

**THE ANGLO-GERMAN TRADE RIVALRY, 1887-1913: A
COUNTERFACTUAL
OUTCOME AND ITS IMPLICATIONS**

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Introduction

We are probably fools not to find a reason for declaring war on Germany before she builds too many ships and takes away our trade.

Arthur Balfour 1907.

Projecting economic variables is a difficult art but one which statesmen practice with relish. In parliamentary democracies it is a rare candidate who does not forecast that under his tenure the pots of the electors will be graced with chickens. A more sober, careful kind of forecasting is required in conducting foreign affairs. Sound judgments about tariffs, subsidies, military and naval force levels, and even alliances depend upon prior analysis of the effects of each such policy over some specified length of run. Although one suspects that some kind of forecasting was always a part of statecraft, industrialization in Western Europe necessitated a change in the time frame of the predictions of statesmen. As the pace of economic change quickened, the rate at which the economic and military potential of states might change also accelerated. For many Englishmen observing the growth of the German economy during the 1890s, learning this lesson produced more than a little anxiety. So great was the attention which the British gave to German economic growth that predictions of Germany's overtaking of Britain came to be a staple item of British politics in the two decades before World War One. Should these predictions have been taken seriously by contemporaries? The best answer is that given by the outcome of the pre-1914 Anglo-German rivalry: Germany did not overtake Britain in that era.¹ Because war intervened, we cannot know the outcome of continued peaceful economic rivalry, but by using a relatively new statistical method we can chart the course this rivalry may well have followed had the peace been kept in 1914. Our projections suggest a sequence of events that never occurred but may nonetheless be used as a guide in evaluating the views and expectations of contemporaries.

German industrialization did not begin in earnest until about 1850 at which point British industrialization had been under way for close to a century. The example of British industrial development had a profound impact in Germany where more energetic entrepreneurial types set as their goal to be "los von England."² In many respects that goal was achieved in the latter half of the nineteenth century. Before 1870 British dominance in exports of cotton and woolen textiles, coal, and metallurgical goods was scarcely contested and even in 1880 the British position still seemed reasonably secure. Not until the last two decades of the nineteenth century was the scope of the German challenge to Britain revealed.³ Among older industries, British

cotton, coal, and shipping did well in the face of intensified competition, but iron and steel did not. In terms of average annual steel output (by ton), Germany had already overtaken Britain in the years 1895-1899 and in average annual pig iron output Germany was no longer very far behind. Among newer industries, German superiority in chemical and electrical goods could scarcely be questioned. A combination of stronger foreign competition and higher tariffs on the Continent and in the United States made export sales increasingly difficult for British industry as the turn of the century approached. Although American competition did not go unnoticed, the Anglo-German commercial rivalry gave rise to far more comment and concern.

The German assault on British export markets produced a range of responses within Britain. Reacting to losses in non-imperial markets, British exporters concentrated their efforts on imperial markets where political influence might provide welcome assistance. In 1897 Canada went so far as to impose preferential rates on United Kingdom goods, a step that was bitterly resented in Germany. In defense of the home market there arose in Britain a vociferous, if not terribly effective, "fair trade" movement. Its aim was a system of preferential tariffs for the empire. Fair trade agitation began in the mid-1880s and its intensity tended to vary inversely with the business cycle. One of the movement's few accomplishments was the passage of the Merchandise Marks Act of 1887, which required that the origin of an imported article be plainly identified. Hoffman notes that the act's "practical effect was to put the stamp 'made in Germany' on countless imported wares throughout the United Kingdom and the Empire, to awaken the British to a realization of the surprisingly large quantity of goods that came from Germany . . ."⁴ This greater public awareness had its price, for many buyers of British reexports discovered where their purchases were actually manufactured and struck a better bargain by buying directly from Germany. With this exception the consequences of the fair trade movement were political rather than economic. Joseph Chamberlain's speeches helped to make tariff reform a major political issue and to sour Anglo-German relations but did not turn Britain away from free trade.

What is not clear is the extent to which trade rivalry and the fair-traders' reaction to it were responsible for the deterioration of Anglo-German relations in the period 1897-1914. Serious conflicts among European nations also arose in colonial regions during these years and Britain's colonial quarrels with Germany proved more difficult to compose than those with France and Russia. There is no need to review the familiar record of British disputes with Germany over arrangements in Southern Africa, Persia, Mesopotamia, and China. German pro-Boer sentiments alone were sufficient to affect Anglo-German relations adversely. A third irritant, related to both commercial rivalry and colonial tensions, was the Anglo-German naval race. The building of Admiral Tirpitz's battle fleet was perceived in Britain as a challenge that had to be met. How should the strength of these various irritants to Anglo-German relations be gauged? Angelike Banze argues that "German-English economic rivalry was not an independent factor in political decisions before the [First] World War" but rather that "the economic rivalry was used for political purposes."⁵ The political factor she stresses is antago-

nism arising from colonial disputes. Ross Hoffman takes the opposite view. After charting the course of German displacement of British trade in the years 1875-1914, Hoffman concludes that

the world's greatest industrial, commercial, maritime trading power found a deadly enemy in its most successful economic rival—is it conceivable that this enmity did not spring mainly from that rivalry?⁶

These conflicting interpretations are also reflected in analyses that appeared during the First World War. Anton Hofrichter's *Krieg und Handelsrivalität* (1917) presents a view that differs little from that of Banze, and E.R.A. Seligman's *An Economic Interpretation of the War* (1915) offers an argument similar to that of Hoffman.⁷ Although the influence of trade rivalry in worsening Anglo-German relations is not clear, historians and contemporaries have at least analyzed the problem so that alternative interpretations are clearly identifiable.

Can quantitative methods generate a new perspective that will add to our understanding of the problem with which these familiar interpretations are concerned? While only written sources can convey the perceptions of those who took part in events of that era, there is a quantitative way to examine certain of those events. The Anglo-German commercial rivalry provides a helpful example of how such a novel method may be employed. It is evident that a basic concern of the participants in such a rivalry is its outcome. In Britain there were those who believed that Germany was overtaking them and those who were confident that Britain would hold her own. In Germany there was a similar range of views. There is no reason to doubt that these different views represent honestly held beliefs about the future. Such beliefs differ because individuals are subject to different combinations of influences and because they respond to these influences differently. Under certain circumstances a statistical procedure can also be used to predict the future course of the Anglo-German rivalry. While contemporaries could argue about possible outcomes, leaving us at a loss to know whose predictions would have been soundest, this statistical technique identifies one outcome that is more probable than any other. This unique outcome can then be used as a counterfactual result in the light of which the views of contemporaries may be examined.⁸

Analyzing the Anglo-German commercial rivalry as a forecasting problem requires that some appropriate forecasting method be chosen. A suitable method is the Markov probability analysis (explained below). This technique requires only that data on annual exports and imports of the nations included in the model be chosen. The model formulated below includes Austria-Hungary, France, Germany, Italy, Russia, the United Kingdom, and the United States. These seven countries were chosen because the total of their exports and imports comprised a large part of world trade and because, given their factor endowments and the level of industrialization they had attained, they were judged to be the countries best placed to expand their trade during the period under consideration.⁹ The period 1897-1913 has been

selected because it was in these years that Anglo-German commercial rivalry became a major issue in both nations and predictions of its outcome began to appear frequently in the press and elsewhere. Furthermore, the years 1897-1913 were characterized by relatively greater prosperity and stability than those of the preceding "great depression," so that it is not possible to argue that the severity of the great depression in Britain somehow biased our analysis against the British. The output of this analysis is a set of annual forecasts of the shares of exports and imports for each nation extending twenty years. Our forecasts, which assume that the forces at work between 1897 and 1913 had remained at work for another twenty years, provide a counterfactual outcome that is independent of the perceptions of contemporaries. This outcome is thus a kind of neutral projection with which the fears and hopes of contemporaries may be compared.

In our view more familiar forecasting techniques like regression and extrapolation are not suitable for analyzing the problem at hand because the data that would have resulted if there had been no war are not available. Using a Markov probability model makes it possible to circumvent this data constraint so that counterfactual forecasting may be performed. The key to the Markov transition matrix approach is the use of available (pre-war) data to estimate a transition matrix which embodies the dynamic movements of the variables (in this case, shares of imports and exports) through time; such a matrix may then be used to forecast.

Use of the Markov Transition Matrix

Assume that q_{ti} is the percentage of imports (exports) of the i th country in period t .¹⁰ Let Q_t be a row vector of length 7 consisting of the shares (q) of imports of the seven selected countries in period t . Note that

$$\sum_{i=1}^7 q_{ti} = 1$$

which means that the sum of the shares of imports (or exports) equals 1. If a matrix P (called the Markov transition probability matrix) of rank 7 is estimated to minimize the errors of the model within the sample period, then $\hat{Q}_{t+1} = Q_t P$ in the sample period where \hat{Q}_{t+1} is a vector of the estimated shares of the imports in period $t+1$. Forecasts of shares of imports can be made outside the sample period that depend only on past values of the shares and Markov matrix P . Such a model can be used when variables needed to predict the shares (i.e., from a regression model) cannot be obtained.

If it is necessary to extend the forecast horizon beyond one period forecasts, as the problem at hand requires, we note that $Q_{t+2} = Q_t P^2$ and, in general, the k th period ahead forecast of the equilibrium share of imports is $Q_{t+k} = Q_t P^k$. In such cases the P matrix is estimated within the period for which data are available. When forecasts are desired outside that period, the investigator need merely raise the Markov transition matrix P to higher powers. In contrast to this approach, regression methods require data for all important variables in the period during which forecasts are desired. The disruption in trade caused by World War One and the accompanying "distortion" of trade data preclude investigation based on regression. Moreover, even if there were data suitable for regression analysis, the Markov approach would still be preferable because it constrains the percen-

tages (shares) to sum to 1, a constraint that would be difficult to impose using either regression or simpler extrapolation techniques. We next offer some empirical results to show how the Markov technique may be used.

The Empirical Evidence

In the previous section we presented the most familiar interpretations of the Anglo-German trade rivalry. In this section we examine the data, paying special attention to two basic aspects of the problem: the relative performance and the absolute performance of the countries under study. Let us first examine data concerning the absolute performance of Austria-Hungary, France, Germany, Italy, Russia, the United Kingdom, and the United States (shown in Table 1).¹¹

In 1897 the largest exporting country was the United Kingdom (U.S. \$1431.9 million) followed closely by the United States (U.S. \$1153 million), Germany (U.S. \$865.13 million) and then France (U.S. \$694.41 million). During the period 1897-1913 the growth rates of exports of the seven countries under study differed markedly. For example, while the compound rate of growth of German exports was 6.6 percent, the British rate was 4.9 percent and the French rate only 4.1 percent.¹² In Austria-Hungary the growth rate of exports was the lowest of the group (3.8 percent). On the import side a different picture emerges. While Italian imports were growing the fastest (7.3 percent), in the United Kingdom the rate of growth of imports was only 3.4 percent. Among the countries in our sample during the period 1897-1913, the balance of trade improved in the United States and Germany and, to some extent, in the United Kingdom while worsening in the other countries of the sample. The dominant position of the United Kingdom in exports at the beginning of the period was seriously eroded by the end.¹³ Although the United Kingdom still exported more than other countries, it appears that if the prevailing pattern continued, Germany would have overtaken the United Kingdom before long. Of course, World War I caused a massive disruption of the world economy whose impact was particularly severe in Europe. Nevertheless, we may still chart the hypothetical course implied by Germany's remarkable compound rate of growth of exports had peace continued.

The Relative Position of a Country's Export/Import Share—A Markov Approach

The data presented in Table 1 have been expressed in relative percentage form in Tables 2 and 3. In this section we outline the use of a technique, Markov probability analysis, which allows one to project such relative percentages of exports and imports into the future. In this way we can determine whether under peaceful conditions Germany would have been likely to overtake Britain, and if so, in what time frame.

The basic assumption of a Markov probability model is that for a finite number of possible outcomes of relative percentages of import (export) levels, the probability distribution of these outcomes for a particular time period (in this case, one year) depends only on the outcomes of the preceding period.

TABLE 1

The Behavior of Imports and Exports in the Period 1897-1913
In U.S. Dollars (Millions)

	Austria- Hungary	France	Germany	Italy	Russia	U.S.	U.K.	Total
Exports 1897	311.	694.41	865.13	211.53	375.80	1153.	1431.9	5042.7
Exports 1913	562.31	1327.8	2403.1	471.11	782.85	2615.	3089.6	11252.
Imports 1897	306.73	763.51	1114.1	215.00	288.40	880.	2195.0	5762.7
Imports 1913	691.62	1625.3	2563.3	662.38	707.61	1923.	3741.3	11914.
% Gain Exports	80.81	91.21	177.77	122.72	108.32	126.80	115.77	123.13
% Gain Imports	125.48	112.87	130.08	208.08	145.36	118.52	70.45	106.74
Compound Rate Growth Exports	3.7710	4.1345	6.5935	5.1319	4.6936	5.2513	4.9239	5.1442
Compound Rate Growth Imports	5.2130	4.8353	5.3458	7.2857	5.7700	5.7700	3.3890	4.6440
Bal Trade 1897	4.27	-69.1	-248.97	-3.47	87.4	273.	-763.1	-993.0
Bal Trade 1913	-129.31	-297.5	-160.2	-191.27	75.24	692.	-651.7	-1354.

Data Sources: see text. All figures have been converted to U.S. \$'s using gold standard par value. Compound rate of growth has been calculated assuming annual compounding.

TABLE 2
 Distribution of Exports in the Period 1897-1913
 Proportionate Shares

Year	Austria- Hungary	France	Germany	Italy	Russia	U.K.	U.S.	Total in \$
97	.0617	.1377	.1716	.0419	.0745	.2839	.2286	.5042734E + 04
98	.0625	.1292	.1705	.0445	.0720	.2730	.2483	.5243891E + 04
99	.0662	.1405	.1755	.0486	.0566	.2811	.2315	.5705512E + 04
00	.0642	.1292	.1788	.0424	.0601	.2810	.2442	.6137551E + 04
01	.0621	.1255	.1709	.0433	.0636	.2744	.2602	.6169215E + 04
02	.0624	.1318	.1788	.0455	.0711	.2729	.2376	.6228230E + 04
03	.0664	.1259	.1832	.0441	.0791	.2694	.2319	.6516312E + 04
04	.0629	.1273	.1843	.0450	.0768	.2677	.2360	.6745727E + 04
05	.0625	.1289	.1872	.0451	.0761	.2723	.2278	.7286551E + 04
06	.0601	.1265	.1884	.0457	.0702	.2791	.2300	.8033914E + 04
07	.0578	.1251	.1887	.0433	.0628	.2919	.2304	.8634094E + 04
08	.0571	.1216	.1900	.0417	.0641	.2772	.2483	.8017535E + 04
09	.0565	.1324	.1883	.0435	.0882	.2741	.2171	.8336480E + 04
10	.0533	.1306	.1931	.0438	.0810	.2822	.2161	.9213684E + 04
11	.0504	.1212	.1993	.0436	.0847	.2800	.2208	.9679195E + 04
12	.0531	.1240	.2040	.0426	.0748	.2789	.2226	.1045166E + 05
13	.0500	.1180	.2136	.0419	.0696	.2746	.2324	.1125177E + 05

Estimated Transition Matrix

.0000	.0000	.0000	.0000	.0000	.0000	1.0000
.0000	.4007	.0000	.0000	.0000	.0000	.5993
.0000	.0000	1.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000	.0000	1.0000
.0000	.1710	.0000	.1522	.6768	.0000	.0000
.0000	.0000	.0118	.0000	.0000	.9882	.0000
.2541	.2713	.0000	.1401	.0941	.0067	.2337

TABLE 2 (cont'd.)

Year	Austria- Hungary	France	Germany	Italy	Russia	U.K.	U.S.
Predicted Proportionate Shares							
98	.0581	.1299	.1749	.0434	.0720	.2821	.2396
99	.0631	.1314	.1737	.0457	.0721	.2714	.2425
00	.0588	.1288	.1788	.0411	.0601	.2793	.2531
01	.0621	.1283	.1821	.0434	.0637	.2793	.2411
02	.0661	.1318	.1742	.0461	.0675	.2729	.2414
03	.0604	.1294	.1820	.0441	.0705	.2712	.2423
04	.0589	.1269	.1863	.0445	.0754	.2678	.2401
05	.0600	.1282	.1874	.0448	.0742	.2661	.2393
06	.0579	.1265	.1904	.0435	.0730	.2706	.2381
07	.0584	.1251	.1917	.0429	.0692	.2773	.2354
08	.0585	.1234	.1921	.0418	.0642	.2900	.2299
09	.0631	.1271	.1932	.0446	.0668	.2756	.2297
10	.0552	.1270	.1915	.0439	.0801	.2723	.2300
11	.0549	.1248	.1964	.0426	.0752	.2803	.2258
12	.0561	.1229	.2026	.0438	.0781	.2782	.2182
13	.0566	.1229	.2072	.0426	.0716	.2771	.2220
14	.0591	.1222	.2168	.0432	.0690	.2729	.2169
15	.0551	.1196	.2200	.0409	.0671	.2711	.2262
16	.0575	.1208	.2232	.0419	.0670	.2694	.2205
17	.0560	.1196	.2264	.0411	.0659	.2677	.2233
18	.0567	.1198	.2295	.0413	.0656	.2660	.2210
19	.0561	.1192	.2327	.0410	.0652	.2644	.2215
20	.0563	.1190	.2358	.0410	.0650	.2627	.2202
21	.0560	.1185	.2389	.0408	.0647	.2611	.2200
22	.0559	.1182	.2420	.0407	.0645	.2595	.2192
23	.0557	.1179	.2450	.0453	.0643	.2579	.2187
24	.0556	.1175	.2481	.0404	.0641	.2563	.2180

TABLE 2 (cont'd.)

Year	Austria- Hungary	France	Germany	Italy	Russia	U.K.	U.S.
25	.0554	.1172	.2511	.0403	.0639	.2547	.2174
26	.0552	.1169	.2541	.0402	.0637	.2532	.2167
27	.0551	.1165	.2571	.0401	.0635	.2516	.2161
28	.0459	.1162	.2600	.0399	.0633	.2501	.2154
29	.0547	.1158	.2630	.0398	.0631	.2486	.2148
30	.0546	.1155	.2659	.0397	.0629	.2471	.2142
31	.0544	.1151	.2688	.0396	.0628	.2456	.2136
32	.0543	.1148	.2717	.0395	.0626	.2441	.2129
33	.0541	.1144	.2746	.0394	.0624	.2427	.2123

Mean squared error for within sample predictions .3864E - 04

For a discussion of data sources see text. The transition matrix reported above has been estimated using the LP method discussed in Lee, Judge and Zellner (1970).

TABLE 3

Distribution of Imports in the Period 1897-1913
Proportionate Shares

Year	Austria- Hungary	France	Germany	Italy	Russia	U.K.	U.S.	Total in \$
97	.0532	.1325	.1933	.0373	.0500	.3809	.1527	.5762738E + 04
98	.0552	.1431	.2004	.0419	.0527	.3796	.1271	.6033254E + 04
99	.0519	.1386	.2074	.0432	.0541	.3751	.1298	.6292758E + 04
00	.0512	.1347	.2039	.0457	.0479	.3783	.1382	.6729090E + 04
01	.0512	.1286	.1968	.0480	.0466	.3875	.1412	.6555934E + 04
02	.0520	.1263	.1995	.0469	.0459	.3829	.1465	.6716859E + 04
03	.0532	.1295	.1996	.0467	.0491	.3690	.1530	.7157332E + 04
04	.0571	.1194	.2078	.0474	.0461	.3685	.1536	.7276961E + 04
05	.0565	.1197	.2202	.0485	.0425	.3569	.1556	.7704652E + 04
06	.0548	.1252	.2202	.0533	.0476	.3412	.1577	.8670906E + 04
07	.0535	.1265	.2193	.0559	.0460	.3311	.1677	.9493668E + 04
08	.0561	.1254	.2102	.0620	.0541	.3324	.1598	.8681648E + 04
09	.0601	.1300	.2188	.0619	.0503	.3278	.1510	.9273871E + 04
10	.0568	.1358	.2085	.0590	.0548	.3237	.1614	.1019737E + 05
11	.0606	.1456	.2161	.0582	.0560	.3096	.1540	.1069263E + 05
12	.0628	.1381	.2213	.0581	.0525	.3151	.1521	.1149996E + 05
13	.0580	.1364	.2151	.0556	.0594	.3140	.1614	.1191438E + 05

Estimated Transition Matrix

.148577	.054412	.706162	.000000	.090854	.000000	.000000
.016811	.582591	.000000	.000000	.232099	.168498	.000000
.000000	.000000	.440345	.009666	.000000	.000000	.000000
.072945	.000000	.000000	.702388	.193801	.000000	.030864
.244926	.473963	.281111	.000000	.000000	.000000	.000000
.000000	.016353	.057631	.000000	.000000	.926009	.000000
.195562	.150635	.298597	.095312	.033421	.000000	.226465

Table 3 (cont'd.)

Year	Austria- Hungary	France	Germany	Italy	Russia	U.K.	U.S.
98	.0550	.1330	.2043	.0426	.0479	.3750	.1421
99	.0514	.1367	.2019	.0435	.0506	.3756	.1403
00	.0518	.1349	.2036	.0447	.0496	.3707	.1448
01	.0520	.1310	.2025	.0472	.0494	.3731	.1449
02	.0523	.1274	.2004	.0491	.0485	.3805	.1417
03	.0532	.1265	.2033	.0488	.0480	.3758	.1444
04	.0554	.1307	.2062	.0493	.0490	.3635	.1459
05	.0553	.1237	.2119	.0499	.0472	.3614	.1506
06	.0548	.1222	.2159	.0511	.0475	.3507	.1579
07	.0566	.1278	.2158	.0546	.0497	.3371	.1585
08	.0582	.1291	.2164	.0574	.0507	.3279	.1603
09	.0595	.1313	.2142	.0608	.0516	.3290	.1537
10	.0575	.1309	.2169	.0600	.0527	.3255	.1565
11	.0600	.1378	.2142	.0588	.0535	.3227	.1531
12	.0595	.1429	.2175	.0576	.0557	.3112	.1555
13	.0585	.1368	.2201	.0574	.0541	.3151	.1579
14	.0611	.1402	.2187	.0565	.0531	.3138	.1566
15	.0592	.1389	.2192	.0567	.0543	.3142	.1575
16	.0594	.1387	.2187	.0570	.0539	.3143	.1580
17	.0594	.1385	.2187	.0572	.0539	.3144	.1578
18	.059	.1384	.2186	.0573	.0539	.3145	.1578
19	.0594	.1383	.2186	.0574	.0539	.3146	.1577
20	.0594	.1383	.2186	.0574	.0539	.3146	.1577
.
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33	.0594	.1382	.2185	.0576	.0539	.3147	.1577

Mean squared error for within sample predictions .2185E - 04

For a discussion of data sources see text. The transition matrix reported above has been estimated using the QP method.

The probability distribution can be estimated, and, if it remains stable through time, can be used to project relative shares of different countries in total exports outside the sample period. In this manner projections of what would have happened in the absence of World War I can be obtained.

In a more formal sense, if we assume that q_{ti} is the percentage of exports (imports) of the i th country in the t th period and that the probability distributions can be estimated and are contained in the transition matrix P (containing elements $p_{i,j}$), then

$$\hat{q}_{t+1,i} = \sum_{j=i}^m q_{tj} p_{ji} \quad i = 1, \dots, m$$

where $\hat{q}_{t+1,i}$ is an estimate of the percentage of imports (exports of the i th country in the $t+1$ period.¹⁴

Transition matrices of the form of P have been estimated for the countries discussed in Table 1 for exports and imports and are reported in Tables 2 and 3. These matrices enable us to identify the time frame within which Germany appears to have been overtaking the United Kingdom (and the United States) in percentage of exports. At the top of Table 2 we have reported the raw data of the percentages of exports of the respective countries. By using the percentages and the total export figures, it is possible to reconstruct the data reported in Table 1.¹⁵

Predicted proportional (relative) export shares obtained from the estimated transition matrix are given at the bottom of Table 2. Had pre-war analysts been forecasting with the Markov technique, they would have projected that the German relative percentage of exports would surpass that of the United States in 1916 and that of Britain in 1926. Even those writers least prone to fits of nationalist hysteria would have read such forecasts with grave concern. And the worst fears of the anti-German "jingo" types would have been confirmed by these projections. From the vantage point of more than half a century, it seems safest to interpret our results as strongly suggesting that both the change that was occurring in export shares between 1897 and 1913 and the change that could reasonably be forecast were rapid and shocking enough to give a real basis to the fears of all parties involved in the Anglo-German trade rivalry. Interpretations like those of Hoffman and Seligman, which emphasize the role of economic rivalry in provoking and then aggravating international tensions in the pre-War years find broad agreement in the results of our Markov analysis. An environment in which one major power is gaining on, and very likely preparing to overtake, another in so vital a measure of strength as exports is an environment in which grave conflicts, perhaps even war itself, should come as no surprise.

The provocative pattern found in our Markov analysis of export shares is not mirrored in our analysis of import shares (reported in Table 3). In contrast to export findings, which suggest that the relative percentages were far from stable in 1913, the import findings indicate that the relative percentages of imports in 1913 are very close to the long run asymptotic solution of the

transition matrix. The economic implication of this result is that by 1913 the relative import distribution had stabilized. As Table 2 shows, this conclusion is clearly not warranted on the export side. Perhaps this asymmetric adjustment pattern had the potential to become another source of economic tension. In any case imports in general, as opposed to British imports from Germany, did not receive much attention in contemporary discussion or subsequent historical treatment of the Anglo-German trade rivalry. In the context of Markov analysis, the stability of import shares serves to highlight the striking instability of export shares.

Conclusion

Markov probability analysis has proved a suitable tool for forecasting the shares of exports and imports that seven major nations may have had in the period 1914-1933 if World War I had not occurred. What outcome does this analysis predict for the Anglo-German trade rivalry? The German share of exports would have exceeded that of Britain for the first time in 1926. By 1933 Germany would have overtaken Britain decisively in the struggle for export markets. Import share predictions yield no dramatic changes.

Using these forecasts to reconsider the Anglo-German commercial rivalry raises some difficult historiographical problems. We must imagine how choices would have been constrained by events that never occurred and could not in the pre-World War I era have been predicted using Markov analysis. Nonetheless, let us assume that our hypothetical outcome was the best prediction that could have been made by contemporaries. How does this outcome relate to the interpretations of Hoffman, Banze, Seligman, and Hofrichter? As the expectation grew stronger that the German share of total exports of the seven countries included would exceed that of Britain by 1926 or shortly thereafter, it is questionable that Britain would have placidly accepted such a defeat. Gloomy predictions filled the British press as early as 1897 when the British relative export share was still 11 percent larger than that of Germany. Although it is hard to measure, public concern with German economic competition appears to have mounted as the relative British export share fell to a level only 6 percent higher than that of Germany in 1913. Nonetheless the absolute increase in the level of British exports prior to 1913 helped to take some of the sting out of foreign competition and British public opinion seems not even to have been ready to support tariffs much less a preventive war. Evidently, the rate at which the relative German export share was gaining on that of Britain was not enough to provoke a drastic defensive reaction in Britain (e.g., tariffs) with the German overtaking of Britain still about thirteen years off. From the vantage point of 1913, the views of Banze and Hofrichter have considerable appeal. If the Anglo-German commercial rivalry was ever to reach a critical point, that point had not yet come in 1913.

Nevertheless, our forecasts suggest that the views of E.C.H. Vincent and Joseph Chamberlain may be worth more careful consideration than these views are generally given.¹⁶ In an atmosphere of dumping and high tariff walls on the Continent, it is far from clear that a sensible case could not have been made for an imperial preferential tariff system. Furthermore, if

Germany had begun to make the gains that seemed to be in store, and to make them at the expense of Britain in basic industries like iron and steel, political support for free trade may soon have waned. Perhaps, the fair-traders were simply ahead of their time. The same may be said of the interpretation of Hoffman. His study marshals a great deal of evidence indicating that trade rivalry troubled Anglo-German relations. This irritant appears to have had the potential to cause more serious discord, a potential that was growing ominously from 1897 to 1913 and may well have brought about "tariff reform" at some point had war not intervened. A good forecaster might perhaps have determined that Britain was headed on a course that would make free trade unattractive or unacceptably costly. It is hard to imagine that peace would become unattractive in the same way. Balfour notwithstanding, when so simple a remedy as tariffs was at hand, why should Britain have preferred the risks and trials of preventive war? When they came under severe pressure in a period far different from the prosperous pre-War era, the British did finally abandon free trade in February, 1932. Later in that year they established an imperial preference system. The war-time and post-war periods gave rise to enormous structural changes in the economic system described by our pre-war Markov analysis, yet it may not be entirely accidental that British tariffs were imposed at a point at which our analysis suggests that Britain may have needed protection.

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NOTES

1 See: Charles P. Kindleberger, "Germany's Overtaking of England, 1806-1914," *Weltwirtschaftliches Archiv* (1975).

2 K. W. Hardach, "Anglomanie und Anglophie während der industriellen Revolution in Deutschland," *Schmollers Jahrbuch für Wirtschafts und Sozialwissenschaften*, 91 (1971) and R. H. Tilly, "Los von England: Probleme des Nationalismus in der deutschen Wirtschaftsgeschichte," *Zeitschrift für die gesamte Staatswissenschaft*, 124 (1968).

3 The rise of powerful United States producers was, of course, also a source of competitive pressure. For a good discussion of the emergence of foreign competition to British industry see: Derek H. Aldcroft, ed. *The Development of British Industry and Foreign Competition 1875-1914* (Toronto, 1968).

4 Ross J. S. Hoffman, *Great Britain and the German Trade Rivalry 1875-1914* (New York, 1964).

5 Angelike Banze, *Die deutsche-englische Wirtschafts rivalität* (Berlin, 1935), 96.

6 Hoffman, *Great Britain and the German Trade Rivalry 1875-1914*, 303.

7 Anton Hofrichter, *Krieg und Handels rivalität* (Berlin, 1917); Edwin R. A. Seligman, *An Economic Interpretation of the War* (New York, 1915).

8 Our counterfactual result is a modest one in as much as it is not the product of an elaborate econometric model. It is not clear whether theory would enable such a model to be constructed; in any case, the required data are not available even to contemplate such an effort.

9 In the model employed in this paper, Markov analysis is limited to seven countries (shares). Extension of this technique beyond that number would be very difficult and could be expected to yield little relative to the effort required.

10 We discuss the theory of the Markov model using imports only because all the mathematics remains the same in analyzing exports; only the estimated matrix would be different.

11 Sources for import and export data are: Austria-Hungary - *Österreichisches Statistisches Handbuch*; France - *Annuaire Statistique* (1966); Germany - W. G. Hoffman, *Das Wachstum der deutschen Wirtschaft seit der Mitte des 19 Jahrhunderts* (Berlin, 1965); Italy - *Annali di Statistica*, serie VIII, vol. 9; Russia - P. A. Khromov, *Economic Development of Russia in the 19th and 20th Centuries, 1800-1917* (Moscow); United Kingdom - B. R. Mitchell and P. Deane, *Abstract of British Historical Statistics* (Cambridge, 1962); United States - *Historical Statistics of the United States, Colonial Times to 1970*, Part 2 (Washington, D.C., 1975). All European series have been converted into United States dollars using gold standard par value exchange rates given in A. I. Bloomfield, *Short-Term Capital Movements Under the Pre-1914 Gold Standard* (Princeton, 1963), Appendix I, 95.

12 The compound rate of growth is calculated assuming annual compounding. For example, in the case of Germany

$$865.13 \times (1.065935)^{16} = 2403.1$$

13 For data on the relative percentages of exports and imports of each country, see Tables 2 and 3.

14 More detailed discussion of the methods whereby transition matrix P can be estimated are contained in *Estimating the Parameters of the Markov Probability Model from Aggregate Time Series Data* by T. Lee, G. Judge, and A. Zellner (North Holland, 1970). *Statistical Decomposition Analysis* by H. Theil (North Holland, 1972) indicates that by a spectral decomposition it is possible to measure the convergence rate of the estimated transition matrix. This analysis has been performed and the convergence rate of the export and import matrices reported in Tables 2 and 3 are .9941 and .7879, respectively. Additional requirements that all transition matrices must meet are

$$0 \leq P_{i,j} \leq 1 \quad \text{for all } i \text{ and } j$$

and

$$\sum_{j=1}^m P_{i,j} = 1 \quad \text{for } i = 1, m$$

and the requirement that the largest eigenvalue must be equal to one. All transition matrices reported have been tested as noted above and meet these requirements. The accuracy of the forecasts of a transition matrix can be tested by inspection of the mean squared errors for within sample predictions. Mean squared errors accompany the forecasts reported below.

The use of the reported Markov transition matrix can be seen if we show the predicted proportionate shares relate to the estimated Markov matrix and the shares for the past year. For example in Table 3 we indicate that the predicted share of imports for France in 1898 is .1330. This share can be obtained by multiplication of the share vector for 1897 by the second column of the estimated Markov matrix. In this case we note that $.1330169981 = (.054412)(.0532) + (.582591)(.1325) + (.1933)(0) + (.0373)(0) + (.473963)(.05) + (.016343)(.3809) + (.1527)(.150635)$.

15 For example, $0.2286 \times 0.5042734E = 04 \ 1152.7689$ or the level of exports of the United States in 1897.

16 Colonel C. E. H. Vincent was one of the founders of the United Empire Trade League and a member of Parliament for Sheffield.