The Review of Economic Statistics

VOLUME XXIV FEBRUARY, 1942 Number 1

DOES CONSUMPTION LAG BEHIND INCOMES?

RELATION BETWEEN INCOME AND CONSUMPTION

THE fact that consumption outlay of individuals as well as of groups of individuals depends on their income is well known. Although this statement will hardly be doubted, it may be tested statistically from family budget statistics, as has been done by various investigators. These statistics can show only that consumption outlay by different people, having different incomes at the same moment, depends on income. Consumption outlay by the same family in different years, showing varying income, will not necessarily depend on income in the same way that is shown by family budget statistics.

This latter relation plays a highly important rôle in the causation of business cycles, a fact perhaps most stressed by Mr. Keynes, who created the term "propensity to consume" and who used this notion in various deductions. The importance of the propensity to consume for the quantitative approximation of some business-cycle problems has led a number of authors to measurements of that coefficient.

How large the propensity to consume may be is not the only important question. Another question is "What lag exists between income changes and changes in consumption outlay?" The longer this lag, the more slowly will the economic system react to changes in income and the longer, other things being equal, will be the process of adjustment (e.g., a business cycle).

The answer to this question — put by Mrs. Gilboy in this REVIEW [1] — cannot be given by family budget data, as already stated. The only possible method of securing an answer is by use of time series. The use of time series, however, always implies the difficulty that a number of *ceteris paribus* clauses are no longer fulfilled. Not only changes in income are the causes of any given changes in consumption outlay; other factors that also influence consumption outlay may have changed. A discussion of the most important of these other factors has been presented by Dr. Polak in this REVIEW,[2] where he applied the use of time series to consumption fluctuations in the United States during the period 1919–32. The same method that he employed was used in an investigation of United Kingdom data, 1870–1910, of which the present paper is a short account. Because of the nature of the statistical material available, one difference between the two studies lies in the choice of variables. This difference will be treated below (p. 5).

CONSUMPTION DATA, U. K., 1870–1910

The figures on which our calculations are based are of moderate quality only. The period and country under discussion, however, provide in so many respects a classical case for business-cycle research that experimenting with the material seemed worth while. Details of the calculation are shown in Table 1.

Hoffmann's index of industrial production [3] seems to be the best index that can be constructed from the statistical material at hand. For the period that we are discussing, the index covers about two-thirds of total industrial production. For such important industries as cotton and wool spinning and for some smaller industries, data on consumption of raw materials have been used. For most of the other industries, net imports of raw materials only were available, which means that additions to raw-material stocks both by dealers and by industrial entrepreneurs have been included. We have tried to make a correction for this drawback (see p. 5 below).

[1] Elizabeth W. Gilboy, "Income-Expenditure Relations," this REVIEW, XXII (1940), pp. 115–21.

[2] J. J. Polak, "Fluctuations in United States Consumption, 1919–1932," this REVIEW, XXI (1939), pp. 1–12.

[3] Walther Hoffmann, "Wachstum und Wachstumsformen der englischen Industriewirtschaft von 1700 bis zur Gegenwart," *Probleme der Weltwirtschaft* (Schriften des Instituts für Weltwirtschaft an der Universität Kiel, Nr. 63, Jena, 1940).

TABLE I. — CALCULATION OF CONSUMPTION AND PRODUCTION

(Series 3, 6, 14, 15, and 16 rounded off to ten units.)

Description of Series and Symbols	Source*	Unit	1866	1867	1868	1869	1870	1871	1872
1. Production of manuf. consumers' goods (Hoffmann).....	W.A. 1	1907=426	223	220	238	228	249	272	270
2. Coal production....................................	S.A. 1	Mln. 1907£	46	47	46	48	49	52	55
3. Production of manuf. consumers' goods (our definition)..	See note	"	520	510	550	530	570	620	620
4. Production of agricultural products..................	W.A. 2	"	190	196	212	206	214	210	200
5. Total production of consumers' goods (3 + 4)..........		"	710	706	762	736	784	830	820
6. Imports of consumers' goods (ready for retail trade †)	Cf. text	"	100	100	110	110	110	120	140
7. Exports of consumers' goods (on wholesale basis).......	"	"	104	109	115	118	124	138	146
8. Consumption of consumers' goods (5 + 6 − 7).........	"	"	706	697	757	728	770	812	814
9. Retail price index.................................	"	1907=100	113	119	117	113	113	113	119
10. Value of consumption of consumers' goods (8 × 9: 100)...		Mln. £	797	830	886	822	870	918	968
11. Consumption of services............................	See note	Mln. 1907£	263	266	269	270	273	278	282
12. Price index of services............................	Cf. text	1907=100	70	71	73	76	78	80	82
13. Value of consumption of services (11 × 12: 100).........		Mln. £	184	189	196	205	213	222	231
14. Total value of consumption (10 + 13)................		"	980	1020	1080	1030	1080	1140	1200
15. Total volume of consumption (8 + 11)...............		Mln. 1907£	970	960	1030	1000	1040	1090	1100
16. Total volume of production (5 + 11)................		"	970	970	1030	1010	1060	1110	1100

	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893
1.	284	292	284	282	287	272	254	301	293	311	317	322	301	304	316	334	349	351	364	340	337
2.	57	56	59	60	60	60	60	66	69	70	73	72	71	71	73	76	79	81	83	81	73
3.	660	670	660	660	670	640	600	700	700	730	750	760	710	720	750	790	820	830	860	810	790
4.	209	226	228	217	199	215	175	214	215	204	218	226	220	230	218	223	230	234	242	236	227
5.	869	896	888	877	869	855	775	914	915	934	968	986	930	950	968	1013	1050	1064	1102	1046	1017
6.	150	150	160	170	170	180	190	200	190	180	190	190	190	190	210	200	220	260	260	250	240
7.	136	139	138	135	138	131	133	152	162	156	161	165	161	170	173	178	179	180	174	170	164
8.	883	907	910	912	901	904	832	962	943	958	997	1011	959	970	1005	1035	1091	1144	1188	1126	1093
9.	120	117	113	111	113	111	105	109	108	109	106	105	101	97	95	95	97	97	97	97	95
10.	1059	1061	1029	1012	1019	1002	874	1049	1019	1043	1058	1061	969	941	955	985	1060	1110	1151	1091	1039
11.	287	291	295	299	301	305	306	311	315	320	323	325	328	331	334	337	341	345	350	352	356
12.	84	86	86	85	84	83	83	82	82	83	83	83	84	84	85	86	87	89	90	91	93
13.	241	250	254	254	253	253	254	255	258	266	268	270	276	278	284	290	297	307	315	320	331
14.	1300	1310	1280	1270	1270	1260	1130	1300	1280	1310	1330	1330	1250	1220	1240	1280	1360	1420	1470	1410	1370
15.	1170	1200	1210	1210	1200	1210	1140	1270	1260	1280	1320	1340	1290	1300	1340	1370	1430	1490	1540	1480	1450
16.	1160	1190	1180	1180	1170	1160	1080	1230	1230	1250	1290	1310	1260	1280	1300	1350	1390	1410	1450	1400	1370

	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
1.	351	370	380	369	390	401	392	390	392	383	377	399	407	426	420	413	416	432	460	466	446
2.	84	85	87	90	90	98	101	98	102	103	104	106	112	120	117	118	118	122	116	129	119
3.	840	870	900	880	920	960	950	940	950	930	920	970	1000	1050	1030	1020	1030	1060	1110	1140	1090
4.	233	232	234	229	239	235	231	237	246	227	242	246	248	250	258	261	256	250	246	246	257
5.	1073	1102	1134	1109	1159	1195	1181	1177	1196	1157	1162	1216	1248	1300	1288	1281	1286	1310	1356	1386	1347
6.	260	270	280	300	320	330	330	350	340	340	350	340	360	360	360	350	360	370	370	400	390
7.	176	184	188	180	179	190	181	181	186	188	197	211	222	234	211	224	234	245	254	258	215
8.	1157	1188	1226	1229	1300	1335	1330	1346	1350	1309	1315	1345	1386	1426	1437	1407	1412	1435	1472	1528	1522
9.	93	91	89	93	93	93	95	96	97	97	97	97	97	100	101	101	101	103	105	105	105
10.	1076	1080	1090	1141	1210	1241	1262	1291	1310	1270	1275	1305	1345	1426	1450	1420	1426	1479	1546	1603	1600
11.	362	365	371	378	383	390	394	401	406	410	414	418	425	430	435	436	443	447	450	462	467
12.	94	95	95	96	96	96	96	97	97	98	98	99	100	100	101	101	101	102	104	106	109
13.	340	347	353	363	368	374	378	389	394	402	406	414	425	430	439	440	447	456	468	490	508
14.	1420	1430	1440	1500	1580	1620	1640	1680	1700	1670	1680	1720	1770	1860	1890	1860	1870	1940	2010	2090	2110
15.	1520	1550	1600	1610	1680	1730	1720	1750	1760	1720	1730	1760	1810	1860	1870	1840	1860	1880	1920	1990	1990
16.	1440	1470	1510	1490	1540	1590	1580	1580	1600	1570	1580	1630	1670	1730	1720	1720	1730	1760	1810	1850	1810

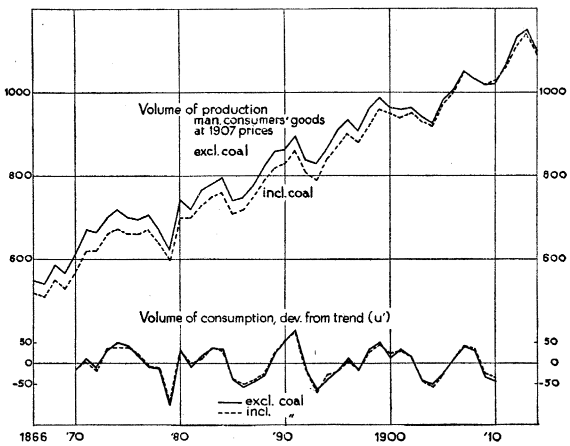
* *Source references.* — W.A.1 = W. Hoffmann, "Ein Index der industriellen Produktion für Grossbritannien seit dem 18. Jahrhundert," *Weltwirtschaftliches Archiv*, 40 (1934), p. 383.
W.A.2 = L. Drescher, "Die Entwicklung der Agrarproduktion Grossbritanniens und Irlands seit Beginn des 19. Jahrhunderts," *Weltwirtschaftliches Archiv*, 41 (1935), p. 270.
S.A.1 = *Statistical Abstract of the United Kingdom.*

† Brought on retail value basis by multiplication by the ratio $\frac{360}{220}$, derived from 1907 figures.

Note on calculation. Hoffmann's index of industrial production of consumers' goods excludes coal, which we consider as chiefly a consumers' good (following Cassel). Therefore coal production had to be included; both series have been converted to the base of 1907 pounds sterling (i.e., calculated at prices of 1907). For coal the 1907 value of production is 120 million £; this is indicated by Hoffmann to be 14.9 per cent of total production, which therefore was £804 million; of this, 53 per cent, or £426 million, related to consumers' goods in the Hoffman sense. The total of series 1 and 2 has as its base 1050 for 1907, which is the retail value of consumers' goods production, according to Sir Alfred Flux (Census of Production 1907, General Report, pp. 25–33). The 1907 figures for series 4, 6, 7, and 11 have been taken from the same source. The series for consumption of services (11) is composed of the following items (weights for 1907 indicated in brackets, based on Flux's figures): (i) housing services, being the product of population and average number of rooms available per head of population (weight: 230); (ii) number of passengers carried by railways (75); (iii) domestic services, taken constantly at 80, since the number of people engaged in these services is almost constant; (iv) number of passengers carried by tramways (15); (v) letters delivered by postal service (30). For further particulars, see source references above and (for price indices, series 9 and 12) text.

To Hoffmann's index of industrial production of consumers' goods we first added coal production [4] (which Hoffmann considered a producers' good) and then added production of agricultural products (Drescher's index), in

CHART 1. — INDICES OF THE VOLUME OF PRODUCTION OF MANUFACTURED CONSUMERS' GOODS (UNADJUSTED AND ADJUSTED FOR TREND), IN THE UNITED KINGDOM, ANNUALLY, 1866–1914 *



* For description of indices, see text.

order to secure total production of consumers' goods. Next, imports of such goods were added and exports deducted, to obtain consumption of consumers' goods. (Here again additions to stocks are included.) Finally, an index of consumption of services was added. Separate price indices for goods and services were applied to the indices of the consumption of consumers' goods and the consumption of services in order to obtain value figures. Since all volume indices were expressed in 1907 pounds sterling — i.e., they were value indices at 1907 prices — the price indices were taken with 1907 as a base. Various value figures for 1907 were obtained from Sir Alfred Flux's General Report on the 1907 Census of Production (cf. note to Table 1).

The index of agricultural production as given by Drescher [5] covers about 78 per cent of total agricultural production in 1925. The data for animal production are very rough, since they are based on figures for total live stock, of which a slowly changing percentage is assumed to be slaughtered each year.

[4] If coal production is not added, the course of the series is almost exactly the same. See Chart 1.

[5] L. Drescher, "Die Entwicklung der Agrarproduktion Grossbritanniens und Irlands seit Beginn des 19. Jahrhunderts," *Weltwirtschaftliches Archiv*, 41 (1935), p. 270.

The index of the imports of consumers' goods is based on goods ready for use and covers 69 per cent of these goods for 1907. This index, like the index of industrial production of consumers' goods, is based on retail value as given by Flux. The index for exports of consumers' goods covers 87 per cent of such exports in 1907. The index of consumption of services is explained in Table 1.

The index of retail prices is a combination of Colin Clark's index [6] (for the trend movement) and Wood's index of retail prices [7] (for the shorter fluctuations). Our index is the product of Wood's index and a smoothly moving cofactor; the cofactor is equal to the ratio between Clark's figures and Wood's figures for the middle of the periods for which Clark's figures are given (averages for cycles); between these midperiods, the cofactor has been linearly interpolated.

The index of service prices has been taken from Clark [8] and linearly interpolated on the assumption that service prices move smoothly. For railway, tram, domestic, and postal services this assumption does not seem to be unreasonable; for rents, it is less certain; it is, however, also applied by Professor Bowley.[9]

INCOME DATA

Two kinds of incomes may be distinguished: wages and non-workers' income. For total wages in this study we have used Professor Bowley's estimate; [10] and in order to estimate the fluctuations in other incomes, assessed incomes according to the income tax data, as corrected by Professor Bowley and Lord Stamp, have been taken as raw material. This material has, however, been adjusted somewhat further. (See Table 2.)

One reason for making adjustments was that Professor Bowley and Lord Stamp do not agree as to the timing of the series. Professor Bowley

[6] Colin Clark, *National Income and Outlay* (London, 1937), p. 231.

[7] See George H. Wood, "Real Wages and the Standard of Comfort Since 1850," *Journal of the Royal Statistical Society*, LXXII (1909), pp. 94–95, 102–3.

[8] *Op. cit.*

[9] A. L. Bowley, *Wages and Income in the United Kingdom since 1860* (Cambridge, England, 1937), p. 121.

[10] A. L. Bowley, *Economic Journal*, XIV (1904), p. 457, continued by A. C. Pigou, *Industrial Fluctuations* (London, 1927), p. 356.

TABLE 2. — CALCULATION OF NON-WORKER'S INCOME

Description of Series and Symbols	Source*	Units	1870	1871	1872	1873	1874	1875	1876
1. Taxable income	Bowley, Stamp	Mln. £	460	490	525	545	555	560	560
2. Average of year and following year of series (1)		"	475	508	535	550	558	560	558
3. 1.5 × series (2)		"	713	762	803	825	837	840	837
4. Physical index of farm production	Drescher		214	210	200	209	226	228	217
5. Index of home farm prices	Rousseaux		109	120	119	127	125	117	121
6. Value of farm production, (4) × (5)		Mln. £	233	252	238	265	282	267	262
7. Three-year moving average of series (6)		"	240	241	252	262	271	270	256
8. Series (6) − (7)		"	−7	11	−14	3	11	−3	6
9. Non-worker's income: (3) + (8) = Z		"	706	773	789	828	848	837	843

	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	1894
1.	555	540	545	560	575	590	585	580	580	580	595	615	640	640	635	625	630	645
2.	548	543	553	568	583	588	583	580	580	588	605	628	640	638	630	628	638	653
3.	822	815	830	852	875	882	875	870	870	882	908	942	960	957	945	942	957	980
4.	199	215	175	214	215	204	218	226	220	230	218	223	230	234	242	236	227	233
5.	120	115	113	111	110	112	109	100	92	87	86	92	86	94	93	91	87	82
6.	239	247	198	238	237	228	238	226	202	200	187	205	198	220	225	215	197	191
7.	249	228	228	224	234	234	231	222	209	196	197	197	208	214	220	212	201	191
8.	−10	19	−30	14	3	−6	7	4	−7	4	−10	8	−10	6	5	3	−4	0
9.	812	834	800	866	878	876	882	874	863	886	898	950	950	963	950	945	953	980

	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
1.	660	680	715	735	765	790	800	805	810	825	835	875	905	895	910	940	985	1055
2.	670	698	725	750	778	795	803	808	818	830	855	890	900	903	925	963	1020	...
3.	1005	1047	1088	1125	1167	1193	1205	1212	1227	1245	1283	1335	1350	1355	1388	1445	1530	...
4.	232	234	229	239	235	231	237	246	227	242	246	248	250	258	261	256	250	246
5.	80	76	86	88	79	88	85	91	88	92	87	88	89	89	97	100	107	105
6.	186	178	197	210	186	203	201	224	200	223	214	218	222	230	253	256	268	258
7.	185	187	195	198	200	197	209	208	216	212	218	218	223	235	246	259	261	261
8.	1	−9	2	12	−14	6	−8	16	−16	11	−4	0	−1	−5	−7	−3	−7	−3
9.	1006	1038	1090	1137	1153	1199	1197	1228	1211	1256	1279	1335	1349	1350	1395	1442	1537	...

* *Source references.* — Bowley, Stamp: Figures from Bowley (*Economic Journal*, 1904) as given by Sir W. Layton, *An Introduction to the Study of Pric* (London, 1920), p. 187, supplemented by figures from Lord Stamp, *British Incomes and Property* (London, 1916), p. 319, converted to a comparable basis
Drescher: cf. Table 1 (W.A.2).
Rousseaux: P. Rousseaux, *Les Mouvements de fond de l'economie anglaise, 1800–1913* (Bruxelles, 1938), pp. 264–65.
Note on calculation. Starting from taxable incomes, we have corrected these figures first, for timing (see below) by taking two-year averages; second, f the smoothing effect of (a) these two year-averages and (b) the three-year moving averages prescribed by tax laws and for the fact that low incomes are n taxed, by multiplying by 1.5 (cf. text). The correction for smoothing would, however, be sufficient only if all incomes show only eight-year cycles. This approximately true for most incomes, but in addition agriculture presumably shows short erratic fluctuations, due to crop fluctuations or price fluctuation which are almost entirely absent in rent figures, upon which the income estimates for farmers are based, according to tax regulations. Therefore, an estima is made of farm income by multiplying Rousseaux' price index of home farm products by a physical index of farm production, converted to such a basis to yield a product of these two series equal to 222 in 1907, which is the value of farm production according to Sir Alfred Flux (cf. Table 1). Deviations fro three-year moving averages of this series are added to the estimates (3) already obtained. It may be remarked at once that a further correlation analys suggests that fluctuations in non-workers' income actually have been some three times the figures for Z (i.e., deviations from nine-year moving averages for Z that we arrive at in this table. The timing of series 1 is that assumed by Prof. Bowley. Lord Stamp indicates a somewhat different timing; he attribut the same figures to a period half a year earlier. "The assessed profits for the year ending 5th April, 1909, may be taken to be actual profits for the year to th beginning of June 1907, in times of normal and regular increase" (*British Income and Property*, 1916 edition, p. 178). Hence the average of two years h been taken (second line of table). Since this calculation of the lag does not take account of (a) businesses set up during the year of assessment, of (b) th possibility of reporting losses at once [cf. H. B. Spaulding, *The Income Tax in Great Britain and the United States* (London, 1927), pp. 218–19], and (c) so-call "133rd section," permitting a more recent moving average in some cases of declining profits [cf. Lord Stamp, *The National Capital and Other Statistical Studi* (London, 1937), p. 286.], circumstances all leading to a smaller lag between earned income and assessment, it may be that the true income figures lag som what behind our series (cf. text). According to private information obtained from Lord Stamp, the effect of provision (b) on the statistical figures has not bee large.

considers that the figure for the year of assessment 1908–09 corresponds to incomes earned in 1907; [11] Lord Stamp indicates the year ending June, 1907 as the corresponding income period. To begin with, we have followed Lord Stamp and have taken the two-year average of Professor Bowley's figures for 1907 and 190 to represent the 1907 income.

This series has been multiplied by 1.5, sinc for three reasons its fluctuations are, withou doubt, too small: First, assessed incomes ar for most types of incomes, a three-year movin average. Secondly, we have already taken two-year moving average. On the assumptio

[11] Cf. the note in the *Economic Journal* of 1904, noted above.

that the fluctuations are eight-year period sine curves, it is easily computed that the original fluctuations have been reduced by about one-sixth. Thirdly, some incomes are below the exemption limit. An estimate of these low incomes has been made by several authors, for various years.[12] On the average they amount to about one-quarter of assessed incomes. *In summa*, multiplication by $\frac{5}{4} \times \frac{6}{5}$, or 1.5, is therefore needed. This factor is correct only for the fluctuations of the series around its trend; it need not be correct for the trend values themselves. Because of the arguments used, these values should be multiplied by only 1.25. For other reasons a multiplication by 1.5 for the trend values also seems appropriate; but these reasons need not occupy us now since we are interested in the deviations only.[13]

One component of income fluctuations is not included in income tax figures, viz., the short fluctuations in agricultural incomes. Farmers are taxed in proportion to rents, and rents change slowly because of the long duration of the contracts. In the long run, rents will follow agricultural profits more or less, but certainly not in the short run. We have, therefore, added the deviations from three-year moving averages of the value of farm production. This value was estimated in the following way: An index for the volume of farm production calculated by Drescher[14] was multiplied by an index of prices for home farm products calculated by Rousseaux.[15] The value of the product for 1907 was estimated by use of the figures mentioned by Flux in the General Report on the 1907 Census. Although this method is a rough one — Drescher's index is unsatisfactory as far as the production of meat is concerned, in particular — the estimate of agricultural income thus secured seemed better than no estimate whatsoever.

The final figures obtained are tabulated in line 9 of Table 2. We have tried to test these figures with independent figures from other sources. Limitations of space prevent us from giving all the details of this test;[16] briefly, however, we have attempted to reconstruct non-labor income from data on production, prices, international trade, and wages. The comparison does not prove to be very satisfactory unless it is assumed that (1) Professor Bowley's timing is correct; (2) raw material cost is calculated at lagged prices (prices at moment of purchase instead of prices at moment of delivery of production); and (3) the fluctuations in actual incomes are about three times as large as those given in Table 2. From all series calculated the trends have been eliminated by using deviations from nine-year moving averages.

RELATIONS BETWEEN INCOMES AND CONSUMPTION TESTED

In accordance with general economic theory, we have assumed that consumption outlay, U', depends, first of all, on total wages, L, non-labor income, Z, and cost of living, p. Since our figures for consumption also include additions to stocks, one or two factors explaining these additions have been included. From another investigation[17] that we made on this subject, we felt justified in including the following factors:

(1) the rate of increase in the volume of consumption: $u'_t - u'_{t-1}$

(2) the interest rate, m^s.

Our previous investigations led us to believe, however, that the influence of m^s would be very small.

For the timing of the explanatory series, we assumed that wages are spent without much delay. For the case of non-workers, the possibility of a lag between incomes earned and consumption outlay had to be recognized. A lag may occur for various reasons: First, these incomes can often be disposed of only at a time period later than that of earning. Secondly, even if they are disposed of at the moment of earning (shopkeepers, e.g.) their exact magnitude is determined later (after the closing of

[12] Cf. Stamp, *British Incomes and Property* (London, 1916), p. 427, where a number of estimates have been reproduced.

[13] Another question remains, viz., whether there are not other reasons for assuming that the income fluctuations as reported by assessments are too weak. Cf. below.

[14] *Op. cit.*

[15] P. Rousseaux, *Les mouvements de fond de l'économie anglaise, 1800–1913* (Bruxelles, 1938), pp. 264–65.

[16] A number of these details are treated in my forthcoming book, *Business Cycles in the United Kingdom, 1870–1914.*

[17] "An Acceleration Principle for Holding Stocks," to be published in *Studies in Mathematical Economics and Econometrics: Henry Schultz Memorial Volume.*

the books), and, therefore, that magnitude can influence outlay only at a later moment. Thirdly, the effect of the knowledge that one's income has risen or fallen on one's consumption outlay may also take place only after some time — the duration of the psychological reaction. The less the pressure of income forces one to react immediately to changes, the longer that reaction may take. Finally, income payments (e.g., dividends) as well as some types of consumption outlay (travel expenses, Christmas presents) show seasonal fluctuations.

Since the lag cannot be fixed beforehand, a test of the relation with a fixed *a priori* value of that lag did not seem adequate; we, therefore, based our test on a not *a priori* restricted statistical estimate of lag. This estimate may be obtained most easily by the inclusion of two different values of Z — e.g., for t and $t-1$. If the lag is between 0 and 1, the coefficients for Z_t and Z_{t-1} will both be positive; if it is more than 1, the coefficient for Z_{t-1} will be positive and that for Z_t negative. It is appropriate then to try Z_{t-1} and Z_{t-2}; if both coefficients are positive, the lag lies between 1 and 2; and so on. Graphical trials may shorten this process of adaptation; in the present case, it proved to be appropriate to include Z_{t-1} and Z_{t-2}.

In the case of p, an influence without delay could reasonably be expected, since the amount to be paid depends on the level of actual prices in a direct way. But a lagged influence could also be imagined to exist; decisions based on earlier prices may contribute to the actual behavior of the consumer. For that reason p_{t-1} was also included in some of the calculations.

In summary: attempts have been made to explain the fluctuations in consumption outlay by a linear combination of the fluctuations in total wages (L_t), non-labor income with lags of 1 and 2 years (Z_{t-1} and Z_{t-2}), price level p_t, and rate of increase in quantity of consumption ($u_t - u_{t-1}$); and in additional attempts the price level with a lag of 1 year (p_{t-1}) and the interest rate (m^s) have been added.

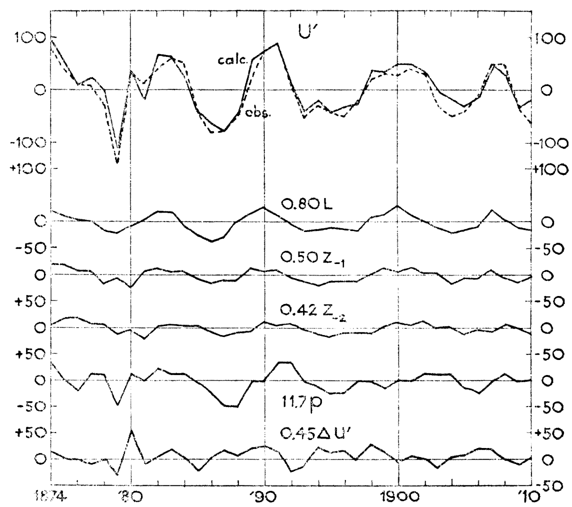
Unfortunately, the correlation between L and Z_{t-1} appears to be high, which makes accurate determination of the coefficients for both these variables impossible. One coefficient has to be determined on *a priori* grounds. We have chosen that for L, at 0.8; various investigations point to about that value for the marginal propensity to consume for workers' families.[18]

The two factors p_{t-1} and m^s appeared to have only very subordinate influence; therefore, they were not included in the final equation. With the remaining variables, the best result obtained was

$$U'_t = 0.80\,L + 0.50\,Z_{-1} + 0.42\,Z_{-2} + 11.7\,p + 0.45\,(u_t - u_{t-1}).$$

(See Chart 2.)

CHART 2. — ESTIMATES OF CONSUMPTION OUTLAY IN THE UNITED KINGDOM, ANNUALLY, 1874–1910 *



* For description of series, see text.

SIGNIFICANCE OF RESULTS

The significance of the free coefficients (i.e., all except that for L) was tested in various ways. One way was the rather elementary method of trying alternatives, as follows:

1. The regression coefficient for L was varied and values of 0.9 and 0.7 were tried.
2. As has been mentioned already, m^s, the rate of interest, and p_{-1}, cost of living one year before, were included as additional variables.

[18] For the United States, cf. my *Business Cycles in the United States, 1919–1932* (Geneva, 1939), pp. 36–37, where the figures 0.83 and 0.95 are mentioned. For Holland, cf. J. Tinbergen and A. L. G. M. Rombouts, "Statistische meting van Keynes' begrippen 'propensity to consume' en 'propensity to save' voor Nederland," *De Nederlandsche Conjunctuur*, XI (1940), p. 21, where a figure of 0.8 is found. It would seem that English workers are more like Dutch than like American workers, in that they will save more in good times and dissave in bad times.

All calculations show the same order of magnitude for the coefficients (Table 3). Those for p and $u-u_{-1}$ are particularly stable. Those for Z_{-1} and Z_{-2} are less stable, but always positive. This means that the lag of the Z-term is always between one and two years or, taking account of what has been said about the timing of Z, that the lag in the influence of non-labor income on consumption is between one-half and one and one-half years.

TABLE 3. — SOME RESULTS OF ALTERNATIVE CALCULATIONS (1874–1910)

No.	Regression coefficients for terms with:							Corr. coeff.
	L*	Z_{-1}	Z_{-2}	p	$u-u_{-1}$	p_{-1}	m^s	
1	0.8	0.50	0.42	11.7	0.45	..	..	0.922
2	0.9	0.44	0.41	11.4	0.44	..	..	0.915
3	0.7	0.56	0.43	11.8	0.47	..	..	0.925
4	0.8	0.46†	0.46†	11.5	0.46	0.0	..	0.921
5	0.8	0.48†	0.48†	11.4	0.47	..	1.63	0.935

* This coefficient has been given *a priori*.
† In these cases, the coefficients for Z_{-1} and Z_{-2} have, for convenience, been chosen equal.

A second elementary test of the significance of the regression coefficients consisted in the splitting up of the period into two subperiods, and the establishment of a regression equation for each subperiod. The results are given in Table 4. Again, not much variation is evident in the order of magnitude of the coefficients.

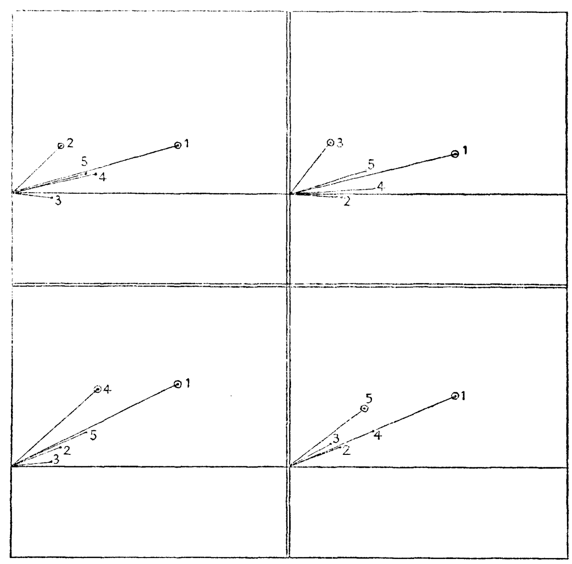
TABLE 4. — RESULTS FOR TWO SUBPERIODS

No.	Period	Regression coefficients for terms with:							Corr. coeff.
		L*	Z_{-1}	Z_{-2}	p	$u-u_{-1}$	p_{-1}	m^s	
1	1874–1910	0.8	0.50	0.42	11.7	0.45	..	..	0.922
6	1874–1895	0.8	0.35	0.68	9.0	0.55	..	..	0.950
7	1896–1910	0.8	0.42	0.73	8.4	0.55	..	..	0.826
2	1874–1910	0.9	0.44	0.41	11.4	0.44	..	..	0.915
8	1874–1895	0.9	0.44	0.30	12.6	0.42	..	..	0.941
9	1896–1910	0.9	0.49	0.29	13.0	0.43	..	..	0.821

* The coefficient for L has been chosen *a priori*.

A third test was made along the lines of R. A. Fisher's methods. The assumptions made by Fisher are (i) that there are no error components in the explanatory variables, but only in the variable to be explained, (ii) that the error component in the latter is a sample from a normal universe, and (iii) that that sample is a random one. We think assumption (i) is approximately fulfilled, since the errors of measurement are far less important than the errors made by the use of an incomplete theory. As to assumption (ii), the distribution of the residuals was compared with a binomial distribution for $n=10$, and the χ^2-test applied. The probability of the deviations found appeared to be $P=0.80$, which is quite satisfactory. Assumption (iii) was tested by the determination of the serial correlation of the residuals; this appears to be -0.05 ± 0.17, which is also satisfactory. The assumptions

CHART 3. — TESTS OF FREE COEFFICIENTS, BY USE OF BUNCH MAP



upon which Fisher's method is based are, therefore, fulfilled. Calculation of the standard deviations of the regression coefficients yields:

Explanatory variable	Z_{-1}	Z_{-2}	p	$u-u_{-1}$
Regression coefficient	0.50	0.42	11.7	0.45
Standard deviation of regression coefficient	0.13	0.15	1.83	0.07

These results are in accordance with the results already mentioned: the coefficients for p and $u-u_{-1}$ are very stable, those for Z_{-1} and Z_{-2} less stable, but it is very improbable that they are not both positive. Of course, we should not forget that the coefficient for L has been assumed as given beforehand. We do not think, however, that this invalidates this conclusion very much. A glance at Table 3 shows that a change of 0.1 in the regression coefficient for L has not a very great influence on the other regression coefficients.

A fourth test, finally, was made by the construction of a bunch map. Here again the coefficient for L was taken at its *a priori* value 0.8. The spread in the bunches is not ideal; but again the coefficients for p and $u-u_{-1}$ are, according to this test, the most stable ones, whereas those for Z_{-1} and Z_{-2} are, practically speaking, positive. Only one of the beams shows a slope slightly below zero (cf. Chart 3, which gives only the 12345-set).

CONCLUSIONS

The chief conclusion to be drawn from our results concerns the theme of this paper, viz., the lag between income and consumption outlay. Since the regression coefficients for both the Z_{-1}-term and the Z_{-2}-term are positive, the average lag must be between one-half and one and one-half years, with the most probable value at about one year. Thus our results suggest *an average lag of one year between nonlabor incomes and consumption outlay.* This lag is of great importance for the explanation of the business cycle.[19] We have tried to find confirmation of this result in the behavior of consumption figures for separate commodities and we have succeeded. Consumption of sugar as well as of coffee, tea, spirits, and cotton manufactures all show the same feature.

A second conclusion may be drawn from our equation, viz., from the regression coefficient for p. In principle this coefficient would enable us to calculate some sort of average elasticity of demand for consumers' goods. Given the average values of consumption outlay (1500) and of the price level (99), we find that the elasticity of outlay with respect to prices is 0.78. It follows that the elasticity of quantity demanded with respect to prices is $0.78-1=-0.22$. This is a low figure, contrary to what is often assumed. In order to test this result too, we have calculated the elasticity of demand of some individual commodities. The results were

Sugar	0.06
Coffee	0.08
Tea	0.00
Spirits	0.16
Cotton manufactures	1.5

Although this small sample cannot prove very much, it is not in contradiction to the general result; four out of five elasticities are very low indeed.

Even a third conclusion may be drawn, but with still more caution. It concerns the marginal propensity to consume for non-workers. If our income figures were exact, the sum total of the two regression coefficients — 0.50 and 0.42, or 0.92 — would indicate that marginal propensity. Since, however, our test of the income figures (cf. above, p. 5) suggests that our series underestimates by about three times the intensity of the income fluctuations, the marginal propensity should accordingly be taken at one-third of the above value, or 0.31, which might seem too low. One fact must not be forgotten when judging this figure: Incomes include undistributed profits, of which nothing is consumed but all saved. And the English consumer probably is conservative. Nevertheless, the figure is low; and the question remains whether it may be due partly to the low quality of our statistics. Only fresh material could help us answer this question.

Summarizing our results very briefly, we are led to believe that for the United Kingdom, 1870–1914, consumption outlay of non-workers lags about one year behind the corresponding incomes; and the elasticity of demand as a whole and the marginal propensity to consume seem to be very low figures.

[19] Cf. *Business Cycles in the United Kingdom, 1870–1914,* where this thesis will be considered in detail.

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[Footnotes]

[7] **Real Wages and the Standard of Comfort since 1850**
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[10] **Tests of National Progress**
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