FLOUR-MILL OUTPUT (WHEAT CONSUMPTION FOR FOOD)

Year	*Production minus seeds plus net imports (Millions of quintals)*	*Feed (Millions of quintals)*	*Available for food consumption (Millions of quintals)*	*Index 1900 = 100 (Smoothed by four-year moving averages)*
1881	32.6	1.0	31.6	71
1882	33.6	1.1	32.5	73
1883	34.6	1.1	33.5	76
1884	35.6	1.1	34.5	78
1885	36.2	1.2	35.0	77
1886	38.5	1.2	37.3	76
1887	40.0	1.3	38.7	75
1888	32.9	1.1	31.8	75
1889	34.6	1.1	33.5	77
1890	37.1	1.3	35.8	79
1891	39.0	1.3	37.7	78
1892	37.8	1.3	36.5	76
1893	38.6	1.3	37.3	77
1894	34.6	1.2	32.4	72
1895	36.8	1.3	35.5	74
1896	39.5	1.3	38.2	75
1897	29.1	1.0	28.1	77
1898	37.5	1.3	36.2	88
1899	39.3	1.3	38.0	92
1900	42.5	1.4	41.1	100
1901	50.0	1.6	48.4	104
1902	45.9	1.5	44.4	105
1903	53.7	1.7	52.0	111
1904	50.0	1.6	48.4	110
1905	51.4	1.6	49.8	110
1906	57.6	1.8	55.8	112
1907	51.4	1.6	49.8	109
1908	50.9	1.6	49.3	109
1909	55.8	1.8	54.0	112
1910	51.0	1.5	49.5	113
1911	51.0	1.5	49.5	121
1912	58.1	1.7	56.4	123
1913	57.6	1.7	55.9	129

The beer and sugar index and the flour-mill index were combined by attributing a weight of .109 to the former and a weight of .891 to the latter. These weights were estimated on the assumption that the value-added-per-worker ratios between the cotton industry, on the one hand, and the sugar and the flour-mill industry, on the other, were similar to those which prevailed between these industries in the United States in 1899 (see above). Naturally, this procedure involves no assumption with regard

to absolute productivity levels in the United States and in Italy. For the value added per worker in the Italian cotton industry, see the section on textiles. The computed data on value added per worker were then multiplied by the respective labor-force figures and the ratios of the products (total value added) used as weights in combining the two indices. The final index is as follows.

FOODSTUFFS INDUSTRY

Year	*Index (1900 = 100)*
1881	63
1882	65
1883	68
1884	70
1885	69
1886	68
1887	67
1888	67
1889	69
1890	71
1891	70
1892	68
1893	69
1894	65
1895	66
1896	67
1897	69
1898	80
1899	86
1900	100
1901	106
1902	111
1903	120
1904	112
1905	115
1906	119
1907	122
1908	127
1909	128
1910	130
1911	141
1912	146
1913	166

Chemical industry

Tagliacarne used a single series — output of sulphuric acid — to represent the output of the chemical industry. Patently inadequate as this

procedure is, it was accepted in the present index. The tonnage series, taken over from Tagliacarne, p. 83, and the index series with the base year changed to 1900 are as follows.

CHEMICAL INDUSTRY (SULPHURIC ACID)

Year	*Output (1,000 tons)*	*Index (1900 = 100)*
1881	20	8.7
1882	25	10.9
1883	30	13.1
1884	35	15.2
1885	40	17.4
1886	45	19.6
1887	50	21.8
1888	55	24.0
1889	60	26.1
1890	65	28.3
1891	64	27.9
1892	62	27.0
1893	59	25.9
1994	71	31.1
1895	96	41.7
1896	111	48.5
1897	129	56.1
1898	139	60.7
1899	165	72.1
1900	230	100.0
1901	235	102.4
1902	252	109.8
1903	263	114.6
1904	278	121.0
1905	302	131.6
1906	365	158.9
1907	425	185.2
1908	524	228.4
1909	590	256.9
1910	645	280.8
1911	596	259.7
1912	634	276.4
1913	645	280.9

THE PRESENT INDEX: WEIGHTS

The six index series described in the preceding section were combined to an aggregate index of Italian industrial output by the alternative use of three sets of weights pertaining to the census year 1903.

Employment

The relevant data were obtained from the survey (*Riassunto delle notizie sulle condizioni industriali del Regno*, Rome, 1906, part 1, table 4, pp. 12f). They are reproduced in the following table.

WORKERS IN SELECTED ITALIAN INDUSTRIES (PRESENT-INDEX INDUSTRIES) IN 1903

Branch	*Numbers*	*Weight*
Mining and mineral processing	71,633	7.79
Metalmaking	34,580	3.75
Engineering	101,684	11.05
Textiles	452,969	49.24
Foodstuffs	223,980	24.34
Chemicals	34,994	3.83
	919,840	100.00

Horsepowers

The relevant data were obtained from the *Survey*. They are reproduced in the following table.

HORSEPOWERS INSTALLED IN SELECTED INDUSTRIES (PRESENT-INDEX INDUSTRIES) IN 1903

Branch	*Number*	*Weight*
Mining and mineral processing	14,657	2.90
Metalmaking	48,075	9.44
Engineering	47,680	9.39
Textiles	137,803	27.08
Foodstuffs	214,187	42.09
Chemicals	46,498	9.10
	508,900	100.00

Value-added estimates, 1903–04

The third set of weights was obtained through a series of value-added estimates.

Mining and mineral processing. It was assumed on the basis of comparable information from other European countries that the ratio of value added to value of product was 70 percent. According to the *Survey* (p. 28), the value of product in 1903 amounted to 85,204,934 lire, and the value added was estimated at 60 million lire. While this results in a fairly high amount of value added per worker (1,000 lire), it was not considered

implausible in view of the large share of sulphur in the total and the monopolistically high price which at that time attached to the mineral. On the other hand, the value added in the small group of mineral processing, of which processing of sulphur was again the largest part, was assumed to produce a much lower value added per worker, estimated in the aggregate at 5.7 million lire.

Metalmaking. The two main groups of the industry were iron and steel and copper, the former dominating the field. The value of product in iron and steel amounted in 1903 to about 80 million lire. Applying to this figure the 1899 U.S. ratio of value added to value of product in the iron and steel industry of a little less than 30 percent, the amount of 23.5 million lire was obtained. The value of product in the Italian copper industry in 1903 amounted to 22,043,000 lire. Applying to this sum the 1899 ratio of value added to value of product in the United States of 25.5 percent, an amount of 5.64 million was obtained. The value added in iron and steel plus copper, amounting to 29.14 million lire in 1903 (23.50+ 5.64), when divided by the number of workers in the two industries, yields a value added per worker of 1,356 lire. It was assumed that the remaining number of about 13,000 workers, mostly employed in small shops, contributed a value added of 500 lire per worker, giving a total for metalmaking outside iron and steel and copper of 6.5 million. Adding up the three subgroups results in a value-added sum of 35.64 million lire for the series of metalmaking.

Textiles. In the previous section some value-added estimates were used in order to combine the silk and cotton indices. The value added in the Italian wool industry can be similarly estimated. Value of product in the wool industry amounted in 1903 to 110 million lire (*Survey*, p. 163). Applying to this figure the 1899 U.S. ratio of value added to value of product in the American wool industry of 39 percent, a value added by Italian wool manufacturing of 42.9 million lire is obtained. The average value added per worker in the silk, cotton, and wool industries can be accordingly computed as follows.

Branch	*Number of workers*	*Estimated value added (million lire)*	*Value added per worker (lire)*
Silk	191,651	109.0	568.74
Cotton	138,880	145.5	1,048.0
Wool	37,744	42.9	1,136.6
	367,275	297.4	809.74

Total workers in textile industry	452,969
Total workers in silk, cotton, and wool industries	367,275
Balance	85,634

Applying to the remaining branches of the textile industry the average per worker value added by manufacturing in the three main subgroups yields an amount of value added of 69.4 million lire. Adding this sum to the amounts previously computed gives a total value added in the textile industry of 366.8 million lire.

Engineering. The number of workers occupied in the Italian machinery industry can be broken down as follows:

Big machinery factories	38,104
Shipbuilding	25,936
Various machinery	19,560
Small specialized shops	18,357
	101,957

Since no data on Italian value of produce in engineering were available, the following method of estimation was applied. The 1899 U.S. value added by manufacture per worker was computed for individual branches of the American machinery industry. Thereafter, the ratio of the results to value added per worker in the American cotton industry was obtained. Finally, these ratios were applied to the lire amount of value added by manufacture in the Italian cotton industry.

For the first group, the ratio of value added per worker in the American metalworking machinery output ($868) was used. This amount exceeded the corresponding magnitude in the American cotton industry ($537.04) by a coefficient of 1.53. Applying this coefficient to the value added per worker in the Italian cotton industry (1,048.3 lire) yields an amount of 1,603 lire per worker.

The corresponding 1899 American ratio for the shipbuilding industry was 1.45 ($781:$537.04), which yields a value-added estimate for Italy of 1,520 lire (1.45 times 1,048.3 lire).

For the group of various machinery in Italy in which bicycle production was a strong component, the data on U.S. bicycle output in 1899 were used and similarly related to the value added per worker in the American cotton industry, yielding a coefficient of 1.37 ($734:$537.04). Applying this coefficient to the value added per worker in the Italian cotton industry yields an amount of 1,436 lire (1.37 times 1,048.3 lire).

It was assumed that the balance of the engineering industry in Italy, in which small but highly specialized shops prevailed, showed a similarly high value added per worker, which was estimated at 1,500 lire.

Accordingly, total value added for the Italian machinery industry was estimated as follows.

APPENDIX I

VALUE ADDED IN ENGINEERING, 1903

Branch	*Workers*	*Value added per worker (lire)*	*Total value added (million lire)*
Big machinery factories	38,104	1,603	61.08
Shipbuilding	25,936	1,520	39.42
Various machinery	19,560	1,436	28.09
Small specialized shops	18,357	1,500	25.54
			156.13

Foodstuffs industry. The method of estimating the amounts of value added was analogous to that used for the same purpose with regard to the engineering industry. The value added per worker in the Italian sugar industry was estimated to bear the same value-added-per-worker relation to the Italian cotton industry as in the United States ($1,050:$537.04 times 1,048.3) thus equaling 2,044 lire, which resulted in a total for value added produced of 25.5 million lire. As to the most important single component — flour mills — it seemed excessive to accept the full American mill:cotton ratio of about 4 to 1; in view of the less modern character of Italian flour mills in relation to Italian cotton manufacturing, the ratio was reduced to 3:1, yielding a value added of 208.1 million (3,144 lire times 66,191 workers).

It was assumed that the rest of the industry, occupying 145,320 workers but a very small proportion of the industry's horsepower, produced a value added of 500 lire per worker, yielding a total of 72.65 million. Summing up the three groups (208.1+25.5+72.65) gives a total value added for the foodstuffs industry of 306.25 million lire.

Chemical industry. The 1899 U.S. ratio of value added per worker in phosphate production to value added per worker in cotton-goods output ($1,355:$537.04) of about 2.5 was applied to the value added per worker in the Italian cotton manufacturing, yielding the amount of value added of 2,620 lire per worker and 89.1 million lire for the whole industry (2,620 times 34,994).

The weights for the six industries which were obtained in the described fashion are summarized in the following table.

VALUE-ADDED ESTIMATES FOR SELECTED INDUSTRIES (PRESENT-INDEX INDUSTRIES) IN 1903

Branch	*Amount (million lire)*	*Weight*
Mining and mineral processing	65.70	6.43
Metalmaking	35.64	3.49

VALUE-ADDED ESTIMATES FOR SELECTED INDUSTRIES (PRESENT-INDEX INDUSTRIES) IN 1903 (*cont.*)

Branch	*Amount (million lire)*	*Weight*
Engineering	156.13	15.27
Textiles	366.80	35.86
Foodstuffs	306.25	29.99
Chemicals	91.68	8.96
	1,022.20	100.00

THE RESULTS

The six index series of Italian industrial output have been combined into an aggregate index through arithmetic averages as applied to the three sets of weights that have been discussed in the foregoing pages. The results are as follows.

AN INDEX OF ITALIAN INDUSTRIAL OUTPUT, 1881–1913

Year	*Value-added weights*	*Employment weights*	*Horsepower weights*
1881	53.86	55.46	51.91
1882	56.81	57.56	53.83
1883	63.91	64.99	60.09
1884	62.68	62.66	59.57
1885	64.78	64.96	61.92
1886	67.00	67.82	64.51
1887	72.92	73.92	69.23
1888	73.66	74.75	71.54
1889	71.85	73.35	72.91
1890	72.34	75.49	72.16
1891	66.55	69.53	66.58
1892	63.94	67.38	63.21
1893	69.83	74.79	68.50
1894	71.98	77.91	69.31
1895	73.37	78.47	71.09
1896	75.18	80.11	72.82
1897	77.83	81.80	75.28
1898	85.91	90.23	89.94
1899	92.30	95.38	91.32
1900	100.00	100.00	100.00
1901	104.06	100.00	100.00
1902	108.82	109.61	108.99
1903	113.65	113.04	115.57
1904	116.83	116.88	116.76
1905	125.65	124.81	126.64
1906	138.84	136.89	140.39
1907	151.95	149.67	151.40

AN INDEX OF ITALIAN INDUSTRIAL OUTPUT, 1881–1913 (*cont.*)

Year	*Value-added weights*	*Employment weights*	*Horsepower weights*
1908	163.34	155.09	165.31
1909	168.10	157.02	173.87
1910	169.23	154.40	177.19
1911	174.18	160.09	182.68
1912	182.03	169.15	190.98
1913	184.14	169.12	195.96

It is possible now to show the rates of growth implied in our index series for the index period as a whole and for portions of that period. That raises the problem of the choice of appropriate subperiods into which the total index period should be divided.

It is not easy to select appropriate subperiods, at least for some stretches of the index period. Tagliacarne used the following division: 1881–91, 1891–96, 1896–1913. In order to make the rates of the present index comparable with Tagliacarne's results, figures for the same subperiods have been computed. But this division has certain shortcomings. The period 1881–91 throws together the years of the upswing to 1887 or 1888 and the years of stagnation and decline thereafter. On the other hand, the period 1896–1913 again combines the period of rapid growth to 1908 with a period of slower advance thereafter. Accordingly, rates have been also computed for the periods 1881–88, 1888–96, 1896–1908, 1908–1913, and finally also for the whole period 1881–1913.

As to the method of rate of growth computations, it has been decided to use a "two-point" rate which links the first and the last year of the given period by the compound-interest formula. A rather extensive experimentation with the alternative method of fitting a straight line to the logarithms of the index data and using the slope of the line as the average rate of growth for the given period did not result in sufficiently large discrepancies between the two rates.

The annual average rates of growth which are implied in the three indices presented in the last table are as follows.

ANNUAL AVERAGE RATES OF GROWTH OF ITALIAN INDUSTRIAL OUTPUT, 1881–1913 AND SUBPERIODS

Period	*Value-added estimates*	*Employment*	*Horsepower*
1881–1888	4.6	4.4	4.7
1888–1896	0.3	0.9	0.3
1881–1896	2.2	2.5	2.3
1881–1891	2.1	2.3	2.5

ANNUAL AVERAGE RATES OF GROWTH OF ITALIAN INDUSTRIAL OUTPUT, 1881–1913 AND SUBPERIODS (*cont.*)

Period	*Value-added estimates*	*Employment*	*Horsepower*
1891–1896	2.5	3.9	1.8
1896–1908	6.7	5.7	7.1
1908–1913	2.4	1.7	1.1
1896–1913	5.4	4.5	6.0
1881–1913	3.8	3.5	4.3

Computed on the assumption of a geometric rate of growth between the first and the last years of the specified periods.

The comparison of the three indices shows two obvious features. (1) The index based on value-added weights in almost all cases comes to lie between the indices based on horsepower and employment, respectively. It thus constitutes a compromise between the latter two which does not seem unreasonable in terms of the underlying economic relations. (2) The index based on horsepowers shows, in comparison with the index based on employment, a faster rise during the good periods and a slower rise during stagnation periods, thus suggesting that industries with more capital equipment are more sensitive to cyclical variations, which again is something that one would expect.

The rates shown in the preceding table should be viewed against the rates of increase (or decrease) in the individual component series of the present index. These rates are shown in the following table.

ANNUAL AVERAGE RATES OF GROWTH IN THE SIX INDEX INDUSTRIES

Branch	*1881–1888*	*1888–1896*	*1881–1891*	*1891–1896*	*1896–1908*	*1908–1913*	*1881–1913*
Mining	0.0	1.30	0.7	0.8	1.8	0.0	1.0
Metalmaking	22.50	−3.24	12.6	−0.5	12.4	6.1	9.3
Textiles	4.40	3.20	3.1	5.2	3.5	−1.2	2.5
Engineering	9.20	−7.40	0.0	0.0	12.2	2.0	4.7
Foodstuffs	0.9	0.0	1.1	0.9	5.5	5.5	3.1
Chemicals	15.1	9.4	12.0	11.8	13.7	1.8	11.3

Computed on a compound basis using the first and the last years of the specified periods.

The following facts may be gleaned from the preceding table.

(1) The rate of growth in mining was steady but very low throughout the whole period under review.

(2) Metalmaking showed an extremely high rate in the eighties and a very high rate in the period 1896–1908. It was severely affected during the early nineties, showing a decline of output between 1888 and 1896. A reduced but still very respectable rate of increase continued after 1908.

(3) The older textile industry had a steadying and stabilizing effect on the rate of industrial growth by developing at a medium speed. The depression of the nineties failed to affect it seriously, the revival coming as early as 1893. But the decline in output between 1908 and 1913 did reflect a serious crisis in the cotton industry and a rather precarious situation in the silk industry.

(4) Engineering output showed a very rapid increase in the eighties, but was immediately and profoundly affected by the depression. It will be noted how Tagliacarne's choice of periods disguises both the rise and the fall in output. After 1896, the industry shows a very high rate until 1908, but it proves quite sensitive to the following recession while retaining a positive rate of growth. As far as the period 1896–1908 is concerned, it is engineering and metalmaking that are mainly, if not solely, responsible for the big industrial movement of those years.

It is useful at this point to compare the rates of growth implied in the engineering index (iron and steel consumption minus production of rails and related materials) with the rates of growth of the unadjusted iron and steel consumption in the country.

AVERAGE ANNUAL RATES OF GROWTH OF IRON AND STEEL CONSUMPTION

Period	*Adjusted*	*Unadjusted*
1881–1888	9.20	8.04
1888–1896	−7.40	−8.00
1881–1891	0.00	1.85
1891–1896	0.00	−1.17
1896–1908	12.20	12.20
1908–1913	2.00	3.4

This comparison reveals that in the depression of the nineties railroad building and maintenance not only failed to exert a steadying effect on the economy but even accentuated the downward trend. This is true whether the depression period is represented by the years 1888–96 or, as Tagliacarne does, by the years 1891–96. This throws interesting light on the general policies pursued during the period. By contrast, the period of slower development, 1908–13, is characterized by a faster growth of iron and steel consumption, including railroad-building materials. In 1905, the major Italian railroads were taken over by the government and considerable modernization programs were begun a few years later.

(5) The foodstuffs industry fared poorly in the eighties and even showed declines in the nineties. The explanation lies in the composition of the series. The Italian sugar industry had not yet begun its rapid development and flour-mill output, being represented by wheat alone rather than

by wheat and corn, appears less depression-resistant than it probably was in reality. From 1896 on, the food industry shows a fairly high rate of increase, its output continuing to grow after 1908 at the same rate — essentially because of the increasing weight of sugar output.

(6) The chemical industry mirrors the rapid rise of sulphuric-acid production. Throughout the eighties it developed at a very high speed and continued almost unabated through the depression of the nineties into the following period. It was, however, particularly affected by the recession after 1908, its rate having been reduced to a fraction of its former level.

AN APPRAISAL OF THE INDEX

The foregoing detailed description of the way in which the present index has been constructed makes it unnecessary to present more than a brief discussion of its weaknesses.

The following tabulation shows the coverage of the index made under the — somewhat spurious — assumption that the indirect measures used for the engineering and cotton series yield a complete coverage.

COVERAGE OF THE INDEX

Branch	*Number of workers (1903)*		*Percent of industry included to imputed*	*Horsepowers (1903)*		*Percent of industry included to imputed*
	Included	*Imputed*		*Included*	*Imputed*	
Mining and mineral processing	60,147*	71,633	84*	9,800*	14,657	67*
Metalmaking	34,580*	34,580	100*	48,075*	48,075	100*
Engineering	101,684*	101,684	100*	47,680*	47,680	100*
Textiles						
Silk 191,651						
Cotton 138,880	330,531	452,969	73	98,929	137,803	72
Foodstuffs						
Mills 66,191						
Sugar and beer 12,469	78,660	223,980	35	178,311	214,187	83
Chemicals	8,000*	34,994	23*	35,000*	46,498	75*
	613,602	919,840	67	417,795	508,900	82
Outside the index		488,301			268,927	
		1,408,141			777,827	
Percent of included to total			44			54
Percent of imputed to total			65			65

* Approximately

Despite the generous assumptions, the picture is far from comforting. No less than 35 percent of Italian industry has remained outside the scope

of the index. The excluded segments comprise many "diverse" industries from hat making to output of musical instruments. They comprise the paper industry with its 28,000 horsepowers installed and the straw-working industry employing almost 125,000 workers (all figures refer to 1903–04). The output of the paper industry amounted to about 1 million quintals at the end of the nineteenth century; it was close to 3 million quintals before the outbreak of World War I.[6] A great deal of modernization of the industry occurred at that time. If the industry had been included in the present index, the latter's rate of growth probably would have increased somewhat during the period 1896–1913. That period, however, is marked by the first stage of rapid development of electric-power production. The first large power-producing plants were built in the last years of the century. Consumption of electric power in Italy rose from 60 million kwh. in 1891 to 160 million kwh. in 1896; by 1908 a level of consumption of 1,009 million kwh. was reached, and this amount was further doubled in the remaining years until 1913 (2,312 million kwh.); the weight to be attributed to the industry before the First World War was probably not excessively large. (In 1938, after an unprecedented further upswing, the total value added produced by the industry was still below that of the chemical industry, which developed very fast but less impetuously than did power production.) Still, there is no doubt that inclusion of electric-power output would have raised the rate of growth in the period 1896–1913 in a perceptible manner. On the other hand, many an excluded industry probably showed a rather low rate of change.[7]

As for the industries included in the present index, it may be said that mining and metalmaking are fairly well covered as far as the important branches of the two industries are concerned. The percentages of included branches to imputed branches are high for mining, both for labor and for horsepower. What has remained outside is essentially the processing of minerals. The metalmaking index must be considered as almost complete. It must be remembered that aluminum output, which is not included, was first recorded in 1907 and remained very small until the 1920s.

The main problem with regard to engineering lay in the aptitude of a steel-consumption index to reflect correctly the changes in value of output in that industry. Since the process of industrialization presumably consists in growing amounts of value added per weight unit of steel consumed, the engineering series probably tends to understate the industry's rate of growth.

[6] See *Industria Italiana alla meta del secolo XIX*, Confederazione Italiana dell' Industria Italiana (n.p., n.d.), p. 8.

[7] It is, however, comforting to see that the larger coverage of the Golzio index does not show strong differences in the rates of growth between the present-index industries and the rest of industrial output. See the final section on the Golzio index.

The same should apply, though less strongly, to the cotton industry, which is represented by imports of raw cotton. Production of raw silk is, of course, a poor measure of progress achieved in silk weaving, which was slow to develop in Italy. In addition, it must be noted that the raw-silk-output series itself does not include treatment of imported raw silk for further processing that is still confined within the raw-silk stage of production.[8] This consideration apart, the fact that the silk and cotton industries have both been represented gives a high ratio of included to imputed coverage for the textile industry as a whole, 72–73 percent, for both labor and horsepower.

The foodstuffs industry with its three series for sugar, beer, and flour mills is much less well represented. The coverage with regard to labor is only 35 percent, though, thanks to the flour-mill industry, it is 83 percent with regard to horsepower.

It would have been desirable to have the flour-mill industry represented by a combined wheat-corn input series rather than by wheat alone. (It is true that, in addition to wheat and corn, Italian mills also ground some oats and rye, though not barley, but the quantities involved were very small.) It was somewhat difficult, however, to obtain the requisite data. Though the published sources contain the amounts used for seeds, they do not record quantities of corn used for poultry feed and alcohol production, and such data would be indispensable for computing corn-milling availabilities as a residuum. By the time a series on corn-milling availabilities was made available to this writer by the much-appreciated courtesy of Professor Benedetto Barberi (director general of Istituto Centrale di Statistica, Rome), it was too late for inclusion of these data into the body of the present computations. Still, it was possible to compute the index of the foodstuffs industry including both wheat- and corn-milling availabilities and also to see whether such an inclusion affects the annual average rates of growth of the aggregate index as presented in the preceding section. This is done in the following computations.

CORN-MILLING AVAILABILITIES (IN MILLIONS OF QUINTALS)

1881	13.4	1889	11.1
1882	10.1	1890	12.0
1883	12.3	1891	10.5
1884	13.1	1892	10.1
1885	14.7	1893	10.3
1886	11.8	1894	10.7
1887	12.1	1895	9.0
1888	11.6	1896	10.9

[8] See "L'Industria dell seta in Italia," *Statistica Industriale, Annali di Statistica*, Serie IV (Rome, 1891), p. 21.

CORN-MILLING AVAILABILITIES (IN MILLIONS OF QUINTALS) (*cont.*)

1897	11.5	1906	11.3
1898	11.1	1907	10.5
1899	12.7	1908	10.2
1900	12.3	1909	11.4
1901	10.8	1910	12.8
1902	11.3	1911	13.3
1903	9.5	1912	12.1
1904	10.8	1913	12.0
1905	10.8		

These data have been combined with the (comparable) wheat series by using as weights the average wheat-corn price ratio for the years 1896–1904 (24.5:15.5). The price data have been obtained from Cianci, *Dinamica dei prezzi delle merci in Italia dal 1870 al 1929*, pp. 357–8, 363–4.

The combined data were smoothed by using four-year moving averages, and thereupon they were combined with the series of beer and sugar output as described earlier above. The result was a new index of foodstuffs industry. In the following tabulation this index is compared with the index as included in the present index.

FOODSTUFFS INDUSTRY INDEX OF OUTPUT, 1881–1913 (1900 = 100)

Year	*Including corn available for milling*	*Excluding corn available for milling*
1881	64.7	63
1882	66.0	65
1883	72.6	68
1884	74.6	70
1885	72.9	69
1886	71.4	68
1887	70.3	67
1888	70.0	67
1889	71.4	69
1890	73.0	71
1891	71.2	70
1892	70.0	68
1893	70.8	69
1894	67.4	65
1895	69.2	66
1896	71.3	67
1897	72.9	69
1898	81.8	80
1899	88.3	86
1900	100.0	100

FOODSTUFFS INDUSTRY INDEX OF OUTPUT, 1881–1913 (1900 = 100) (*cont.*)

Year	*Including corn available for milling*	*Excluding corn available for milling*
1901	104.8	106
1902	109.6	111
1903	120.0	120
1904	110.7	112
1905	113.8	115
1906	118.8	119
1907	120.9	122
1908	127.2	127
1909	128.5	128
1910	130.0	130
1911	136.3	141
1912	139.9	146
1913	155.6	166

Similarly, it is possible to compare the annual average rates of growth which are implied in the aggregate index of Italian industrial output *including* corn availabilities with the aggregate index as given above (which does not include such availabilities). This is done in the following table.

ANNUAL AVERAGE RATES OF GROWTH OF ITALIAN INDUSTRIAL OUTPUT

Period	*Including corn-milling availabilities*	*Excluding corn-milling availabilities*
1881–1888	4.6	4.6
1888–1896	0.3	0.3
1881–1896	2.2	2.3
1881–1891	2.1	2.1
1891–1896	2.5	2.7
1896–1908	6.7	6.5
1908–1913	2.4	2.1
1896–1913	5.4	5.2
1881–1913	3.8	3.9

We may conclude, therefore, that inclusion of corn-milling availabilities does not affect the index of the foodstuffs industry significantly, except during the last three years of the index period 1881–1913. Naturally, the rates of growth of the aggregate index are affected even less.

The series of the chemical industry probably is the least reliable of the six. It is represented by a single product (sulphuric acid), and it requires a good deal of stretching even to arrive at the ratio of 23 percent

for included-to-imputed output with regard to horsepower. On the whole, it must be assumed that the series of the chemical industry overstates the rate of growth of the industry. This must be true of the period 1881–96. But the degree of overstatement may not be unduly large for the years after 1896. The production of fertilizers in general (for which sulphuric acid is an important material) grew at an almost similar pace. In addition, with the beginning of the century a number of new products was taken up by the industry (caustic soda and others) which showed very high rates of increase. On the other hand, the rate of increase plummeted to a low level after 1908. To sum up, at least for the later portions of the index period (after 1896), the use of sulphuric acid to represent the industry as a whole may be somewhat less hazardous than appears at first glance.

Still, when everything is said and done, the final conclusion of the table, according to which 67 percent of the labor force in the six index industries and 82 percent of their horsepowers have been included directly or indirectly in the index, must be taken with a grain of salt. And even this figure implies that less than 50 percent of the aggregate industrial labor force has been included in the present index.

That the mode of combining both the subgroups and the six main series is open to question should be obvious. The use of prices (unit values) rather than value added per unit for aggregating the subgroups in mining and metalmaking and the beer and sugar subgroup is approximate indeed, even though in principle it is much preferable to Tagliacarne's ton-per-ton summation. Furthermore, for reasons of consistency, prices (unit values) pertaining to the year 1898 had to be used, while the weights combining the main series pertained to the survey years 1902–03. The latter, however, may be regarded more in the nature of a beauty blemish inasmuch as a check on those 1903 prices (unit values) that were obtainable failed to produce any significant changes in price structure.

The value-added weights used for the main aggregation are of course uncertain. Time and again recourse had to be had to the data of the American census of 1899 and to the assumption that the ratios of value added per worker in the individual industries were roughly the same in the two countries. This artificial assumption is sweeping in the extreme. True, nothing is assumed about the absolute levels of productivity as between the two countries. But, as a rule, no attempt has been made to adjust for the differences in the comparison of the labor force by sex and age in the two countries, for the length of the working day, or for the differences in the composition of output. Moreover, where a variety of nonhomogeneous goods is produced, as in the engineering or chemical industry, it was necessary to select as basis of comparison some subgroup or subgroups of products and to assume that the computed value-added ratios applied to the larger segments of the industry as well.

The weights computed on the basis of employment and horsepower might be expected to be more reliable than the computed value-added weights, and in a sense they probably are. But even here it should be noted that the Italian survey of 1902–03 was far from being as complete as the later censuses. Actually, the first real industrial census in Italy was not taken until 1911. It is significant that an attempt to compute, with the help of the present index, changes in labor productivity between 1902–03 and 1911 had to be abandoned precisely because the 1911 census "discovered" a large number of workers in small enterprises, particularly in metalmaking and engineering. As a result, the number of workers per shop was greatly reduced which led, in metalmaking, to quite implausible *declines* in productivity of labor over the period concerned. There is no assurance, of course, that the inadequacy of ascertaining the labor force and horsepowers installed in the 1902–03 survey was necessarily the same in all the industries considered.

As said before, the six series were combined through the use of arithmetic rather than geometric averages. This need not be considered a disadvantage, even though Tagliacarne makes strong assertions to the contrary (p. 53). An attempt to compute geometric averages of index numbers for the beginning and ending years of the period 1881–1913 and for subperiods thereof has not yielded significantly different results. The following table compares the rates of growth computed on the basis of two sets of index numbers, those averaged arithmetically and those averaged geometrically.

PRESENT INDEX: THE RATES OF GROWTH IN ITALIAN INDUSTRY, 1881–1913
(VALUE-ADDED WEIGHTS)

Period	*Weighted arithmetic average*	*Weighted geometric average*
1881–1891	2.1	2.4
1891–1896	2.5	2.7
1896–1908	6.7	6.9
1908–1913	2.4	2.3
1881–1913	3.8	3.7

Computed on a compound basis using the first and the last years of the specified periods.

It is easily seen that, with one exception (1908–13), the differences are fairly minor. It is, of course, natural for rates resulting from geometric averages of index numbers *below* the base year to be *higher* than rates resulting from arithmetic averages. Since both series show 100 in the base year (1900) and since each single geometric average is lower than its arithmetic counterpart, the former must rise faster than the latter in order

to reach equality in the base year. For the years subsequent to the base year the position is reversed.

While the use of weighted arithmetic averages need not be regarded as a deficiency of the present index, the shortcomings listed before are, no doubt, very real ones. And it must also be considered that the listing does not include a discussion of the reliability of the underlying basic data in terms of physical quantities. The standards of statistical accuracy improved rather slowly in the course of the index period, and it should be clear that no absolute faith can be placed in the series concerned.

All these deficiencies must be fully recognized. They are no doubt very serious and, with regard to the rate of growth, the present writer finds it difficult to state whether on balance the present index tends to understate or overstate the aggregate rate of growth. The probable understatements in cotton manufacturing and engineering must be set against some probable overstatement in the chemical industry throughout the index period and in the foodstuff industry during its second half. Nor is it clear to the writer that the present index is sufficiently refined to react in a very significant manner to a change in weights so that use of weights pertaining to an earlier (or later) period would relevantly raise (or lower) the rate of growth. To achieve that result a much more detailed index of engineering weighted by values added per unit, or at least prices, would probably be necessary. (But compare the discussion of the Golzio index in the final section.)

The present index is probably capable of being improved by further study. But such improvements would be spotty. Possibly one or two additional subgroups could be added to the chemical industry; introduction of a series on wool output would make the index of the textile industry more complete. The data on steel consumption might be further refined. Above all, a series for electric-power production might be introduced, although the problem of finding an appropriate weight for it would be fairly difficult. Finally, one might experiment with the use of 1911 weights and perhaps even with 1876 weights, although the survey of that year is even much less comparable to that of 1902–03 than is the 1911 census. But despite all these amplifications and emendations, the main features of the present index would remain unchanged and so would its shortcomings.

However, nothing can be gained by exaggerating those shortcomings. Whatever their extent, the resulting indices reveal a pattern that is altogether meaningful in terms of our qualitative knowledge of Italian industrial development. It is, furthermore, of considerable importance that the use of three alternative sets of weights yields results which, by and large, are quite similar to each other. In particular, they lead to the view that the golden age of Italian industrialization prior to 1914, such as it was, falls into the long period 1896–1908; thereafter some decline in the rate of

growth took place throughout the remaining years until 1913. In this the present index agrees both with the results of Tagliacarne and with those of Dessirier, despite significant discrepancies between these two indices and the present index with regard to the absolute level of rates and particularly with respect to the very different picture the three indices present for the period 1891–96.

The three variants of the present index and the two previous indices, expressed by the rates of growth implied in them, are compared in the following table.

ANNUAL AVERAGE RATES OF GROWTH, 1881–1913 AND SUBPERIODS

	Present index				
Period	*Value-added weights*	*Employment weights*	*Horse-power weights*	*Tagliacarne* index*	*Dessirier index*
1881–1891	2.10	2.30	2.50	5.10	4.70
1891–1896	2.50	3.90	1.80	−4.00	4.90
1896–1908	6.70	5.70	7.10	11.40	5.80
1908–1913	2.40	1.70	1.10	6.30	1.25
1881–1913	3.80	3.50	4.30	6.10	4.60

All rates computed on a compound basis using the first and the last years of the specified periods.

* Tagliacarne also supplied the results of his computations of the rates of growth on the basis of an arithmetically weighted average. They are as follows: 1881–91, 6.5; 1891–96, −3.6; 1896–1913, 22.8. This rate of growth for the period 1896–1913 contrasts with Tagliacarne's rate for the same period computed on the basis of weighted geometric averages of 9.80. The 1896–1913 rate of growth implied in the present index is 6.7, 5.7, and 7.1 for the three sets of weights. The difference is striking. Unfortunately, it cannot be put down to the vagaries of the weighted arithmetic average. The present writer recalculated the rate of growth on the basis of Tagliacarne's indices, applying a weighted arithmetic average, and found the resulting rate to be more than 50 percent below the rate computed by Tagliacarne, 22.8 percent, which is quite reasonable in relation to his geometric rate. It is clear that pressures causing haste in preparation must have been responsible for this error.

TAGLIACARNE'S INDEX AND THE PRESENT INDEX: COMPARISON OF THE COMPONENT SERIES

A comparison of the rates of growth in the index constructed by Tagliacarne with its modification in the present index may serve to underscore some important features of the latter and to provide some additional explanation for the behavior of the aggregated series in the present index. The rates of growth implied in the seven groups of Tagliacarne's index are as follows.

APPENDIX I

COMPONENT SERIES

Industry	1881–1888	1888–1896	1881–1891	1891–1896	1896–1908	1908–1913	1881–1913
Silk	1.1	−0.1	−0.7	2.5	0.5	−1.1	0.0
Cotton	6.4	5.2	6.7	4.0	5.2	−0.5	4.6
Beer and sugar	1.6	−1.2	1.5	−2.7	26.6	11.0	11.1
Metals and minerals	12.9	−4.0	6.5	−2.1	11.7	10.4	7.6
Mining	0.0	−0.5	0.2	0.6	4.2	4.3	2.4
Shipbuilding	−3.8	−2.0	2.4	−14.0	7.0	4.0	1.8
Sulphuric acid	15.1	9.4	12.0	11.8	13.7	1.8	11.3

Computed on a compound basis using the first and the last years of the specified periods.

The first thing to be noted is that the chemical industry shows exactly the same rates of growth in the two indices, being represented in both by the same single series of sulphuric acid (see the tabulation on p. 403 for this and other rates). Nor is the impact of the series upon the aggregate index different in the two cases. Tagliacarne assigned to the chemical industry a weight of 9.5 percent, while in the present index a weight of 8.96 percent (value-added weights) is attached to it.

In the field of mining the differences are more important, though not before 1896. In the preceding periods both indices tend to record a close-to-zero rate of change in the industry, although the present index rises better than 1 percent a year between 1888 and 1896. Thereafter, however, Tagliacarne's index shows a high participation of mining in the upswing 1896–1908 and lets the industry's growth continue unreduced until 1913 with the annual rates of growth of 4.2 and 4.3 percent, respectively. The present index indeed shows an improvement in 1896–1908, but no change at all between 1908 and 1913. The explanation probably lies partly in the very crude weights in which the subseries for the industry were combined in Tagliacarne's index, giving much too low a weight to the extraction of zinc ore and much too high a weight to iron ore and sulphur; partly in the exclusion of copper-ore mining from Tagliacarne's series.

The series of the metalmaking industry shows discrepancies more in the level of rates than in their variation from period to period. These discrepancies, too, are to some extent explicable in terms of the difference between unweighted and weighted methods of combining the subseries. In addition, they must be also attributed to the fact that Tagliacarne's index contains output of pig iron, which has been deliberately excluded from the present index. To some extent, the very high rate of growth which Tagliacarne's index reveals between 1896 and 1908 is the result of an exaggerated drop which his series shows between 1891 and 1896.

The series of the engineering industry (Tagliacarne's shipbuilding) shows very far-reaching discrepancies. First of all, there is the deep

plunge of the nineties, with an annual rate of *decrease* of 14 percent between 1891 and 1896. (The difference between the rates for 1881–88 and 1888–96, on the one hand, and 1881–91 and 1891–96, on the other, is due to the sudden brief rise which the shipbuilding index takes around 1891.) All the more surprising is the failure of the series to show a comparable rate of increase during the following period 1896–1908. The rate of 7.0 percent per year is high but much below the rate shown by the present index, and it also lies far below the rate shown by Tagliacarne's series for metalmaking (11.7 percent). The reason is fairly obvious: shipbuilding is hardly apt to picture correctly the behavior of output of the many new machinery industries which showed a strong upward drift after 1896. By contrast, the adjusted steel-consumption series in the present index assigns a strong role to engineering throughout 1896–1908 (12.2 percent per year). These differences appear to be quite important for the interpretation of the signal features of the period 1896–1908.

The textile industry in the present index is a combination of Tagliacarne's series on raw-silk output and raw-cotton imports. What is different is the impact of the two series upon the aggregate index, because Tagliacarne's weights assign less importance to silk than is done in the present index. Tagliacarne's weight attribution, pertaining as it does to a much later period, does not seem to do justice to the relative conditions prevailing around the turn of the century.

Finally, there are the truly enormous differences in the foodstuffs industry. Tagliacarne's index shows in 1896–1908 quite a fantastic annual rate of 26.6 percent for that industry. This is the result of letting the industry be represented by sugar output (to which the small tonnage of beer output was added). This series fairly dominates Tagliacarne's index, even though the weight attached to it is relatively low in terms of the situation around 1900. It is interesting to note that Tagliacarne's aggregate rate of growth for the period 1896–1908 of 11.4 percent per year would be reduced to 9.2 percent if his series of the foodstuffs industry were to be excluded.

To sum up: the effects of the depression of the early nineties appear to be exaggerated in Tagliacarne's index. This is particularly true of engineering and, to a much smaller degree, of the metalmaking and foodstuffs industries. The subsequent upswing is essentially dominated by the foodstuffs industry, while the much more basic development in engineering appears to be unduly understated.

THE INDEX OF SILVIO GOLZIO

The distinguishing feature of the Golzio index is its wide coverage. In addition to the series included in the present index, it contains the following series: (1) cement and lime, (2) wood, (3) paper, (4) tan-

neries, (5) clothing, (6) printing, and (7) rubber. Moreover, some of those series which are contained in both Golzio's index and the present index comprise a larger number of subseries. Thus, the foodstuffs industry includes, in addition to beer, sugar, and the flour-mill industries (the latter represented, as in the present index, by a wheat series), indirect representations of the wine and olive-oil and fruit-and-vegetable canning industries. (The introduction, from 1911 on, of a meat and milk series is of less importance for a pre-1914 index.) The textile industry, in addition to silk output and cotton imports, also takes (as did Dessirier's index) the imports of wool into account.

The subseries in the textile industry and in the foodstuffs industry have been combined by using constant prices. Unfortunately, Golzio does not reveal the year to which these prices pertain, which makes it impossible to gauge their appropriateness for the periods preceding 1914. Developing a comparable set of prices must have raised some interesting problems. Futhermore, nothing at all is said on the mode of combining the subseries in mining, metalmaking, and cement and lime. It is possible, therefore, that these series have been combined in the same fashion as was done by Tagliacarne, that is to say, by an unweighted addition of tonnage data.[9] This would be unfortunate in a study which does not have Tagliacarne's excuse of considerable time pressures. Some of the indirect measurements used by Golzio are very ingenious. Thus, his series for the clothing and shoe industries is represented by a combination (through geometric averages) of the textile-industry series, a series on imports of wool and a series on availabilities of hides and skins.

The engineering industry is represented by the production plus net imports of iron and steel. This corresponds to what was done in the present index, except that no attempt was made to eliminate from the series the consumption of iron and steel for railroad construction and maintenance. Furthermore, *along* with the series on engineering, Golzio presents a series on shipbuilding and it is not at all clear how the two series were merged in the final computation of a total index. The use of an independent series for shipbuilding would have made it all the more important to carry through adjustments in the iron and steel series.

Ingenious as are Golzio's attempts to mirror output through indirect series, he seems at times to go much too far. Thus, his fruit-and-vegetable canning series is based (if his laconic statement on p. 53 means what it says) on a series of fresh fruit and vegetable output, which is obviously a very inadequate measure of the process of growth in the canning industry.

[9] In fact, this is more than a mere possibility. Upon adding up the figures on output of mines for the individual products for several five-year periods as given in *Annuario* 1949–50, one finds a very close correspondence between the ratios of the resulting sums and Golzio's index for mining.

In addition, it is not clear what constant price of what commodity could have been applied to combine this series with the other subseries in the foodstuffs industry. The computation of changes of output in the leather industry on the basis of availabilities of hides seems quite justified in itself, but these availabilities had to be estimated and Golzio does not reveal the bases of his estimates (p. 53).

Finally, it might be mentioned that it is not clear whether or not Golzio used *net* cotton imports for his cotton-industry series. Since he speaks of imports *tout court*, the presumption cannot be rejected that, like Tagliacarne, he used gross imports, which, if true, would tend to falsify the picture for the earlier years very considerably.

After having obtained his subseries, Golzio applied to them the respective 1938 lire amounts of net product (as obtained from the 1937–39 census). These amounts are as follows.

Industry	*Billions of lire*	*Percentage*
Mining	.79	2.29
Foodstuffs	7.50	21.80
Hides and leather	.42	1.20
Textiles	5.36	15.54
Clothing, etc.	1.42	4.12
Wood	1.12	3.25
Paper	.67	1.94
Printing	.75	2.18
Metalmaking	2.29	6.64
Engineering	8.83	25.62
Nonmetallic minerals	1.03	2.99
Chemicals	3.29	9.54
Rubber	.52	1.50
Others	.48	1.39
	34.47	100.00

Within the confines of industries included in the present index Golzio's set of weights is as follows.

WEIGHTS IN GOLZIO'S INDEX
(PRESENT-INDEX INDUSTRIES)

Branch	*Present index (1903)*	*Golzio index (1938)*
Mining and mineral processing	6.43	6.25
Metalmaking	3.49	7.86
Engineering	15.27	30.35

WEIGHTS IN GOLZIO'S INDEX (*cont.*)
(PRESENT-INDEX INDUSTRIES)

Branch	*Present index (1903)*	*Golzio index (1938)*
Textiles	35.86	18.40
Foodstuffs	29.99	25.82
Chemicals	8.96	11.32
	100.00	100.00

Changes of this nature would seem to be a natural result of the industrialization over a period of three and half decades. It is, of course, to be expected that the weight of engineering should increase, while the weight of textiles and foodstuffs in total industrial output should decline. Still, one cannot help wondering why the weight of textiles should decline so much more than the weight of foodstuffs, while the weight of chemicals should increase so little. It is true that the value-added estimates for 1902–03 are approximations and as such much less reliable than the value-added (or net-product) amounts obtained by the 1937–39 census. But it does not seem that the explanation lies necessarily with the 1903 estimates.

Since Golzio very conveniently computed output of individual industries in terms of 1938 lire (from lustrum to lustrum of his index period), it is interesting to observe the composition around 1903 according to his data. Since he presents his data in five-year averages, one is forced to take the period 1901–05 as comparable with 1903. For that period he shows the following distribution of output.

Branch	*Golzio value of net output (million 1938 lire)*	*Percentage*	*Present-index weights*
Mining and mineral processing	506	4.36	6.43
Metalmaking	303	2.62	3.49
Engineering	1,661	14.30	15.27
Textiles	3,175	27.34	35.86
Foodstuffs	5,463	47.04	29.99
Chemicals	505	4.34	8.96
	11,613	100.00	100.00

This comparison is instructive. The weights of the Golzio index do not seem appropriate to the years around the turn of the century. To impute to the foodstuffs industry a weight of 47 percent for 1903 does not seem reasonable in the light of the available data on both labor and horsepower,

particularly if it is considered that the value added per horsepower must be a good deal lower in the foodstuffs industry than in the other industries of the present index. On the other hand, the weight for engineering for 1903 as implied in the Golzio index would seem to be very close to that of the present index. Finally, the weight of the chemical industry is a good deal below that of the present index. One is tempted to say that this is a natural result of applying "postindustrialization" weights or, at any rate, applying weights pertaining to a later stage of industrialization to an earlier period thereof. The effect of industrialization is to make the products of traditional industries dearer in terms of those of more modern industries. In fact, one would have expected the weight of engineering in the Golzio index to lie a good deal below that of the present index.

But what is not at all clear and appears rather unexpected is that the textile industry should show a lower rather than a higher weight in the Golzio index as compared with the present index. A possible explanation is that in Italian conditions, with the upsurge of artificial fibers in the 1920s, the textile industry remained a "new" industry and behaved accordingly with respect to both output and prices. On the other hand, the failure of engineering — a typically new industry in this sense — to show a much lower Golzio weight in 1903 may be the result of the monopolistic price structure of the industry. However that may be, we might perhaps conclude on the strength of the great weight differential in the foodstuffs industry that the Golzio index should reveal a lower rate of growth for the prewar period as compared with the present index, although this index-number effect might appear mitigated by the "unorthodox" behavior of the weight ratios in engineering and, particularly, in textiles.

It is obvious, however, that the weights can tell only a part of the story. In addition, there is the problem of coverage. The industries which are excluded from the present index may have grown at a lower rate than the industries which remained excluded from the present index but which are included in Golzio's computations. And, finally, there is the question of the correspondence between the actual series in the two indices. Thus, though *a priori* one should expect the Golzio index to yield a lower rate of growth, this cannot be taken as a foregone conclusion. A comparison of the two indices may follow first (1881 = 100).

Period	*Present index*	*Golzio index*
1881–1885	112	117.1
1886–1890	135	138.5
1891–1895	129	135.8
1896–1900	160	150.0
1901–1905	211	184.4
1906–1910	294	250.3

Golzio's index and the present index show roughly parallel developments until 1896–1900. Prior to that, the present index proves to be a little bit more sensitive to the depression of the early nineties. The great difference, however, begins after 1900. In 1906–10, the present index is almost 50 points above the Golzio index. This can be attributed to two factors: (1) the drag of the more slowly developing indices which are included in the Golzio index; (2) the effect of Golzio's using a "post-industrialization" weight system. To separate the two factors, a tabulation of the Golzio figures is presented which is confined to industries contained in the present index. The result is as follows (1881 = 100).

Period	*Present index*	*Golzio index (Present-index industries)*	*Golzio total index*
1881–1885	112	122	117.1
1886–1890	135	145	138.5
1891–1895	129	139	135.8
1896–1900	160	153	150.0
1901–1905	211	191	184.4
1906–1910	294	256	250.3

This is an interesting result. Excluding the "other industries" from Golzio's index makes surprisingly little difference. The "other industries" retarded a little the growth of the eighties. They, being more stable, made Golzio's total index somewhat less sensitive to the depression of the early nineties. But, apart from those minor variations, the important conclusion is that they did not appreciably change the character of the upswing years after 1900 as pictured in Golzio's index. In 1906–10, Golzio's index, liberated from the presumable downward pull of "other industries," rises only 6 points above his total index.

This is a rather comforting result from the point of view of the present index. The latter's more restricted coverage may be a smaller deficiency than is likely to appear at first sight. On the other hand, a comparison of the component series in Golzio's index and the present index shows not unimportant, and to some extent surprising, discrepancies. The data for both indices are given in the following table (P = present index; G = Golzio index).

COMPARISON OF COMPONENT SERIES

	Mining		*Metal-making*		*Textiles*		*Engineering*		*Foodstuffs*		*Chemicals*	
Period	*P*	*G*	*P*	*G*	*P*	*G*	*P*	*G*	*P*	*G*	*P*	*G*
1881–1885	108	97	120	112	107	111	134	113	107	133	144	150
1886–1890	100	104	382	218	134	147	163	151	108	142	247	317
1891–1893	109	103	297	171	154	159	95	96	107	143	342	353
1896–1900	127	126	401	213	182	182	146	115	128	146	551	774
1901–1905	147	149	561	316	223	219	184	161	179	175	1289	1330
1906–1910	135	170	1299	696	255	275	371	350	199	182	2467	2550

The discrepancy is most surprising in the case of the chemical industry, since both index series are based on the single sulphuric-acid series of output. Unless Golzio used a series of output not accessible to the present writer, the discrepancy is likely to be the result of errors in computation. Golzio's series outruns that of the present index until 1896–1900, whereupon its growth is much slower than that of the present index. Taking 1896–1900 as equal to 100, the Golzio index reaches 330 in 1906–10, whereas the present index almost hits the 450 mark. The foodstuffs series does not show similar discrepancies, except in the earlier periods. But its growth, too, is slower between 1896–1900 and 1906–10 (128 as against 155). The engineering series in the two indices run fairly parallel, but here the Golzio series shows a much faster rise during the later periods, which probably is the result of the Golzio series not being liberated from the weight of steel consumption by railroads. Such consumption naturally is extraneous to what the series purports to measure.

The textile series develops, on the whole, *pari passu* in the two indices, although the Golzio series shows a jump ahead in the last five-year period. The same is true of his mining series. By contrast, the series on metal-making shows a very great lag in the first portions of the index period. In the second half of that period, the two indices move at almost exactly the same pace. The earlier discrepancy may find its explanation in the use of unweighted aggregation of the component subseries.

The final conclusion may, therefore, be stated as follows: (1) The differences in coverage do not seem to cause discrepancies betwen the two indices. (2) The Golzio index receives some legitimate downward bias as a result of using weights pertaining to a very late date. (3) It would seem that the lags which Golzio's index shows in the later subperiods in the chemical industry and in the foodstuffs industry are likely to have further accentuated the downward bias inherent in his index.

APPENDIX II

Industrialization in Bulgaria: Basic Data and Calculations

NET OUTPUT OF STATE-ENCOURAGED INDUSTRY, DATA AND CALCULATIONS (TABLES 1–9)

Table 1. Number of enterprises

Industry	1909	1929	1937
Textiles	61	198	197
Flour mills	62	313	157
Other foodstuffs	38	155	118
Metals	16	136	103
Leather	22	54	46
Chemicals	25	104	96
Woodworking	18	48	46
Pottery	10	101	87
Paper	3	4	4
Energy	2	45	48
Total	257	1,158	902
Total without energy	255	1,113	854

Source: Glavna Direktsiya na Statistikata, *Statisticheski Godishnik na Búlgarskoto Tsarstvo*, 1910 (Sofia, 1911), p. 253; 1931 (Sofia, 1931), pp. 230–237; 1939 (Sofia, 1939), pp. 384–389. Hereafter cited *Godishnik*, with references to year and page.

Table 2. Number of workers employed

Industry	1909	1929	1937
Textiles	4,064	16,368	24,313
Flour mills	660	2,747	1,442
Other foodstuffs	907	4,369	3,671
Metals	892	5,469	4,603
Leather	398	1,029	864
Chemicals	432	1,767	2,618
Woodworking	1,130	1,165	1,144

Table 2. Number of workers employed (cont.)

Industry	1909	1929	1937
Pottery	1,158	3,834	3,772
Paper	152	338	972
Energy	18	908	699
Total	9,973	37,994	44,098
Total without energy	9,955	37,086	43,399

Source: see Table 1.

Table 3. Number of horsepowers used

Industry	1909	1929	1937
Textiles	3,722	17,884	31,186
Flour mills	3,721	22,827	17,794
Other foodstuffs	2,101	23,674	26,717
Metals	379	7,543	9,399
Leather	506	3,056	3,537
Chemicals	454	3,719	6,591
Woodworking	689	1,853	3,296
Pottery	661	13,259	14,718
Paper	233	1,512	8,932
Energy	4,734	56,538	114,292
Total	17,200	151,865	236,462
Total without energy	12,466	95,327	122,170

Source: see Table 1.

Table 4. Number of workers per enterprise

Industry	1909	1929	1937
Textiles	66.6	82.7	123.4
Flour mills	10.6	8.8	9.2
Other foodstuffs	23.9	28.2	31.1
Metals	55.7	40.2	47.7
Leather	18.1	19.1	18.8
Chemicals	17.3	17.0	27.3
Woodworking	62.8	24.3	24.9
Pottery	115.8	38.0	43.4
Paper	50.7	84.5	243.0
Energy	9.0	20.2	14.5
Total	38.8	32.7	48.9
Total without energy	39.0	33.2	50.8

Source: Tables 1 and 2 of this appendix.

Table 5. Number of horsepowers per worker

Industry	1909	1929	1937
Textiles	.92	1.1	1.3
Flour mills	5.64	8.3	12.3
Other foodstuffs	2.32	5.4	7.3
Metals	.42	1.4	2.0
Leather	1.27	3.0	1.3
Chemicals	1.05	2.1	2.5
Woodworking	.61	1.6	2.9
Pottery	.57	3.5	3.9
Paper	1.53	4.5	9.2
Energy	263.00	62.3	164.2
Total	1.72	4.0	5.3
Total without energy	1.25	2.6	2.8

Source: Tables 2 and 3 of this appendix.

Table 6. Value of net output in 1909
(in thousands of current leva)

Industry	Value of product	Cost of raw materials	Cost of fuel	Net output
Textiles	17,445	11,687	576	5,182
Flour mills	32,598	27,448	416	4,734
Other foodstuffs	7,883	3,249	702	3,932
Metals	2,147	833	85	1,229
Leather	4,539	3,361	64	1,114
Chemicals	2,463	1,574	45	844
Woodworking	2,699	1,585	25	1,089
Pottery	1,792	219	265	1,308
Paper	461	178	57	225
Energy	928	6	71	851
Total	73,134	50,320	2,306	20,508
Total without energy	72,206	50,314	2,235	19,657

Source: *Godishnik*, 1910: data on output, p. 277; data on raw materials, p. 276; data on fuel, p. 275.

Table 7. Value of net output in 1929
(in millions of current leva)

Industry	Value of product	Cost of raw materials	Cost of fuel	Cost of power	Net output
Textiles	2,340	1,604	44	10	682
Flour mills	1,788	1,671	30	5	82
Other foodstuffs	1,432	760	54	4	614
Metals	601	322	15	4	260
Leather	408	331	5	2	70
Chemicals	575	359	12	3	201
Woodworking	137	87	.5	.2	49
Pottery	419	46	72	33	268
Paper	53	18	3	2	30
Energy	198	3	18	—	177
Total	7,951	5,201	254	63	2,433
Total without energy	7,753	5,198	236	63	2,256

Source: *Godishnik*, 1931, pp. 230–237.

Table 8. Value of net output in 1937
(in millions of current leva)

Industry	Value of product	Cost of raw materials	Cost of fuel	Cost of power	Net output
Textiles	2,634	1,692	45	44	853
Flour mills	1,077	900	18	11	148
Other foodstuffs	1,057	733	35	8	281
Metals	539	299	15	11	214
Leather	311	230	3	3	75
Chemicals	533	311	9	8	205
Woodworking	110	78	1	1	30
Pottery	365	44	37	31	253
Paper	194	104	6	6	78
Energy	337	76	48	—	213
Total	7,157	4,467	217	123	2,350
Total without energy	6,820	4,391	169	123	2,137

Source: *Godishnik*, 1939, pp. 384–389.

Table 9. Ratio of net output to value of product in state-encouraged industry
(in percent at current prices)

Industry	1909	1929	1937
Textiles	29.70	29.15	32.35
Flour mills	14.52	4.59	13.84
Other foodstuffs	49.86	42.87	26.48
Metals	57.20	43.12	39.56
Leather	24.54	17.04	23.95
Chemicals	34.27	34.90	38.34
Woodworking	40.33	36.00	27.37
Pottery	73.01	64.12	69.37
Paper	49.15	55.57	40.14
Energy	91.77	89.00	84.64
Total	31.19	30.65	34.28
Total without energy	30.11	29.17	31.81

CALCULATION OF NET OUTPUT OF STATE-ENCOURAGED INDUSTRY AT CONSTANT PRICES, VOLUME OF OUTPUT, AND RATES OF GROWTH (TABLES 10–17)

Table 10. Price index numbers of selected commodities, 1929
(base period 1908–1912 = 1)

Commodity	Index number
Beer	36.95
Flour	38.97
Raw hides	30.00
Men's clothing	36.68
Clothing materials	45.47
Underwear	30.84
Coal	26.84
Construction timber (boards)	35.39

Source: All the following references are from *Godishnik*, 1931: For beer, p. 335. Flour, p. 334. Raw hides, no figure available for 1929; the index for 1928 stood at 31.40 (p. 334); since the price for livestock (oxen) in 1929 was about 3 percent below the preceding year, the index number for raw hides was reduced from 31.40 to 30.00. Men's clothing, clothing materials, and underwear price indices as given in official statistics are based on August 1915; the 1929 index numbers were 26.20, 32.48, and 22.03, respectively (p. 339); they were reduced here to 1908–1912 by the use of the general price-level index: 1908–12 = 1; 1915 = 1.4; accordingly, the index numbers in the tables are the result of multiplication of the three numbers as given in this note by 1.4. Coal, p. 335. Construction timber, p. 335; the index number of 32.96 given in *Godishnik* refers to 1928; it was changed to 1929 by the ratio of the general price index for 1929:1928 (p. 335) — accordingly, (35.49/33.05) × 32.96 = 35.39.

Table 11. Price indices of selected commodities, 1937
(base year 1929 = 100)

Commodity	Index number
Sugar	85.70
Flour	45.71
Raw hides	71.74
Pig iron	122.00
Wool yarn	65.17
Cotton yarn	69.00
Caustic soda	90.38
Window glass	55.80
Construction timber	85.95
Coal	85.87
Paper	105.70

Source: All the index numbers in Table 11 have been computed from data given in *Godishnik*, 1939, pp. 554 and 555.

The data from Tables 10 and 11 were used to represent the price changes in the respective industrial branches. The allocation of the individual commodity prices to branches of industry was as follows:

Industry	*Period 1908/12–1929*	*Period 1929–1937*
Textiles	Unweighted average of men's clothing, clothing materials, and underwear	Unweighted average of wool yarn and cotton yarn
Flour mills	Flour	Flour
Other foodstuffs	Beer	Sugar
Metals	General price index	Pig iron
Leather	Raw hides	Raw hides
Chemicals	General price index	Caustic soda
Woodworking	Construction timber	Construction timber
Pottery	General price index	Window glass
Paper	General price index	Paper
Energy	Coal	Coal

The indices for the two periods were spliced in 1929. The consolidated result is shown in Table 12.

Table 12. Price indices for branches of state-encouraged industries

Industry	1908–1912	1929	1937
Textiles	1	38.26	25.67
Flour mills	1	38.97	17.81
Other foodstuffs	1	36.95	31.66
Metals	1	35.49	43.30
Leather	1	30.00	21.52
Chemicals	1	35.49	32.08
Woodworking	1	35.40	30.42
Pottery	1	35.49	19.80
Paper	1	35.49	37.51
Energy	1	26.84	23.04

Since Bulgarian price statistics were presented in terms of 1908–1912 prices, and prices for the sole year 1909 were not available, it has been assumed that the prices of 1908–1912 are representative of those of 1909. Inspection of few scattered price data for 1909 seemed to justify the assumption fairly well. The following Table 13 contains the results of deflating the net-output data from Tables 6, 7, and 8 by price index numbers as given in Table 12, using the weights of the year "1909."

Table 13. Net output of state-encouraged industry at "1909" prices

	1909		1929		1937	
Industry	1,000 leva	Percent	1,000 leva	Percent	1,000 leva	Percent
Textiles	5,183	25.27	17,834	25.97	33,201	35.20
Flour mills	4,734	23.08	2,110	3.07	8,371	8.87
Other foodstuffs	3,931	19.16	16,610	24.19	8,839	9.38
Metals	1,229	5.99	7,300	10.63	4,922	5.22
Leather	1,114	5.43	2,317	3.37	3,460	3.66
Chemicals	844	4.12	5,655	8.23	6,366	6.75
Woodworking	1,089	5.31	1,398	2.04	992	1.05
Pottery	1,308	6.38	7,574	11.03	12,794	13.56
Paper	227	1.10	829	1.22	2,071	2.20
Energy	852	4.15	7,041	10.25	13,310	14.11
Total	20,511	100.00	68,668	100.00	94,327	100.00

Deflation of net-output data in Tables 6, 7, and 8 by price index numbers as given in Table 12, using the weights of the year 1929, yields the following result (Table 14).

Table 14. Net output of state-encouraged industry at 1929 prices

	1909		1929		1937	
Industry	1,000 leva	Percent	1,000 leva	Percent	1,000 leva	Percent
Textiles	198,297	26.46	682,328	28.07	1,270,559	38.24
Flour mills	184,478	24.62	82,168	3.38	326,150	9.81
Other foodstuffs	145,237	19.38	613,743	25.24	326,550	9.83
Metals	43,614	5.82	259,092	10.65	174,679	5.25
Leather	33,410	4.46	69,505	2.86	103,803	3.12
Chemicals	29,963	4.00	200,688	8.25	225,950	6.80
Woodworking	38,525	5.14	49,473	2.03	35,115	1.06
Pottery	46,436	6.20	268,813	11.06	454,062	13.66
Paper	8,040	1.08	29,435	1.22	73,499	2.22
Energy	21,286	2.84	175,948	7.24	332,632	10.01
Total	749,286	100.00	2,431,193	100.00	3,322,999	100.00

Deflation of net-output data in Tables 6, 7, and 8 by price index numbers, as given in Table 12 and using the weights of the year 1937, yields the following result (Table 15).

Table 15. Net output of state-encouraged industry at 1937 prices

	1909		1929		1937	
Industry	1,000 leva	Percent	1,000 leva	Percent	1,000 leva	Percent
Textiles	133,044	25.01	577,056	27.98	852,291	35.22
Flour mills	84,310	15.85	37,559	1.82	149,083	6.16
Other foodstuffs	124,444	23.40	525,978	25.50	279,853	11.56
Metals	53,212	10.00	316,093	15.32	213,108	8.81
Leather	23,966	4.51	49,863	2.42	74,468	3.08
Chemicals	27,084	5.09	181,382	8.79	204,214	8.44
Woodworking	33,115	6.23	42,522	2.06	30,185	1.25
Pottery	25,907	4.87	149,971	7.27	253,321	10.47
Paper	8,498	1.60	31,112	1.52	77,688	3.21
Energy	18,279	3.44	151,087	7.32	285,631	11.80
Total	531,859	100.00	2,062,623	100.00	2,419,842	100.00

APPENDIX II

In the following Table 16, the data presented in Table 13 have been converted to indices at prices of "1909."

Table 16. Indices of net output of state-encouraged industry at "1909" prices

Industry	1909	1929	1937
Textiles	100	344	641
Flour mills	100	45	177
Other foodstuffs	100	423	225
Metals	100	594	401
Leather	100	208	311
Chemicals	100	670	754
Woodworking	100	128	91
Pottery	100	579	978
Paper	100	366	914
Energy	100	827	1,563
Total	100	335	460

The average annual rates of growth of industrial output as implied in the data in Table 16 have been computed on a compound basis, using the initial and terminal years of the respective periods. In alternative computations, the Balkan wars and World War I have been taken into account by an arbitrary reduction of the respective periods by four years. The results are shown in the following Table 17.

Table 17. Average annual percentage rates of growth of net output of state-encouraged industry
(based on "1909" prices)

Industry	1909–1929 (20 years)	1909–1929 (16 years)	1929–1937 (8 years)	1909–1937 (28 years)	1909–1937 (24 years)
Textiles	6.38	8.03	8.08	6.86	8.05
Flour mills	−3.85	−5.00	18.80	2.05	2.40
Other foodstuffs	7.47	9.42	−9.65	2.94	3.44
Metals	9.32	11.78	−3.61	5.08	5.95
Leather	3.70	4.68	5.15	4.13	4.84
Chemicals	9.98	12.62	1.50	7.48	8.78
Woodworking	1.26	1.58	−4.19	−.33	−.40
Pottery	9.18	11.60	6.77	8.48	9.97
Paper	6.70	8.45	12.12	8.22	9.66
Energy	11.14	14.11	7.97	10.22	12.03
Total	6.23	7.85	4.05	5.60	6.56

CALCULATION OF THE CHANGE IN INDUSTRIAL PRODUCTIVITY (TABLES 18–20)

L. Berov's computation of investment in fixed industrial capital yielded the following series at constant prices of 1939.

Table 18. Gross investment in fixed capital in Bulgarian industry, at 1939 prices

Year	1,000 leva	Year	1,000 leva
1880	5,584	1910	277,552
1881	7,190	1911	229,397
1882	4,927	1912	295,038
1883	2,689	1913	342,595
1884	5,589	1914	236,733
1880–84	25,979	1910–14	1,381,315
1885	23,373	1915	8,719
1886	15,462	1916	11,695
1887	40,915	1917	34,357
1888	36,375	1918	30,541
1889	51,645	1919	6,346
1885–89	167,770	1915–19	91,658
1890	93,896	1920	42,581
1891	49,764	1921	120,653
1892	60,493	1922	132,652
1893	62,518	1923	214,708
1894	126,782	1924	296,905
1890–94	393,453	1920–24	807,499
1895	88,120	1925	394,170
1896	56,109	1926	400,269
1897	111,691	1927	427,710
1898	82,986	1928	559,963
1899	23,470	1929	691,631
1895–99	360,376	1925–29	2,473,743
1900	35,802	1930	451,818
1901	52,751	1931	470,433
1902	76,577	1932	488,711
1903	78,711	1933	393,179
1904	97,836	1934	274,360
1900–04	341,677	1930–34	2,078,501
1905	108,153		
1906	142,431		
1907	198,541	1935	462,756
1908	214,023	1936	634,738
1909	286,376	1937	1,434,936
1905–09	949,524	1935–37	2,532,430

Source: "Kúm vúprosa za tempovete na kapitalisticheskata industrializatsiya na Búlgariya" (On the Question of the Rates of Capitalist Industrialization in Bulgaria), Bulgarska Akademiya na Naukite, *Izvestiya na Ikonomicheskiya Institut*, VIII, nos. 3–4 (Sofia), 158–161.

The fixed-capital stock in Bulgarian industry (at 1939 prices) was computed from the data in Table 18 on the basis of the following assumptions: (1) that the value of capital stock in industry in 1879 was negligible (hence equal to zero); (2) that the capital invested depreciated discontinuously at the rate of 25 percent at the end of every quinquennium. The calculation based on these assumptions is shown in Table 19.

Table 19. Capital-stock computations
(in 1,000 leva at 1939 prices)

(1) Quinquennium	(2) Gross investment	(3) Depreciation multiplier	(4) Capital stock (2) times (3)
1880–1909			
1880–84	25,979	$.75^5$	6,164
1885–89	167,770	$.75^4$	53,082
1890–94	393,453	$.75^3$	221,318
1895–99	360,376	$.75^2$	202,711
1900–04	341,677	.75	256,258
1905–09	949,524	—	949,524
	Capital stock at the end of 1909:		1,689,057
1909–1937			
–1909	1,689,057	$.75^6$	300,616
1910–14	1,381,315	$.75^5$	277,949
1915–19	91,658	$.75^4$	29,002
1920–24	807,499	$.75^3$	340,664
1925–29	2,473,743	$.75^2$	1,391,480
1930–34	2,078,501	.75	1,558,757
1935–37	2,532,430	—	2,532,430
	Capital stock at the end of 1937:		6,430,088

The data on capital stock, as computed in Table 19, refer to the whole complex of Bulgarian industry rather than to the state-encouraged sector alone. They must be related, therefore, to comparably comprehensive data on labor and output. Such data are available for 1937: The labor force amounted to 90,621 workers (*Godishnik*, 1939, p. 391). Value of product amounted to 10,956,472,000 leva. The sum total of the value of raw materials, fuel, and power used amounted to 7,080,407,000 leva. This left a balance of net output of 3,876,065,000 leva (*ibid.*, pp. 392–393).

Comparable data are not available for 1909. It has been assumed, therefore, that the ratio of output and labor in "total industry" to output

and labor in state-encouraged industry was the same in 1909 as in 1937 (all value figures at 1937 prices). Accordingly: Net output of "all industry" in 1909 equals output of "all industry" in 1937 times output of state-encouraged industry in 1909, divided by output of state-encouraged industry in 1937, or: $\frac{3,876,065,000 \times 531,859,000}{2,419,842} = 851,923,000$ leva (for net output of state-encouraged industry in 1909 and 1937, see Table 15 of this appendix).

Similarly, the labor force in "all industry" in 1909 equals the labor force in "all industry" in 1937 times the labor force in state-encouraged industry in 1909, divided by the labor force in state-encouraged industry in 1937, or: $\frac{90,621 \times 9,973}{44,098} = 20,494$ persons.

Neglecting the small inconsistency between capital-stock data, which are expressed in terms of 1939 prices, and net-output data, which are expressed in terms of 1937 prices, the double set of three basic data may be summarized in Table 20.

Table 20. Labor force, fixed capital stock, and net output in all industry in 1909 and 1937

Data	1909	1937
Labor force	20,494	90,621
Capital stock (1,000 leva)	1,689,057	6,430,088
Net output	851,923	3,876,065

These data are then inserted into a production function of the Cobb-Douglas type: $O = F \times L^k \times C^{1-k}$, where:

O = industrial output,
F = productivity factor,
L = labor force (number of workers employed),
C = capital stock,
k = labor's share in industrial output (assuming it is rewarded at its marginal productivity).

Since data on k are not available, the following four alternatives are presented:

(1) $k = .75$
(2) $k = .65$
(3) $k = .50$
(4) $k = .25$

Solving for F — the productivity factor — in each of the four cases yields the following result:

(1) $k = .75$, hence: $F = \frac{O}{L^{.75} \times C^{.25}}$.

$$F_{1937} = \frac{3{,}876{,}065{,}000}{90{,}621^{.75} \times 6{,}430{,}088{,}000^{.25}} = 2{,}621.$$

$$F_{1909} = \frac{851{,}923{,}000}{20{,}494^{.75} \times 1{,}689{,}057.000^{.25}} = 2{,}454.$$

$$\frac{F_{1937}}{F_{1909}} = \frac{2{,}621}{2{,}454} = 1.0685.$$

(2) $k = .65$, hence: $F = \frac{O}{L^{.65} \times C^{.35}}$.

$$F_{1937} = \frac{851{,}923{,}000}{90{,}621^{.65} \times 6{,}430{,}088{,}000^{.35}} = 858.$$

$$F_{1909} = \frac{851{,}923{,}000}{20{,}494^{.65} \times 1{,}689{,}057^{.35}} = 791.$$

$$\frac{F_{1937}}{F_{1909}} = \frac{858}{791} = 1.0847.$$

(3) $k = .50$, hence: $F = \frac{O}{L^{.50} \times C^{.50}}$.

$$F_{1937} = \frac{3{,}876{,}065{,}000}{90{,}621^{.50} \times 6{,}430{,}088{,}000^{.50}} = 160.6.$$

$$F_{1909} = \frac{851{,}923{,}000}{20{,}494^{.50} \times 1{,}689{,}057^{.35}} = 144.8.$$

$$\frac{F_{1937}}{F_{1909}} = \frac{160.6}{144.8} = 1.1090.$$

(4) $k = .25$, hence: $F = \frac{O}{L^{.25} \times C^{.75}}$.

$$F_{1937} = \frac{3{,}876{,}065{,}000}{90{,}621^{.25} \times 6{,}430{,}088{,}000^{.75}} = 9.84.$$

$$F_{1909} = \frac{851{,}923{,}000}{20{,}494^{.25} \times 1{,}689{,}057^{.75}} = 8.55.$$

$$\frac{F_{1937}}{F_{1909}} = \frac{9.84}{8.55} = 1.1512.$$

Using the results just obtained, the average annual rate of change in the productivity factor for the period 1909–1937 (28 years) may be computed as follows:

(1) $\frac{\log 1.0685}{28} = 100.24.$

(2) $\frac{\log 1.0847}{28} = 100.29.$

(3) $\frac{\log 1.1090}{28} = 100.37.$

(4) $\frac{\log 1.1512}{28} = 100.50.$

APPENDIX III

Problems in Measuring Long-Term Growth in Income and Wealth

"Acceptable long-term records of national income and wealth and of their customarily distinguished components constitute indispensable minimum information in the study of economic growth." Few would take exception to this statement by Simon Kuznets in his introduction to the present volume, and this reviewer agrees emphatically.[1] Without knowledge of basic aggregates, economic history at best would remain confined to easy but unsubstantiated generalizations. Most likely, it would relapse into legal and political history, into essays in biography, and into sociological schematism and sociological impressionism. In short, economic history would contain everything but one thing — economics. It is another matter that, once the pertinent *economic* questions have been posed and the requisite empirical information has been assembled and placed within economically significant frameworks, interpretation of the findings inevitably would call for recourse to various noneconomic factors and accordingly to disciplines other than economics. What is at stake, of course, is not professional provincialism but methodological clarity with regard to the specific subject matter of economic history.

For the most part, the volume under review purports to summarize the state of our knowledge of long-term trends of national output and wealth with regard to four major and two smaller countries: the United Kingdom, France, Germany, Japan, Denmark, and Hungary. Some of the essays, however, embody a good deal of original work on the part of the authors. The character and the quality of the individual contributions are not uniform. Nor is the availability and reliability of the basic data. It is partly for this reason that the high initial expectations with which one begins the perusal of the volume are soon tempered by disappointments. No doubt much remains to be done before the results can be used conveniently and confidently for the purposes of historical interpretation within the

[1] This appendix was a review of *Income and Wealth*, V, Simon Kuznets, ed. (International Association for Research and Wealth, 1955). It appeared in the December 1957 issue of the *Journal of the American Statistical Association*.

individual countries; the road to meaningful comparisons among would seem even much longer.

The first paper, by James B. Jefferys and Dorothy Walters ("National Income and Expenditure of the United Kingdom, 1870–1952"), is modestly presented by the authors as a review of progress made. It is more than that, since the process of fitting together and reconciling the various existing estimates involved much additional and original work.

From a statistical point of view, this paper is the most mature of the six contributions. Both the income side and the expenditure side of social accounts are presented. The discrepancies between them are frankly and carefully discussed, and the reader can form an opinion of his own with regard to the reliability of the estimates. It is gratifying to see that after 1890 the disparity between the two series is reduced to quite tolerable proportions. The last section of the paper contains a brief but not inadequate discussion of the methods used in constructing the component series. The weakest point of the calculations seems to lie in the conversion of estimates at current prices into constant prices of 1912–13. Apparently, no attempt has been made to use different deflators for different types of consumers' goods. Nothing is said about the weights employed in the construction of the various price indices which the authors had to link in order to obtain consecutive price series for the whole period. Accordingly, it is not clear at all what weights actually underlie the income series allegedly expressed at prices of 1912–13. To obtain an index of physical volume at constant prices of one period, the deflator for each year's current values, properly speaking, should be a price index based on weights pertaining to that year. In other words, a consistent base-year volume index requires given-year price indices as deflators. In what sense "output values at constant prices of one year" as presented here can be regarded as actually aggregated on the basis of the price structure of that year is anybody's guess. The comparability among the individual subperiods as well as the rate of growth for the period as a whole remains problematic under these circumstances, for the data for the individual years must be subject to a *varying degree* of distortion. The authors might well have included an investigation of the distortions inherent in the series in their list of various "gaps" to be filled by further study. They are careful to point out that their series is not adequate for the purposes of short-term analysis. But as long as we have no idea as to the direction and probable extent of those distortions, the degree of retardation or acceleration over longer periods is also quite elusive. This is a serious limitation on any historical interpretation of the results, although it must be admitted that the deflating techniques used in this paper are greatly superior to those used in some other contributions to this volume.

On the other hand, it is to be welcomed that the authors have presented their data at current prices for each year of the period under

review and have made it possible for the interested reader to compute the national income at constant prices in the same fashion. The mechanical presentation, by calendar decades or quinquennia, be they overlapping or not, is hardly adequate for many problems raised in historical analysis — in particular, for the all-important problem of relation between structural spurts of growth and the intervening cyclical fluctuations. Nor is there much doubt that such an analysis would call for much more detailed breakdowns of growth by production sectors than the ones used in this paper to obtain the aggregate income figures.

From any historical point of view, one must also join the authors in the regret that their series begins at such a late point in the nineteenth century. This is particularly so if one recalls the lower reliability of the data for the seventies and the eighties and the interruptions of continuity by the two great wars. Still, this point must not be overemphasized. There are reasonable limits to ingratitude, and this reviewer should not like to cross them.

François Perroux, the author of the paper on French economic growth ("Prise de vues sur la croissance de l'économie française, 1780–1950"), shows much less interest in the description of statistical techniques and much more concern with broader historical problems. In particular, his distinction between "active" and "passive" components of national income in the process of its growth is very helpful in providing direction and orientation for quantitative research. In Perroux's words, it is "reasoned history" that must inhale meaning into statistical analysis. That in reality there is, and must be, a steady interaction, and that questions addressed to the facts are just as important as questions raised by the facts, is another matter. Unfortunately, the author's dictum has a special meaning because it is designed to convey his distrust of the quantitative data which he makes available: if the latter are at variance with what we should expect from general historical knowledge, they should be rejected.

The reader is unable to pass judgment on this attitude, for the author does not allow him any glimpses into the statistical kitchen in which the estimates have been brewed, beyond giving references to some previous studies. We are not even told just what concept of national income is embodied in the series presented, except that the data have been based on production statistics. The only statistical point on which the author is explicit is his criticism of the methods used to deflate current values to constant price magnitudes. After what has been said before, one can only agree that the job of conversion, should its results make sense, must be regarded as a much more arduous one than is usually assumed. While Perroux does not advert to the basic weighting problem mentioned above, in a special section of his paper he vents bitter contempt on the impropriety of deflating heterogeneously composed values by some specific price index and is eager to

show how the use of unsuitable deflators at times results in curious and unwarranted irregularities in the deflated series which reflect nothing but some spasmodic movements in the deflator chosen.

It is very useful to have all this said, since it should draw much needed attention to the problem and reduce the willingness to engage lightheartedly in mechanical deflations. But Perroux draws a practical consequence. He abandons all pretense at obtaining comparable values at constant prices and decides to take changes in values at current prices as representing changes in physical volume of output. He supports and justifies this procedure by the fact that the period between the reign of Napoleon I and the First World War was free from major monetary disturbances and, accordingly, current values are at least as good as deflated values for that period. It might be noted that Walther Hoffmann arrived at a similar conclusion in his study of British industrial output. The trouble, however, is that to reach such a conclusion reliably, one would have to have correct deflators; in their absence the actual relation between value and volume is quite uncertain. Thus, the rates of growth as given by Perroux must be taken with extreme caution. The margin between maximum and minimum rates of growth shown by Perroux is fairly narrow, and it is quite conjectural just how much importance can be attributed to comparisons among them.

The rhythm of long-term development, as it emerges from the data, is certainly not inconsistent with opinions generally held on the course of French economic history in the nineteenth century. But as long as quantitative research must be tested by vague and impressionistic ideas rather than the other way round, the progress achieved cannot be regarded as impressive.

Perhaps nothing reveals Perroux's skepticism so clearly as his discussion of whether or not French society was economically progressive in the course of the last century and a half. He answers the question in the negative. A progressive economy is one in which "technological inventions are translated into economic innovations with a minimum of delay and a minimum of social cost" involving use of all the human and material resources considered as an entity (p. 72). This, he says, was not the case in France. One must wonder about the relevance of such considerations in a paper of this sort. It is not clear at all that they are presented to explain why the rate of growth was not higher than it actually was, and the value of concepts not adapted to the nature of the material presented is dubious. According to the data given, French national output increased more than fourfold between 1825 and 1909, which surely is a considerable rate of progress for a "nonprogressive" economy. It would seem that in a quantitative study, progressiveness — or the lack of it — must, at least in the first instance, be conceived in quantitative terms and that qualitative concepts should be brought in to explain the results rather than to negate them.

If this is *not* done, it must be taken to mean that quantitative research is not yet able to produce trustworthy results.

The paper on Germany by Paul Jostock ("The Long-Term Growth of National Income in Germany") is much less reticent concerning the nature of the estimates presented. The text contains some discussion of the methods used and more is said in a special appendix. The picture is approximately as follows. For the period before World War I detailed computations of national income exist for one year only, 1913. In addition, there are official extrapolations for the years 1891–1913 on the basis of income-tax returns for Prussia and Saxony only. For 1860–1890 the author prepared an estimate of his own for five years (1860, 1870, 1877, 1883, and 1890) and interpolated values for the intervening years. The "benchmark" years' income was variously estimated. For instance, the value of net industrial output was calculated as follows: a previously available index of *gross* value of industrial output at current prices (which, incidentally, was derived by the multiplication of an index of physical output by an index of wholesale prices) was multiplied by a (previously available) figure of net industrial output in 1913. The implicit assumption as to the constancy of the gross-net ratios over fifty-three years may not be so very implausible since the data are at current prices and the higher degree of fabrication is likely to have been offset by the relative decrease in prices of value-added components. The uncertainty, however, about the mutual appropriateness of weights in the two underlying series may be much more serious.

The computations for national income produced by agriculture are even cruder. As to the remaining sectors of the economy, their contribution for 1890 was estimated roughly as a residual by first extrapolating roughly the official rough estimate for total national income for 1891 back to 1890. For earlier years, "the necessary estimates had to be roughly approximated" by relying "on knowledge of general developments" (p. 120). It must be noted that what was being estimated in this fashion was said to amount to no less than 50 percent of national income in 1890.

The data for 1925–1941 are no doubt much more reliable and, in fact, the best of the whole series. Much less so are those relating to the years after the last war which have been computed by applying production indices to the 1936 census. All current values from 1913 onward have been deflated to constant values by dint of a single cost-of-living index. The data for the years before 1913 were deflated by a single wholesale-price index. The result is said to be a physical-output series at 1928 prices. After what has been said about the problem of weight correspondence between the divisor index and the resulting quotient index and bearing in mind Perroux's strictures, it should be fairly clear that the homogeneity of the physical-volume series is a highly doubtful one, to say the least. It should not be forgotten that all these problems precede, as it were, the real index-

number problem. It is only after the correct weights have been obtained and output values have been consistently expressed in terms of a given period that one can begin to wonder what would happen to the index and the rates of growth implied in it, and to the component series, if another more remote or more proximate period were chosen for the purposes of weighting.

After having presented his data, the author goes into an exploration of a number of interesting and relevant problems. He discusses the meaning of the index in terms of various structural changes in the economy, such as the shifts away from household production, changes in age distribution of the population, expansion of "unproductive" activities, role of military expenditures, and territorial changes. He also tries to adjust his series by taking into account price-level differentials existing among localities of various size. The adjustment, however, is quite mechanical, and the author is well aware of its limitations. To assume constant price differentials among towns of different size over a period of some eighty years is really quite hazardous. Moreover, since the expenditure side of national income is as yet unexplored and the division between consumption and investment unknown, the adjusted data refer to per-capita national income rather than to per-capita consumers' expenditures. In addition, the paper includes an attempt to estimate the value of increased leisure; it investigates the change in income per capita of gainfully engaged population; it provides information on the changing ratio of industrial and agricultural output; and, at least for the post-1913 period, it has something to say on the changes in distribution of income.

All these problems, largely posed or inspired by Simon Kuznets' work, are of course most worthwhile. Yet one cannot shed the feeling that the time for discussing *them* has not arrived. When one considers that the only really consecutive historical period for which long-term change is meaningful is that from 1860 to 1913; when one recalls the nature of the estimates for that period and the degree of their reliability and deflates thereby the elaborations made and the conclusions reached, the resulting real income in terms of safe historical knowledge cannot be very large.

The paper on Denmark by Kjeld Bjorke ("The National Product of Denmark, 1870–1952") provides complete year-by-year estimates of national income from 1870 to 1952. These estimates are divided, on the one hand, into agriculture and "other industries" and, on the other, into consumption and gross investment. The latter, which does not include working capital, has been estimated separately for building, construction, machinery and equipment, and transportation. Consumption appears to be computed by adding the net surplus in the balance of payments to the gross-investment figure and then deducting the resulting sum, representing "gross saving," from the independently made estimates of total national income. The latter have been derived from income-tax returns adjusted

for tax-exempted incomes for the years 1870–1920 and from production statistics for 1921–1952. It is only from 1930 on that an official series began to be computed. There is little opportunity for the reader to gauge the reliability of the methods used. What is made clear, however, is that the physical-output series, that is, national output in terms of 1929 prices, cannot be really regarded as such, except with strong reservations. The data for 1914 to 1928 have been converted into 1929 values by means of a cost-of-living index, except that for the years 1914–1921 an average of a cost-of-living index and a wholesale-price index was used. No attempt has been made to deflate separately for agriculture and "other industries." For 1929–1952, the existing official series at 1935 prices was reduced to 1929 prices by a cost-of-living index. Again, the problem of weighting is shrouded in silence. But the most remarkable part of the procedure is the deflation of the pre-1914 figures. The 1913 data were converted to 1929 prices via the cost-of-living index. Thereupon, the series at current prices for the years 1870–1913 was adjusted by the ratio of the 1913:1929 price relatives. In other words, the data for 1870 to 1913, while adjusted by that ratio, still reflect all the price fluctuations experienced during those forty-three years!

The paper on Hungary by Alexander Eckstein ("National Income and Capital Formation in Hungary, 1900–1950") is by far the most detailed piece in the volume. It is very explicit and careful in the discussion of the concepts employed, and there is no attempt to pass over lightly the techniques employed and the procedures followed. This is the only paper in the volume in which the conversion into constant prices is discussed more freely. While the actual conversion in itself may not be very superior, credit must be given for the attempt to use different deflators for different components of national income, both for the post-World War I period and for connecting the prewar data to the 1938–39 price base. But the deflation of the 1900–1914 figures is fairly dismal. An unweighted price index, based in part on price quotations from other parts of the Hapsburg Monarchy, is used for the purpose.

In general, this is probably the most original of the six contributions. The study of Hungarian national income over a long period presents particular difficulties because of the drastic territorial retrenchment after 1918 and the profound organizational change in the economy and in the prevailing official views regarding coverage of national income after the last war. Though previous studies have been used as far as possible, a great many adjustments and improvements have been introduced by the author. The most independent part of the study refers to capital formation for the years 1924/25–1949. Starting from an existing monograph for the years 1937–40, the author constructed estimates of capital formation for the remaining interwar years and for the first postwar years. As was to be

expected, the worth of individual estimates is subject to variation. The important capital formation in industry, for instance, is based on much less than perfectly convincing methods and there is at least a hint of a possible double counting. Nevertheless, the criteria and the methods developed in the study will certainly be basic to all further progress in this area. An additional advantage lies in the author's willingness to engage in some historical interpretation both with regard to the rate of growth by sectors and to the investment trends. Like Perroux, the author stresses the role of the "active" or "motive" components of national income. He may be mistaken in his belief that the early stress on iron and steel as well as machinery output was peculiar to Hungary alone among the European industrializations, but the attempt to see changes in national income within a broader historical framework is certainly most helpful. All in all, the volume would have gained greatly if some of the authors of the other papers had set for themselves equally high standards of critical analysis and kindliness to the reader.

The last paper, by Yuzo Yamada ("Notes on Income Growth and the Rate of Savings in Japan"), is a brief report on the discrepancies which at present exist among a number of different estimates, including those by the author. These discrepancies are large indeed for the decades of the nineteenth century and the first years of the present century. Nevertheless, the author presents some provisional conclusions, mainly in correction of Colin Clark's estimates which are said to be excessive with regard to the average rate of growth and especially with regard to the rate of savings. Since Japanese economists are eagerly engaged in attempts at reconciling the discrepancies and in improving the nature of the estimates, the present contribution must be considered even more provisional than the other papers in the volume.

It has seemed necessary to dwell at some length on the individual contributions to this volume. The subject matter of these essays is of fundamental importance and the suggestive power of a printed figure is great. It cannot, therefore, be stressed too emphatically that for the most part the long-term rates of growth are much too uncertain to allow of any reliable intertemporal and, least of all, interspatial comparisons. A great deal of work remains to be done and, in particular, the problems of conversion of value to volume must be explored much more painstakingly before the results can be used in any responsible fashion. What this reviewer has found discouraging about the present essays is not so much the present low level of reliability of the deflating procedures as the absence of a clear conception of the problems involved and of any insistence upon the need for constructive solutions. To turn away in disgust, as does Perroux, is perhaps an understandable but not too helpful an attitude. One must consider that price and cost-of-living indices so far have been constructed by scholars and institutions

interested mainly in changes in prices and cost of living for their own sake. Those engaged in investigating long-term trends in national income and its components cannot hope to arrive at satisfactory results unless they embark upon construction of price indices especially designed to serve the needs of their work. Naturally, it will be very helpful to develop a number of specific deflators for as many subgroups as possible. Since in practice each subgroup will still contain very many commodities with very different rates of change of output and price, the need for correct conversion of each subgroup by the given year's deflators will still remain. Moreover, in many cases one will have to continue operating with just one or two comprehensive price indices. In either situation it may be impossible to construct as many price indices as there are years in a long time series. But there is every probability that by constructing price indices for a considerable number of short subperiods, each of them weighted by magnitudes pertaining to a year within each subperiod, we should come reasonably close to a consistent volume index. It would seem that research on long-term-income estimates has reached a stage where this task should receive the highest priority. This at least is the conclusion which emerges rather forcefully from the present volume. It is only when the job has been done and meaningful "physical output" series have been obtained that one will be able to proceed to an investigation of the alternative vantage points in viewing long-term change. The better understanding of the index-number problem will not eliminate the arbitrariness of our approaches, but it will make it possible to gauge its extent and reveal the historical significance of the weighting choices which are made.

All this of course must not diminish our gratitude to the editor and the contributors. There is no intention to deny the importance of the findings summarized here or to overlook the labor invested and the ingenuity displayed. The volume shows with much clarity where we stand now. The very weakness of some of the results can be relied upon to instigate further elaborations and improvements. Our ability to use past experience for the comprehension and solution of present problems largely depends upon the success of this enterprise.

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