'Iron and steel', pp. 602-3.

[20] Irwin, 'Iron industry', p. 292.

[21] Inwood and Keay, 'Iron trade', p. 112.

[22] For a record of changes in the American duty on pig iron, refer to Taussig, *Tariff question*, p. 139.

In contrast to pig iron, American consumption of tinplate was satisfied wholly through imports from Britain, prior to the McKinley Tariff.[23] Using a probit model, Irwin found that the McKinley Tariff initiated the domestic production of tinplate, which displaced the majority of imports by the close of the century.[24] Had the McKinley Tariff not raised the duty on tinplate, domestic production would probably not have commenced until sometime between 1898 and 1903, by which time the relative price of material inputs—the main material inputs were iron and steel—would have declined enough to permit domestic production.[25]

The literature on historical bilateral tariffs includes one outstanding and recent example. Dedinger reconstructed the late nineteenth-century bilateral French tariff toward Germany for the period from 1857-1913. In this endeavour, she benefitted from the unique arrangement of the French trade statistics, which enabled her to identify, for each product class, the value of French imports from Germany and the customs revenue collected thereon. Dedinger then used this bilateral tariff series to argue that French protection did not systematically discriminate against imports from Germany and that French protection had little bearing upon the share of Germany in imports.[26]

The British Board of Trade actually estimated the bilateral American tariff toward Britain, along with the bilateral tariffs of ten other countries, but for just the year 1902.[27] The Board of Trade's estimate of 73 per cent for the bilateral American tariff toward Britain greatly exceeds this article's main estimate of 33 per cent. The discrepancy arises from the dissimilar methods used to estimate the tariff. In this article, the main method entails a weighted average of per-industry *ad valorem* equivalent tariffs, with the weights derived from the composition of bilateral trade. However, the method employed by the Board of Trade used weights derived from the composition of British exports to all countries. The Board of Trade summarized this distinguishing feature of its method as follows: ' … the basis

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[23] A small amount of tinplate was produced in the United States in the mid-1870s, when the relative price of iron and steel declined in favour of domestic production. See Irwin, 'Tinplate industry', pp. 338-9.

[24] Between 1889/90 and 1899/1900, the annual value of tinplate imports fell from $20.1 million to $4.8 million.

[25] Irwin, 'Tinplate industry', pp. 351-2.

[26] Dedinger, 'Franco-German', pp. 1044-5.

[27] *British and foreign trade*, p. 171. The ten other countries and corresponding bilateral tariffs are as follows: Russia (131%), Austria-Hungary (35%), France (34%), Italy (27%), Germany (25%), Canada (16%), Belgium (13%), New Zealand (9%), Australian Commonwealth (6%), and South African Customs Union (6%).

of the calculation is *not* the classes of British goods which we actually sell to each particular country, but those which we sell to the world in general' [emphasis original].[28]

The Board of Trade settled on this method for calculating bilateral tariffs because the resulting estimates are not diminished by the imposition of prohibitive tariffs on classes of British exports.[29] Prohibitive tariffs, which are high enough to block imports entirely, are the most extreme case of the substitution effect, whereby an increase in the tariff on a given class of exports causes the value *and share* of that class of exports to decline. By fixing the shares according to the composition of British exports to all countries, the Board of Trade attempted to ensure that the substitution effect did not erode its estimates of bilateral protection. The main series of the bilateral American tariff toward Britain, reconstructed in the next section of this article, does not adjust for the substitution effect. Not adjusting for the substitution effect preserves the comparability between the bilateral tariff series and the average tariff of the United States, thereby allowing for the calculation of the relative bilateral American tariff toward Britain.

Nevertheless, the substitution effect cannot be wholly ignored, at least insofar as this article aims to examine closely the relationship between tariffs and Anglo-American trade costs. Hence, the next section of this article also reconstructs an alternative series of the bilateral American tariff toward Britain that adjusts, however imperfectly, for the substitution effect. The method for estimating the alternative series is an unweighted average of per-industry *ad valorem* equivalent tariffs. This method, suggested by Federico and Tena as one possible option for handling the substitution effect, has the advantage of being easily implemented given the data available.[30] Of course, the equal weights implicit in an 'unweighted' average underweight (overweight) what would be the relatively large (small) industries in the hypothetical free-trade composition of bilateral imports.

Estimates of bilateral tariffs, rare in their existence, are practically absent from gravity models of trade. This very topic was recently addressed by Hayakawa in an article titled 'How serious is the omission of bilateral tariff rates in gravity?'. Using the World Integrated Trade Solution database, he calculated annual bilateral tariff series for a large number of country pairs for the years 1996-2007. These bilateral tariffs pertained only to trade in manufactures. In the gravity model, the coefficient of the bilateral tariff variable was

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[28] Ibid., p. 169.
[29] Ibid.
[30] Federico and Tena, 'Protectionist country', pp. 75-6.

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statistically significant.[31] However, the inclusion of this variable had hardly any effect on the magnitudes of the other coefficients and had no effect on the explanatory power of the model.[32] Hayakawa's finding deserves mentioning, but should not be taken as indicative of what the econometric analysis in this article may reveal. Tariffs during the first era of globalization were quite different from (manufactured) tariffs at the turn of the millennium, which were much lower and generally declining.

II

The source used in reconstructing the bilateral American tariff toward Britain is the *Foreign commerce and navigation of the United States*, a series of reports issued annually by the United States Treasury Department. The only other potential source, the *Annual statements of the trade of the United Kingdom*, enumerates British exports to the United States, but does so in a manner inconsistent with the classification of articles in the American tariff schedule. Accordingly, this article relies on the American trade statistics. Each annual report of the *Foreign commerce* covers the fiscal year ending 30 June, rather than the calendar year. For the purposes of this article, 1870/1 means the year beginning 1 July 1870 and ending 30 June 1871. The bilateral tariff series reconstructed here spans the 43 years from 1870/1-1912/3 and is, therefore, in keeping with the conventional periodization of the first era of globalization.

The *Foreign commerce* treats dutiable and non-dutiable imports entirely separately. With regard to the dutiable imports, the two relevant sections of the *Foreign commerce* for reconstructing the bilateral American tariff toward Britain are the article-country disaggregation and industry-tariff disaggregation sections. The article-country disaggregation section records, for example, the value of pig iron imported from Britain. The industry-tariff disaggregation section records, for example, the total value of all iron, steel, and manufactures thereof imported from all countries and the customs revenue collected thereon, which thus enables the calculation of the per-industry *ad valorem* equivalent tariff that the United States imposed upon imports from all countries.

In order to calculate the main series of the bilateral American tariff toward Britain ($MAIN_{b,t}$), it is first necessary to calculate the industry-composite bilateral American tariff toward Britain ($COMPOSITE_{b,t}$):

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[31] Hayakawa, 'Bilateral tariff rates', p. 89.
[32] Ibid.

$$COMPOSITE_{b,t} = \sum_{i=1}^{16}\left(\frac{IMPORTS_{b,i,t}}{\sum_{i=1}^{16} IMPORTS_{b,i,t}}\right)\left(\frac{REVENUE_{a,i,t}}{IMPORTS_{a,i,t}}\right) \tag{1}$$

Here, *IMPORTS* represents the value of *dutiable* imports, while *REVENUE* represents the customs revenue accruing to the United States from those dutiable imports. The subscripts denote American imports from Britain (*b*), American imports from all countries (*a*), the particular industry (*i*), and the year (*t*).[33] Taking $COMPOSITE_{b,t}$ from Equation 1, it is next possible to calculate the bilateral American tariff toward Britain ($MAIN_{b,t}$):

$$MAIN_{b,t} = \frac{(COMPOSITE_{b,t})(DUTIABLE_{b,t})}{DUTIABLE_{b,t}+FREE_{b,t}} \tag{2}$$

In Equation 2, *DUTIABLE* represents the total value of dutiable imports and *FREE* the total value of non-dutiable imports. The meanings of the subscripts are retained from Equation 1.

The industry-composite bilateral American tariff toward Britain, represented in Equation 1, is a weighted average of the per-industry *ad valorem* equivalent tariffs that the United States imposed upon dutiable imports from all countries, taken from the industry-tariff disaggregation section of the *Foreign commerce*. The weights, calculated from the article-country disaggregation section, are the per-industry shares of dutiable imports from Britain within a composite basket of dutiable imports from Britain spanning 16 industries: alkali; books; cement; clocks and watches; (bituminous) coal; cotton manufactures; earthenware and chinaware; flax and manufactures thereof; fur and manufactures thereof; iron, steel, and manufactures thereof; leather and manufactures thereof; salt; silk manufactures; tinplate; wool; and wool manufactures. Table 1 presents the weights and per-industry *ad valorem* equivalent tariffs for four benchmark years: 1870/1, the initial year of the series; 1889/90, the last full year preceding the McKinley Tariff; 1898/9, the first full year following the Dingley Tariff; and 1912/3, the final year of the series. Because the article-country disaggregation section does not explicitly record the total value of dutiable imports from Britain for each industry, it is necessary to sum the values of the dutiable articles imported from Britain for each of the 16 industries, in order to obtain $IMPORTS_{b,i,t}$. In other words, it is necessary to sum the values of (dutiable) pig iron, (dutiable) bar iron, and so forth imported from Britain, in order to obtain the total value of (dutiable) iron, steel, and manufactures thereof imported from Britain.

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[33] Prior to 1890/1, the *Foreign commerce* does not record imports from Britain as a whole, but instead from England (including Wales), Scotland, and Ireland. Between 1890/1 and 1908/9, the *Foreign commerce* records imports from Britain as a single country, after which it reverts to the earlier convention of recording imports from three separate countries. Accordingly, for the years 1870/1-1889/90 and 1909/10-1912/3, the total value of dutiable imports per industry for each of England, Scotland, and Ireland are calculated separately and then added together so as to obtain $IMPORTS_{b,i,t}$.

Table 1. *Industry weights and tariffs, 1870/1-1912/3*

Industry	1870/1	1889/90	1898/9	1912/3
Alkali	2.0 (35.1)	3.9 (32.9)	1.0 (52.3)	--
Books	0.7 (25.0)	1.2 (25.0)	1.7 (25.0)	3.0 (29.7)
Cement	--	0.9 (20.0)	0.7 (24.0)	0.0 (21.9)
Clocks and watches	1.8 (23.3)	0.1 (26.0)	0.2 (35.8)	0.1 (35.8)
Coal	0.2 (47.5)	0.1 (22.2)	0.5 (22.0)	0.0 (14.8)
Cotton manufactures	14.4 (40.5)	9.5 (39.9)	22.1 (56.0)	20.5 (55.0)
Earthenware and chinaware	2.2 (41.3)	3.2 (57.1)	5.1 (58.8)	2.5 (58.2)
Flax and manufactures thereof	10.4 (33.7)	14.7 (33.9)	28.3 (42.0)	29.7 (33.2)
Fur and manufactures thereof	0.8 (19.8)	2.0 (20.2)	2.4 (20.9)	1.0 (26.2)
Iron, steel, and manufactures thereof	22.0 (43.1)	9.9 (38.0)	8.1 (38.1)	12.9 (26.1)
Leather and manufactures thereof	3.5 (35.4)	1.9 (31.7)	4.3 (35.7)	5.4 (27.9)
Salt	0.5 (101.6)	0.6 (41.3)	0.7 (46.7)	0.3 (40.7)
Silk manufactures	12.0 (57.8)	5.4 (49.5)	4.0 (54.0)	3.0 (51.4)
Tinplate	6.2 (22.7)	16.7 (32.5)	4.5 (62.4)	1.0 (29.9)
Wool	1.9 (45.6)	6.7 (33.8)	5.6 (47.3)	13.9 (44.7)
Wool manufactures	21.4 (67.7)	23.2 (69.1)	10.9 (94.9)	6.8 (81.8)

Source: Calculated from *Foreign Commerce*. See text.
Notes: Per-industry *ad valorem* equivalent tariffs are expressed in % and indicated in parentheses. Several industries contain discontinuities, as discussed in the text.

The assumption implicit in Equation 1 is that, within each industry, the intra-industry composition of dutiable articles that the United States imports from Britain mirrors the intra-industry composition of dutiable articles that the United States imports from all countries. Indeed, the danger of this assumption is best conveyed by a simple example. Suppose there is an industry that includes only two articles, X and Y, which the United States imports in equal values. The *ad valorem* equivalent tariff is 20 per cent for article X, 40 per cent for article Y, and 30 per cent for the industry as a whole. However, the United States imports article X exclusively from country A and article Y exclusively from country B. In this example, the true bilateral tariff toward country A is 40 per cent for this industry, but the calculation of $COMPOSITE_{b,t}$ inappropriately relies on an *ad valorem* equivalent tariff of 30 per cent.

The delicate nature of this assumption factors heavily into the selection of the 16 industries listed earlier. For each of these 16 industries, the intra-industry composition of dutiable articles imported from Britain broadly approximates the intra-industry composition of dutiable articles imported from all countries. Since some industries encompass many individual articles of importation, especially the industry of iron, steel, and manufactures thereof, and since the intra-industry compositions of dutiable articles approximate each other to varying extents, the decision to settle on the 16 aforementioned industries is inevitably a discretionary one. The glass industry offers an example of an industry excluded from the calculations for this reason. In 1889/90, the article-country disaggregation section classifies 21 per cent of dutiable glass imports from all countries as 'cylinder and crown glass, polished and silvered', whereas less than 1 per cent of dutiable glass imports from Britain fall under this classification.[34] Because certain industries, such as the glass industry, are excluded from Equation 1, it is essential to observe that $\Sigma IMPORTS_{b,i,t}$ from Equation 1 is always less than $DUTIABLE_{b,t}$ from Equation 2, as the latter value includes all dutiable imports from Britain across all industries, including the excluded industries.

For the industry of flax and manufactures thereof, the intra-industry compositions of dutiable articles imported from Britain and from all countries are roughly similar until 1883/4, when the *Foreign commerce* merges the industries of flax and manufactures thereof; hemp and manufactures thereof; and jute and manufactures thereof. The consolidated industry of flax, hemp, jute, and manufactures thereof encompasses raw hemp and raw jute, the vast majority of which the United States imported from countries other than Britain. Consequently, the introduction of this consolidated industry into the American trade statistics causes the intra-industry composition of dutiable articles imported from Britain to differ considerably from the intra-industry composition of dutiable articles imported from all countries. For this reason, the industry of flax and manufactures thereof would ordinarily be excluded from Equation 1, just as the glass industry is excluded from Equation 1. However, whereas the glass industry constitutes a relatively minor share of American imports from Britain, the industry of flax and manufactures thereof constitutes a quite large share; flax and manufactures thereof accounted for fully 10 per cent of American imports from Britain in 1882/3. No truly representative series of the bilateral American tariff toward Britain can neglect this important industry.

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[34] The United States imported almost all of its 'cylinder and crown glass, polished and silvered' from Germany.

A third section of the *Foreign commerce*, the article-tariff disaggregation section, provides an acceptable solution to the problem created by the merger of flax and manufactures thereof; hemp and manufactures thereof; and jute and manufactures thereof. For the purpose of Equation 1, the industry of flax and manufactures thereof is redefined to include just burlaps and linens for the years from 1883/4-1889/90. Burlaps and linens are two dutiable articles of importation listed congruently in the article-country disaggregation and article-tariff disaggregation sections of the *Foreign commerce*. For the years 1883/4-1889/90, Equation 1 weights the *ad valorem* equivalent tariff that the United States imposed upon burlaps and linens (combined) by the share of burlaps and linens (combined) within the composite basket of dutiable imports from Britain. It is noteworthy that, in 1883/4, the value of burlaps and linens imported from Britain was $14.7 million, while the total value of all flax, hemp, jute, and manufactures thereof imported from Britain was $19.1 million. Seen in this light, redefining the industry as just burlaps and linens still maintains a high degree of representativeness in the calculations.

Yet another classificatory change in the *Foreign commerce* requires another redefinition of the industry of flax and manufactures thereof, for the purpose of Equation 1. Beginning in 1890/1, the article-country disaggregation section shifts linens to the ubiquitous classification of 'all other manufactures of flax, hemp, or jute', a classification without any equivalent in the article-tariff disaggregation section. Since the article-country disaggregation and article-tariff disaggregation sections now differentiate between raw and manufactured flax, hemp, and jute, and since the article-tariff disaggregation section lists an overall *ad valorem* equivalent tariff for all dutiable manufactures of flax, hemp, and jute, the industry is redefined to include all manufactures of flax, hemp, and jute from 1890/1 until the conclusion of the series. In summary, this industry includes flax and manufactures thereof for 1870/1-1882/3, burlaps and linens for 1883/4-1889/90, and all manufactures of flax, hemp, and jute for 1890/1-1912/3.While redefining this industry at two junctures (1883/4 and 1890/1) introduces a small element of inconsistency to the tariff series being constructed here, doing so ensures that the intra-industry compositions of dutiable articles from Britain and from all countries broadly approximately each other, and that the redefined industry matches an *ad valorem* equivalent tariff ascertainable from the *Foreign commerce*.

The chemical industry, as designated in the American trade statistics, embodies highly discrepant intra-industry compositions of dutiable articles, with the United States importing dyestuffs predominantly from Germany and alkali almost exclusively from Britain. This problem is resolved by employing, in Equation 1, a purposely crafted 'alkali industry' in

place of the chemical industry. The alkali industry, as defined here, includes just three dutiable articles of importation, which are congruently listed in the article-country disaggregation and article-tariff disaggregation sections: caustic soda, sal soda, and soda ash. Therefore, Equation 1 weights the *ad valorem* equivalent tariff that the United States imposed upon caustic soda, sal soda, and soda ash (combined) by the share of these three articles (combined) within the composite basket of dutiable imports from Britain.

Starting in 1883/4, the *Foreign commerce* incorporates the tinplate industry, formerly treated as distinct, into the industry of iron, steel, and manufactures thereof. Yet, owing to the identical recording of tinplate in the article-country disaggregation and article-tariff disaggregation sections, it is possible to remove tinplate from iron, steel, and manufactures thereof, and continue treating tinplate as its own industry for the duration of the series. Obviously then, $REVENUE_{a,i,t}$ and $IMPORTS_{a,i,t}$ for the industry of iron, steel, and manufactures thereof are adjusted to exclude tinplate between 1883/4 and 1912/3. More than for the sake of consistency, the rationale for keeping tinplate as a distinct industry lies in the tremendous value of tinplate that the United States imported from Britain, as well as the atypical treatment of tinplate in the American tariff legislation, specifically the provision of the McKinley Tariff of 1890 that delayed an increase in the tariff on tinplate until 1 July 1891.[35]

In a strict sense, the *Foreign commerce* treats wool and manufactures thereof as a single industry. Yet, the article-country disaggregation section unambiguously notes which dutiable articles are wool and which dutiable articles are wool manufactures. Likewise, the industry-tariff disaggregation section decomposes the *ad valorem* equivalent tariff for wool and manufactures thereof into separate *ad valorem* equivalent tariffs for wool and wool manufactures. Altogether, it is not difficult to treat wool and wool manufactures as distinct industries in Equation 1. Yet, simplicity itself does not justify this decision; there are important historical reasons calling for the segregation of these two classes of articles. First, wool and wool manufactures, even when treated separately, rank among the largest of the 16 industries. Second, the United States levied much higher duties on wool manufactures than on wool, in keeping with the compensating system of duties, whereby American tariff legislation set the tariff on wool manufactures high enough to offer domestic wool

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[35] Irwin, 'Tinplate industry', p. 340.

manufacturers both an element of protection and a 'compensation' for the higher price of wool that resulted from there being a tariff on this material input.[36]

An important point germane to the (raw) wool industry is that the fleeting Wilson-Gorman Tariff of 1894 removed all duties on wool imports. Recall that, in Equation 1, $IMPORTS_{b,i,t}$ represents the value of only the dutiable imports from Britain per industry. Therefore, the value of $IMPORTS_{b,i,t}$ is nil for the wool industry in the years 1895/6 and 1896/7. Since the Wilson-Gorman Tariff did not become law until 28 Aug. 1894, $IMPORTS_{b,i,t}$ takes on a small value for the wool industry in 1894/5, representing the value of the dutiable wool imported from Britain during the brief interval from 1 July 1894 to 28 Aug. 1894.

Of the 16 industries covered in Equation 1, several come with a few minor qualifications. The cement industry is introduced into the calculation of Equation 1 beginning in 1883/4, when the article-country disaggregation section of the *Foreign commerce* first accords it separate treatment. In 1906/7, a classificatory change in the article-country disaggregation section makes impracticable the continued inclusion of the alkali industry in Equation 1; in this year, the alkali industry is dropped from the calculation.[37] Other industries are characterized by minor internal discontinuities. The industry of iron, steel, and manufactures thereof includes iron ore starting in 1883/4. From 1909/10 to 1912/3, the book industry also includes paper and manufactures thereof.

Moving from Equation 1, the industry-composite bilateral American tariff toward Britain ($COMPOSITE_{b,t}$), to Equation 2, the bilateral American tariff toward Britain ($MAIN_{b,t}$) entails the assumption that the dutiable imports from Britain falling outside of the 16 industries are subject to the industry-composite American tariff toward Britain. The dutiable imports accounted for in Equation 1 represent anywhere between 65 and 86 per cent of total dutiable imports from Britain, depending upon the year.[38] There are three categories of dutiable imports excluded from Equation 1. The first category, already described at length, includes the dutiable imports of those industries exhibiting highly discrepant intra-industry compositions, such that the corresponding *ad valorem* equivalent tariff for that industry would grossly misrepresent the true bilateral American tariff toward Britain for that industry. The second category includes dutiable imports from Britain classified in the *Foreign*

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[36] The mechanics of the compensating system of duties, as applied to wool and woollens, are detailed in Taussig, *Tariff question,* pp. 322-4.

[37] In 1905/6, American alkali imports from Britain amounted to a paltry $0.2 million.

[38] Since the coverage rate for $FREE_{b,t}$ is 100%, the coverage rate is higher for $MAIN_{b,t}$ than for $COMPOSITE_{b,t}$.

commerce as 'all other dutiable articles'.[39] The third category includes dutiable imports that the *Foreign commerce* enumerates separately, but that are largely inconsequential, such as artificial feathers and smokers' pipes. Equation 2 applies the industry-composite tariff to these three categories of dutiable imports. Additionally, Equation 2 incorporates the non-dutiable imports from Britain, with the result being annual estimates of the *ad valorem* equivalent tariff that the United States levied upon the whole basket of imports from Britain.

In reconstructing the main series, one final adjustment is necessary. Prior to 1879/80, the *Foreign commerce* follows the convention of recording specie, specifically gold and silver bullion and coin, as non-dutiable articles of importation in the article-country disaggregation section. In 1879/80, the American trade statistics cease recording specie as non-dutiable articles of importation and begin recording specie flows in an entirely separate section.[40] The consequence of this change in accounting is an inconsistent tariff series, broken between 1878/9 and 1879/80. To make the tariff series consistent, Equation 2 is adjusted for the years 1870/1-1878/9 by subtracting from the denominator the value of specie imported from Britain ($SPECIE_{b,t}$):

$$MAIN_{b,t} = \frac{(COMPOSITE_{b,t})(DUTIABLE_{b,t})}{DUTIABLE_{b,t}+FREE_{b,t}-SPECIE_{b,t}} \qquad [3]$$

The first column of Table 2 reports the main series of the bilateral American tariff toward Britain corrected for specie flows. Since the average tariff of the United States, as recorded in the *Foreign commerce*, embodies the same inconsistency as just described, it is also adjusted for specie flows prior to 1879/80. The second column reports the average American tariff corrected for specie flows. Inasmuch as the British share of total American imports ranged between 16 and 45 per cent throughout the 43 years covered in this study, the average American tariff is heavily influenced by imports from Britain. Thus, the third column presents the average American tariff excluding Britain. The fourth column presents the relative bilateral American tariff toward Britain, as determined by dividing the bilateral American tariff toward Britain (column 1) by the average American tariff excluding Britain (column 3).[41] It should be observed that the relative bilateral American tariff toward Britain

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[39] 'All other dutiable articles' imported from Britain usually amounted to 1% of total imports from Britain.

[40] A note on p. 557 of the *Foreign commerce* (1880) states, 'This table embraces only merchandise, specie having been omitted. This fact should be observed in comparisons made with the data in corresponding tables for previous years, which tables include both merchandise and specie'.

[41] This method of calculating a relative bilateral tariff differs from Dedinger's. She calculated the relative bilateral French tariff toward Germany by dividing the bilateral French tariff toward Germany by the average French tariff toward all countries *including* Germany.
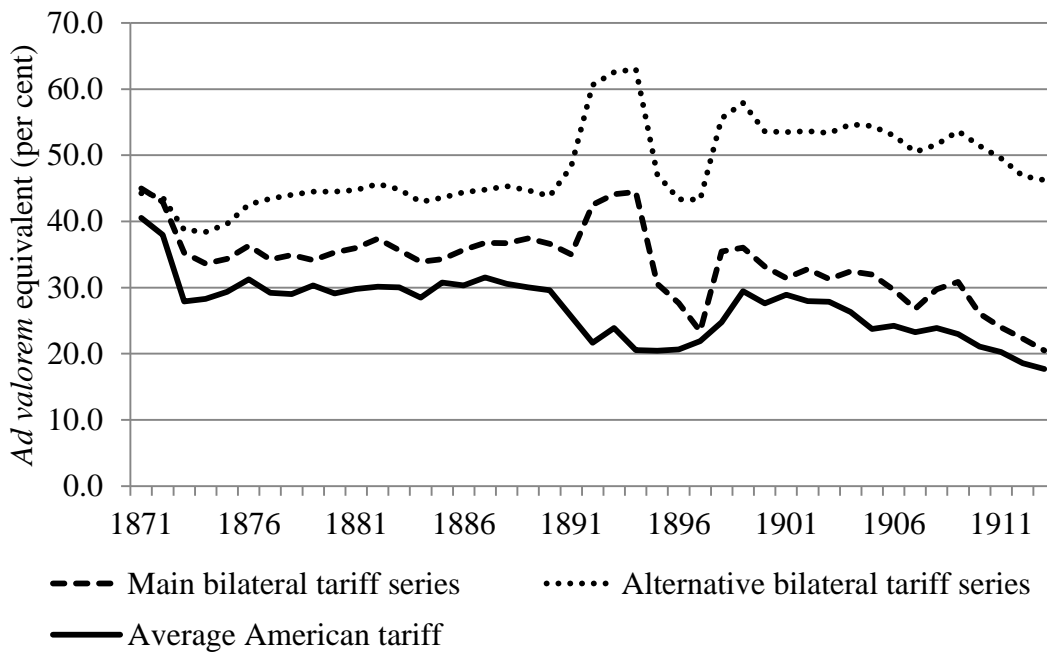
Table 2. *Bilateral American tariff toward Britain, 1870/1-1912/3*

	(1)	(2)	(3)	(4)	(5)
Year	Main series	Average American tariff	Average American tariff excluding Britain	Relative bilateral tariff	Alternative series
1870/1	45.0	40.5	37.0	1.22	44.3
1871/2	42.9	38.0	34.0	1.26	43.6
1872/3	35.2	27.9	23.8	1.48	38.7
1873/4	33.6	28.3	25.8	1.30	38.4
1874/5	34.3	29.4	27.3	1.26	39.6
1875/6	36.3	31.3	29.4	1.24	42.6
1876/7	34.3	29.2	27.4	1.25	43.5
1877/8	34.9	29.0	27.1	1.29	44.0
1878/9	34.2	30.3	29.1	1.18	44.5
1879/80	35.3	29.1	26.0	1.36	44.5
1880/1	36.0	29.8	27.5	1.31	44.8
1881/2	37.4	30.2	27.4	1.36	45.7
1882/3	35.7	30.0	28.0	1.27	44.8
1883/4	33.9	28.5	26.8	1.27	43.0
1884/5	34.3	30.8	29.7	1.16	43.6
1885/6	35.7	30.4	28.6	1.25	44.4
1886/7	36.8	31.5	29.8	1.23	44.8
1887/8	36.7	30.6	28.5	1.29	45.3
1888/9	37.4	30.0	27.6	1.35	44.7
1889/90	36.6	29.6	27.3	1.34	43.8
1890/1	35.0	25.7	22.9	1.53	48.3
1891/2	42.5	21.6	16.6	2.56	60.6
1892/3	44.1	23.9	18.2	2.42	62.6
1893/4	44.5	20.6	15.6	2.84	63.1
1894/5	30.6	20.4	17.6	1.73	47.1
1895/6	27.7	20.7	18.6	1.49	43.3
1896/7	23.4	21.9	21.5	1.09	43.3
1897/8	35.5	24.8	22.3	1.59	55.6
1898/9	36.0	29.5	28.1	1.28	57.9
1899/00	33.2	27.6	26.3	1.26	53.6
1900/1	31.4	28.9	28.4	1.11	53.5
1901/2	32.8	27.9	26.8	1.22	53.7
1902/3	31.3	27.9	27.1	1.16	53.4
1903/4	32.4	26.3	25.0	1.30	54.6
1904/5	32.0	23.8	22.2	1.44	54.4
1905/6	29.6	24.2	23.1	1.28	53.0
1906/7	26.8	23.3	22.5	1.19	50.5
1907/8	29.8	23.9	22.8	1.31	51.6
1908/9	30.9	23.0	21.5	1.44	53.7
1909/10	26.1	21.1	20.0	1.30	51.4
1910/1	24.0	20.3	19.5	1.23	49.5
1911/2	22.3	18.6	17.8	1.25	46.9
1912/3	20.5	17.7	17.1	1.20	46.2

Source: Calculated from *Foreign commerce*. See text.
Notes: All figures, except those in col. 4, are in expressed in %. Col. 1 does not adjust for the substitution effect, whereas col. 5 does.

Figure 1. *Bilateral American tariff toward Britain, 1870/1-1912/3*

Ad valorem equivalent (per cent)

- - - Main bilateral tariff series   ⋯⋯ Alternative bilateral tariff series
——— Average American tariff

Source: Calculated from *Foreign commerce*. See text.

exceeds 1 entirely because of the composition of bilateral imports, not because the United States explicitly discriminated against imports from Britain.

Following the suggestion of Federico and Tena, the alternative series of the bilateral American tariff toward Britain ($ALTERNATIVE_{b,t}$) is calculated as an unweighted average of the per-industry *ad valorem* equivalent tariffs:[42]

$$ALTERNATIVE_{b,t} = \sum_{i=1}^{6}(\frac{REVENUE_{a,i,t}}{IMPORTS_{a,i,t}})/6 \qquad [4]$$

Rather than include all 16 industries, the alternative series is calculated using the six largest industries, defined as those industries for which American imports from Britain exceeded $20 million in at least one year between 1870/1 and 1912/3. This approach adjusts for the substitution effect, but ensures that the *ad valorem* equivalent tariffs of relatively minor industries in the composition of American imports from Britain do not distort the resulting series. The six industries are cotton manufactures; flax and manufactures thereof; iron, steel, and manufactures thereof; silk manufactures; tinplate; and wool manufactures. The last column of Table 2 reports the alternative series of the bilateral American tariff toward Britain. Figure 1 illustrates both the main and alternative series of the bilateral American tariff toward Britain, as well as the average tariff of the United States. The main and alternative series exhibit similar inter-temporal variation during the capricious decade in

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[42] Other studies that have calculated tariff levels using unweighted averages include Tena-Junguito, 'Bairoch revisited'; Tena-Junguito et al., 'Cobden-Chevalier'.

American tariff history, the 1890s. However, there is also a divergence between these series beginning in the 1890s and continuing through the early twentieth century. The divergence between the main and alternative series is the consequence of a rapidly increasing non-dutiable share of bilateral imports from Britain. As Equation 4 indicates, non-dutiable imports are excluded from the calculation of the alternative series, whereas these imports are included in the calculation of the main series. The growth of non-dutiable imports from Britain is addressed in the next section.

III

In the early 1870s, growth in American imports resulted in a perceived excess of customs revenues, and this situation elicited calls for a reduction in duties.[43] The Tariff Act of 1872 decreased the duties on most manufactured imports by 10 per cent, in addition to more substantial decreases in the duties on coal and salt.[44] Between 1871/2 and 1872/3, the main series of the bilateral American tariff toward Britain declines from 43 to 35 per cent. However, the relative bilateral tariff remains fairly constant, partly because the 10 per cent reduction in the duties on manufactured imports was accompanied by an elimination of the duty on coffee, which the United States did not import from Britain.[45] Neither the Tariff Act of 1875 nor the Mongrel Tariff of 1883 caused any discernible change in the bilateral American tariff toward Britain.

The McKinley Tariff of 1890 represents an abrupt departure from the *status quo* of American tariff policy during the 1870s and 1880s, having raised the duties on manufactured imports across a range of industries. Cotton manufactures, wool manufactures, and tinplate, all major British exports to the United States, suddenly fell subject to much higher duties. As for cotton manufactures, the United States imported hardly any of the cheaper grades by the late nineteenth century, but continued to import the more expensive grades.[46] The McKinley Tariff raised the duties on these more expensive grades of cotton manufactures, causing the *ad valorem* equivalent tariff for this industry to increase from 40 to 51 per cent. Yet, the additional protection that the McKinley Tariff extended to cotton manufacturers was not nearly as great as the additional protection that it extended to wool manufacturers. When the McKinley Tariff was being crafted in Congress, moderate upward revisions in the duties on

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[43] Ashley, *Modern tariff*, p. 188.
[44] Taussig, *Tariff history*, p. 185.
[45] Ibid., p. 186.
[46] Saul, *Overseas trade*, p. 145.

wool were proposed and eventually enacted.[47] These proposed upward revisions provided wool manufacturers an occasion to demand greater duties on wool manufactures, in accordance with the principle of compensating duties, as discussed in the previous section of this study. However, so generous were the assumptions about the factor proportion of wool in wool manufactures, and so byzantine was the schedule of duties devised for wool manufactures, that the wool manufacturers ultimately obtained far more than mere compensation for the higher price of wool.[48] By 1891/2, the *ad valorem* equivalent tariff for wool manufactures had reached 96 per cent, compared to an already high 69 per cent in 1889/90.

Given that the McKinley Tariff went into effect on 6 Oct. 1890, the main series of the bilateral American tariff toward Britain ought to register a marked increase between fiscal years 1889/90 and 1890/1, but no such increase is evident. The reason lies in the McKinley Tariff's postponement of an increase in the tariff on tinplate until 1 July 1891. In expectation of the duty on tinplate rising from $0.01 to $0.022 per pound on 1 July 1891, American firms imported an unusually large amount of tinplate during 1890/1. Whereas the United States imported $20.9 million of British tinplate in 1889/90, it imported $35.6 million of British tinplate in 1890/1.[49] In 1890/1, the *ad valorem* equivalent tariff for tinplate was, at 29 per cent, less than the bilateral American tariff toward Britain. Thus, in the calculation of Equation 1 for 1890/1, increases in the per-industry *ad valorem* equivalent tariffs for cotton manufactures and wool manufactures—increases that otherwise would yield a higher bilateral tariff for 1890/1—are counterbalanced by the much greater weight given to the comparatively low *ad valorem* equivalent tariff for tinplate. Because of the delayed increase in the tariff on tinplate, the main series of the bilateral American tariff toward Britain does not reflect the fullness of the McKinley Tariff until 1891/2, when it rises from 35 to 43 per cent. Interestingly, this increase in the bilateral tariff amounted to an exact reversal of the decrease in the bilateral tariff that followed the Tariff Act of 1872.

Between 1870/1 and 1889/90, the relative bilateral tariff fluctuates within the narrow range of 1.2 and 1.5. In 1891/2, the relative bilateral tariff swells to 2.6, and remains at a similarly elevated level through 1893/4. This pronounced increase in the relative bilateral tariff is partly attributable to a higher absolute bilateral tariff, but also attributable to a lower

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[47] Taussig, *Tariff history*, pp. 256-9.
[48] Ibid., pp. 259-66. The schedule of duties on wool manufactures was byzantine because individual articles of importation were subject to both specific and *ad valorem* duties, which together often disguised the actual extent of protection.
[49] In 1890/1, tinplate accounted for 18% of American imports from Britain.

'average American tariff excluding Britain'. The McKinley Tariff was noteworthy for reducing the duties on certain primary-sector imports, few of which came from Britain. The duty on sugar, which regularly comprised over one-tenth of total American imports, was lifted altogether.

The Wilson-Gorman Tariff of 1894 lowered the *ad valorem* equivalent tariffs for many industries well represented within the composition of imports from Britain. Between 1893/4 and 1894/5, the *ad valorem* equivalent tariff for cotton manufactures declined from 56 to 47 per cent; earthenware and chinaware from 58 to 35 per cent; iron, steel, and manufactures thereof from 50 to 39 per cent; leather and manufactures thereof from 33 to 26 per cent; tinplate from 82 to 57 per cent; and wool manufactures from 97 to 57 per cent. Moreover, the Wilson-Gorman Tariff removed all duties on wool. Indeed, with respect to the bilateral American tariff toward Britain, the claim of the early tariff historian Ashley that the Wilson-Gorman Tariff was one of 'relatively little change' simply cannot apply.[50] Moving from 1893/4 to 1894/5, the absolute bilateral American tariff toward Britain falls from 45 to 31 per cent—a much sharper movement than occurs following the McKinley Tariff. The relative bilateral tariff gradually returns to its pre-McKinley level, assisted in this trend by the reimposition of duties on sugar.

With the passage of the Dingley Tariff of 1897, the pendulum swung back in the direction of protectionism. As with the McKinley Tariff, cotton manufactures, silk manufactures, tinplate, and wool manufactures were subjected to higher duties. Furthermore, the Dingley Tariff also greatly increased the *ad valorem* equivalent tariff for the alkali industry, from 31 to 50 per cent. This increase had the effect of excluding British alkali exports from the American market swiftly and conclusively.[51]

Although both the McKinley and Dingley Tariffs sharply raised the *ad valorem* equivalent tariff for wool manufactures, the substitution away from imports of British wool manufactures was much greater following the latter act. Whereas between 1889/90 and 1890/1, American imports of British wool manufactures decreased from $29.1 to $19.5 million, between 1896/7 and 1897/8, American imports of British wool manufactures decreased from $23.0 to $7.0 million. The post-Dingley falloff in American imports of British wool manufactures can largely be explained by developments within one particular branch of this industry: worsteds, which are manufactures of combed wool. American manufacturing of worsteds grew by leaps and bounds in the 1880s and 1890s, with Clapham

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[50] Ashley, *Modern tariff*, p. 217.
[51] Haber, *Chemical industry*, p. 148.

Table 3. *Dutiable and non-dutiable bilateral imports from Britain, 1898/9 and 1912/3*

	1898/9	1912/3
Bilateral imports ($ millions)		
Dutiable	82.2	143.0
Non-dutiable	36.3	152.5
Total	118.5	295.6
Bilateral tariff (per cent)		
Main series (actual non-dutiable share)	36.0	20.5
Main series (counterfactual 1898/9 non-dutiable share)	--	29.4
Alternative series	57.9	46.2

Source: Calculated from *Foreign commerce.*
Notes: The dutiable and non-dutiable bilateral imports do not sum exactly to the total in 1912/3 due to rounding error. The counterfactual main series assumes a constant 1898/9 non-dutiable share of 30.6% of bilateral imports.

noting that, during these two decades, the number of worsted combs increased by a factor of three, and the number of worsted spindles by a factor of six.[52] Unfortunately, the American trade statistics do not provide a separate classification for worsted imports in its article-country disaggregation section. However, the British trade statistics do, in fact, distinguish worsted exports in its article-country disaggregation section. Considering the category of 'worsted tissues, coatings, broad, all wool', the value of British exports to the United States proceeded as follows: £1.1 million (1896), £1.1 million (1897), £0.2 million (1898), and £0.2 million (1899).[53] Here, the impact of the Dingley Tariff is unmistakable. Due to the expanding capacity of American worsted factories, especially in the 1890s, the nearly complete substitution away from imports of British worsteds was possible.

The Dingley Tariff was the longest-governing tariff act in American history, remaining in effect until the Payne-Aldrich Tariff of 1909. During the first decade of the twentieth century, a time of stability within the American tariff regime, the bilateral American tariff toward Britain, expressed as an *ad valorem* equivalent, slowly diminishes, partly due to a trend of rising import prices. Because many duties were imposed on a specific basis (e.g. $0.015 per pound of tinplate), rising import prices reduced the *ad valorem* equivalent of the specific duties.

Another reason for the sustained decline in the main series of the bilateral American tariff toward Britain was the growing non-dutiable share of bilateral imports. As evident from Table 3, the value of non-dutiable imports from Britain increased by 320 per cent from 1898/9-1912/3, while the value of dutiable imports increased by only 74 per cent in the same

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[52] Clapham, *Woollen and worsted*, p. 253.
[53] 'All wool' indicates that the worsted is composed solely of wool, as opposed to a mixture of wool and some other textile material.

period. As has been previously noted, the growing non-dutiable share results in a divergence between the main and alternative series of the bilateral American tariff toward Britain, since non-dutiable imports are included in the calculation of the main series only. Table 3 presents an illustrative counterfactual; if the 1898/9 non-dutiable share (31 per cent) of bilateral imports remained constant, then the main series would have declined by only 7 per cent from 1898/9-1912/3, rather than by 16 per cent. The relative growth of non-dutiable imports accounts for the majority of the post-Dingley decline in the main series of the bilateral American tariff toward Britain.

The increasing non-dutiable share was not because the Dingley Tariff reclassified dutiable imports as free imports; indeed, the movement was generally in the reverse direction. Rather, the increasing non-dutiable share was due to the extraordinary growth of certain bilateral imports that had traditionally been admitted free of duty. Many of these non-dutiable bilateral imports were primary-sector imports that did not originate in Britain, but formed part of Britain's entrepôt trade.[54] Nevertheless, the *Foreign commerce* treats these British re-exports as bilateral imports from Britain, not bilateral imports from the country or colony of origin. India-rubber and tin, two commodities prominent in Britain's entrepôt trade, contributed greatly to the rising share of non-dutiable imports from Britain.[55] India-rubber enjoyed applications in the American automobile industry, and bilateral imports of this commodity increased from $7.0 million in 1898/9 to $33.6 million in 1912/3. The continued expansion of the American tinplate industry in the early twentieth century necessitated greater imports of tin, and bilateral imports of this commodity increased more than tenfold during the same interval, amounting to $24.7 million in 1912/3.

Though obvious, it is equally appropriate to attribute the decline in the main series to the decreasing share of dutiable imports. Undoubtedly, the growth of dutiable bilateral imports was hampered by an ongoing substitution in favour of domestic commodities. Alkali and worsteds were subject to a sudden foreign-domestic substitution in the wake of the Dingley Tariff. Other industries, such as the silk textile industry, were subject to a more

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[54] For a discussion of the rapid growth in British re-exports to the United States, see Saul, *Overseas trade*, p. 59. He attributes this growth, in part, to the 'poor condition of the American merchant marine'.

[55] These commodities were mostly re-exported from British colonial possessions in Southeast Asia.

gradual foreign-domestic substitution commensurate with the more gradual expansion of domestic production.[56]

IV

To estimate the determinants of Anglo-American trade costs, the panel regression employed by Jacks et al. is adapted for a single bilateral trade flow, resulting in the following time-series regression equation (with time subscripts suppressed):

$$\Delta \ln(COSTS) = \beta_0 + \beta_1 \Delta \ln(TARIFF) + \beta_2 \Delta \ln(EXCHANGE) + \beta_3 \Delta\Delta \ln(FREIGHT) + \beta_4(GOLD) + \beta_5 \Delta \ln(RAILWAY) + \epsilon \qquad [5]$$

COSTS are Anglo-American trade costs, as calculated by Jacks et al. Recall that trade costs are a standardized measure of the difference between the actual volume of bilateral trade and the volume of bilateral trade in the absence of any trade barriers. *TARIFF* is a measure of the tariff level in bidirectional Anglo-American trade, and the calculation of this variable is discussed shortly. *EXCHANGE* is the exchange rate volatility between the dollar and sterling. *FREIGHT* is a semi-parametric index of Anglo-American ocean freight rates, as estimated by Jacks and Pendakur.[57] *GOLD* is a dummy variable taking a value of 1 for the years 1879-1913, when both Britain and the United States were on the gold standard. *RAILWAY* is a measure of railway density, calculated as the product of the ratios of railway length per land surface area in Britain and the United States. All continuous variables are expressed in natural logarithms. The data source for all variables, except for certain measures of *TARIFF*, is the same as for Jacks et al.[58]

Equation 5 resembles the panel regression of Jacks et al. in all but two respects. First, most of the variables are further transformed to eliminate unit roots. An Augmented Dickey-Fuller test indicates that *COSTS*, *TARIFF*, *EXCHANGE*, and *RAILWAY* are integrated of the first order, and so these variables are differenced once, whilst *FREIGHT* is integrated of the second order, and so this variable is differenced twice.[59] As a time-series regression, Equation 5 cannot exploit the variation across country pairs, as was done in Jacks et al. Thus, the

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[56] Despite the Dingley Tariff raising the *ad valorem* equivalent tariff on silk manufactures, there was no immediate decline in the value of silk manufactures imported from Britain. In the first decade of twentieth century, the value imported from Britain remained stagnant, while the gross value of silk manufactures produced domestically nearly doubled between the census years of 1899 and 1909. *Census of manufactures*, p. 151.

[57] Jacks and Pendakhur, 'Transport revolution'.

[58] The author thanks David Jacks for making this data available on his website: http://www.sfu.ca/~djacks/data/publications/

[59] After this differencing, the null hypothesis of a unit root is rejected at the 1% level for all variables.

second discrepancy between Equation 5 and the panel regression of Jacks et al. is, inevitably, the exclusion of time-invariant variables. To be clear, the analysis here can only identify the inter-temporal determinants of Anglo-American trade costs. As a consequence, the effect of distance, a variable of fundamental importance to gravity models, cannot be estimated directly. Instead, the effect of distance is estimated indirectly by exploiting the inter-temporal variation in the costliness of distance, as measured by ocean freight rates.

Three different calculations of *TARIFF* are considered in the estimation of the regression. *TARIFF1* is the product of the average British tariff and the average American tariff. This variable represents the standard measure of the tariff level used in gravity models. *TARIFF2* is the product of the average British tariff and the main series of the bilateral American tariff toward Britain ($MAIN_{b,t}$). *TARIFF3* is the product of the average British tariff and the alternative series of the bilateral American tariff toward Britain ($ALTERNATIVE_{b,t}$), which accounts for the substitution effect.

The results of the regression are reported in Table 4. In every specification of the regression, all of the coefficients take on the expected sign, which is positive for *TARIFF*, *EXCHANGE*, and *FREIGHT*, and negative for *GOLD* and *RAILWAY*. However, most of the coefficients are statistically insignificant at conventional levels. Of particular surprise is the statistical insignificance of the coefficient of *FREIGHT* in all but the third specification, in which case the coefficient is significant only at the 10% level. Given what has already been mentioned, the appropriate inference here is not that distance was meaningless in Anglo-American trade, but rather that it is ambiguous whether or not the declining costliness of distance exerted an effect on trade costs. The recent work of Inwood and Keay may provide one possible explanation for this finding. They emphasized the importance of total transportation costs, including both ocean freight rates and inland transportation costs, in determining the volume of British pig iron exports to the United States and Canada.[60] Most pig iron exports to these countries were destined for Pittsburgh and Hamilton for further processing. For this single commodity, therefore, the cost of inland transportation is measurable. However, for entire bilateral trade flows encompassing diverse commodities destined for diverse locations, the cost of inland transportation is not directly measurable.

The coefficient of *TARIFF1* is barely statistically significant at the 10% level (p-value = 0.092). By comparison, the coefficients of *TARIFF2* and *TARIFF3* are statistically significant at the 1% level. Moreover, the second and third specifications of the regression

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[60] Inwood and Keay, 'Iron trade', p. 118-9.

Table 4. *Determinants of Anglo-American trade costs, 1872-1913*

	(1)	(2)	(3)	(4)	(5)	(6)
TARIFF1	4.66*			3.95		
	(2.69)			(2.62)		
TARIFF2		7.10***			6.07**	
		(2.27)			(2.26)	
TARIFF3			9.87***			7.96***
			(2.89)			(2.82)
EXCHANGE	0.49	0.56	0.96			
	(0.70)	(0.65)	(0.65)			
FREIGHT	31.57	37.53	44.36*			
	(25.55)	(23.67)	(23.54)			
GOLD	-1.08	-1.20	-1.05			
	(0.89)	(0.82)	(0.80)			
RAILWAY	-8.13	-10.47	-5.97			
	(11.12)	(10.31)	(10.13)			
Constant	1.57	1.85*	1.41	0.28	0.34	0.23
	(1.03)	(0.95)	(0.92)	(0.31)	(0.30)	(0.29)
R^2	0.13	0.26	0.29	0.05	0.15	0.17
DW statistic	1.92	1.83	1.75	1.98	1.84	1.91
Observations	42	42	42	42	42	42

Sources: The source for all variables, except *TARIFF2* and *TARIFF3*, was the data underlying Jacks et al., 'Trade costs', located at: http://www.sfu.ca/~djacks/data/publications/. For the sources for *TARIFF2* and *TARIFF3*, see text.
Notes: * denotes statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level. All coefficients have been rescaled by a factor of 100.

provide twice the explanatory power of the first specification. These improvements in the outcome of the regression are achieved solely through calculations of *TARIFF* that include a bilateral measurement of the tariff level for just one of the directions of Anglo-American trade, that is, British exports to the United States.[61] The fourth through sixth specifications, which isolate the effect of *TARIFF* on Anglo-American trade costs, are generally consistent with the first through third specifications, although the coefficients are slightly diminished.

The coefficient of *TARIFF3*, which accounts for the substitution effect, expectedly exceeds that of *TARIFF2*, which does not. Still, the coefficients of both *TARIFF2* and *TARIFF3* are greater than the coefficient of *TARIFF1*. In view of these differences, there arises the question of how to interpret the coefficients in a meaningful way. Recall the log-difference expression of both *COSTS* and *TARIFF*. In lieu of a theoretical interpretation of the coefficient, this article offers an interpretation of the coefficient grounded in historical events, specifically the principal American tariff acts of the late nineteenth century. Based

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[61] In general, bilateral measurements of the tariff level for both directions of bilateral trade would be preferable. However, this consideration is less pressing for country pairs that include Britain, given its unique adherence to a policy of free trade.

upon the more conservative coefficient of *TARIFF2* (0.071) and the annual changes in the main series of the bilateral American tariff toward Britain, the one-period effects of the McKinley, Wilson-Gorman, and Dingley Tariffs on bidirectional Anglo-American trade costs were +1.4 per cent, -2.7 per cent, and +2.9 per cent, respectively.[62] The two-period effects were +1.6 per cent, -3.4 per cent, and +3.1 per cent. Altogether, changes in American commercial policy during the first era of globalization altered the wedge between the actual and frictionless volumes of Anglo-American trade to a degree that was modest, but hardly negligible. In comparison, Anglo-American trade costs declined by only 8.0 per cent between 1870 and 1890.[63]

Did the determinants of Anglo-American trade costs conform to the determinants of bilateral trade costs in general? To answer this question involves comparing the inter-temporal determinants of Anglo-American trade costs with inter-temporal *and* cross-sectional determinants of bilateral trade costs in general. Though such a comparison is admittedly imperfect, it will nonetheless be made. When Jacks et al. considered the bilateral trade costs of only the country pairs that included Britain, they found that tariffs were not a statistically significant determinant. In this respect, Anglo-American trade represents a departure from the normal pattern of British trade, which was generally unaffected by foreign protection. Jacks et al. found that *EXCHANGE*, *FREIGHT*, and *GOLD* were determinants of bilateral British trade costs, but the analysis here finds that these variables were not inter-temporal determinants of the subset Anglo-American trade costs. Finally, in neither case does the variable *RAILWAY* take on a statistically significant coefficient, which Jack et al. speculated may have been attributable to the greater importance of ocean freight rates in determining bilateral British trade costs.[64]

V

In *Studies in British overseas trade, 1870-1914*, Saul wrote that 'it seems unlikely that in the period before 1914 tariffs seriously hindered the development of [British] trade, taken as a whole'.[65] Similarly, the econometric analysis of Jacks et al. revealed that tariffs were not a statistically significant determinant of Britain's trade costs. However, it is crucial that any emerging consensus

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[62] These figures adjust for the slight annual variation in the average British tariff, so as to isolate fully the effects of the respective American tariff acts. The figures for the McKinley Tariff assume an imposition year of 1891, for reasons already described.

[63] This figure was calculated using the data underlying Jacks et al., 'Trade costs'.

[64] Jacks et al., 'Trade costs', p. 135.

[65] Saul, *Overseas trade*, p. 165. This passage was reproduced in Hatton, 'British exports', p. 583.

that British trade was unaffected by tariffs be qualified to exclude Anglo-American bilateral trade. As this article has proven, tariffs were an inter-temporal determinant—the sole inter-temporal determinant—of Anglo-American trade costs during the first era of globalization.

The determinacy of tariffs for Anglo-American trade costs only became apparent once the variable for tariffs incorporated a measure of the bilateral American tariff toward Britain. The contribution of a bilateral tariff series was nothing less than an altered understanding of the largest bilateral flow of trade in the first era of globalization. With empirically correct tariff variables, it is possible that even the general understanding of trade during this period may be altered. Such an alteration would likely bestow greater importance to the effect of tariffs on trade.

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