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CHAPTER III

COMPARATIVE CYCLICAL BEHAVIOR OF SHORT-TERM INTEREST RATES IN FOUR COUNTRIES, 1878–1938

Section 1. The Role of Short-Term Rates

Short-term interest rates play a prominent role in many business cycle theories. This corresponds to their great significance in the national money markets. There is further a widespread belief that among economic quantities they are exceptionally exposed to international influences and that their movements may frequently produce favorable or unfavorable conditions abroad. For that reason they are frequently included in studies of foreign exchanges. Their role was undoubtedly great during the classical period of the gold standard, i.e., between 1871 and 1914. It is therefore imperative that we study their cyclical behavior. In this chapter we show the behavior of some typical series, and prepare the ground for further operations to be carried out with them in subsequent chapters.

Short-term interest rates are highly sensitive to institutional changes. Some rates are operationally important at one time, but of merely historical interest later although they may still be quoted. It is therefore important to find out when such breaks in their significance occur and to what they are to be attributed. Often this cannot be determined in a satisfactory manner; if this happens then we must at least exercise great reserve in interpretation.

The rates are determined by a number of elements which need not be identical in all countries. Among them the most important are the supply of monetary funds on the money markets and the willingness of business to borrow at the prevailing rates. The former is influenced by the reserve position of the banks, the movements of gold, and the actions of the central bank, if one exists. The latter are the result of the interplay of little understood forces operating through the "expectations" of businessmen and the comparison of present and expected future profit conditions with the corresponding conditions of borrowing.

Most of these determinants are themselves predominantly dependent upon national conditions. The link with other economies was chiefly established by gold movements and shifts of short-term

capital. Policy measures may intervene one way or the other, though when the strict gold standard was in force they were infrequent and—possibly—of minor importance.

We do not know, at present, how to estimate the relative significance of the domestic and foreign influences. This is a general difficulty discussed above in Chapter II which will keep on cropping up. But it seems likely that the domestic influences outweigh the others in the case of short-term interest rates; the day-to-day fluctuations of the domestic economy would affect the domestic interest rate structure more frequently than the occasional disturbance of foreign origin, because distance alone creates a certain isolation from minor shocks coming from other economies, when there are no really large disturbances in any one country. This would, for example, be true toward the end of a cyclical contraction and at the early stages of an expansion. If a strong central bank is supplying ample funds, then there is another domestic factor frequently overshadowing international influences. So when several countries are simultaneously in these stages, it is plausible that the movement and the level of the various short-term rates are essentially the product of domestic forces. It may be quite different, however, when international financial crises occur.

The interaction of short-term interest rates of different countries therefore need not have been of a stable nature; it may have been weak in some years, strong in others. We have here an instance of the possibility of varying cyclical dependence, mentioned briefly in Chapter I, section 6.

The interdependence of interest rates within each money market is presumably very great, because of the possibility of translating a long-term rate into a series of successive short-term rates, e.g., by repeated borrowing or lending.[1] Because of this systematic interrelation of interest rates—which is affected also by other factors than the one just mentioned, e.g., by variations of risk among short-term and long-term rates—it is permissible to speak of an interest rate *structure*, even if its properties are far from fully known.

To avoid misunderstandings about the scope of the following

[1] Cf., for example, F. A. Lutz, "The Structure of Interest Rates," *Quarterly Journal of Economics*, Vol. LV, 1940, pp. 36–63. For general interest the important work by F. R. Macauley, *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States since 1856*, National Bureau of Economic Research, 1938, may also be referred to.

observations on interest rates it is emphasized again that this is *not* a study of the function of interest, its influence upon the allocation of durable goods, its control of investment on money and capital markets, etc. These are far-reaching problems. We aim mainly at description of a few interest rates and their comparative, international behavior.

If it were our aim merely to get a picture of the movement of interest rates, i.e., of their cyclical behavior, it would probably not be very important which short-term, medium-term, and long-term rates we chose. The members of a given class of rates move closely together. But other considerations enter into our selections. One of them—to be discussed in Chapter IX—relates to the absolute levels of rates in different countries. In measuring such differences in level the comparability of rates is highly important.

Our data cover two main periods, the first from February 1878 to August 1913 (426 months), the second from November 1925 to December 1938 (167 months). In some of the subsequent tables and measurements different periods, i.e., parts of the above, are occasionally used; the technical reasons for such deviations are noted on each one of the tables or in the text. There is notably a subdivision of the postwar data for the period of the more or less general application of the gold or gold exchange standard.

We now formulate the criteria for the selection of the short-term interest rates. What information do we expect our interest rates to give?

First, we are primarily concerned with cyclical behavior. Hence our interest rates must be representative of the category of short-term rates as far as movement is concerned.

Second, we should like our rates to be quantitatively significant, in the sense that a large volume of (domestic) business be transacted in the obligations to which they pertain. This is an important consideration in the event that international influences change the rate and thus directly affect a large volume of transactions.

Third, we shall later want to form differences between short-term interest rates of one country and those of another. The idea is, of course, that these differences may have an important, perhaps even primary, influence upon short-term capital movements between nations. The interest rates should therefore have international significance in the sense that a sufficient difference between the rates of two countries would cause a flow of funds.

These desiderata[2] are difficult to fulfill simultaneously, especially

[2] It is clear that they automatically insure the comparability of our series

since they should be continuously fulfilled for hundreds of months, i.e., taking possible institutional changes into account. This latter condition is especially hard to meet after World War I, even during the few years of the gold standard. But fortunately the task is not hopeless, if a reasonable latitude of view is adopted.[3] Then it turns out that the internationally significant rate is generally one of great domestic importance too and hence relevant to the cyclical behavior of all short-term rates.

Thus we find that the contacts among the large money markets are multiple: The domestic factors influencing the rate of interest —such as monetary policy—transmit repercussions to other national markets by affecting the differentials of the rates, while at the same time the domestic rate is subject to influences from abroad, because this rate is in turn exposed to similar repercussions emanating from the other centers.

The rates selected were for the United States the commercial paper rate and the New York call money rate; for Great Britain the London open market discount rate; for France the Paris open market discount rate; and for Germany the Berlin private discount rate. A brief description of these five will be found in the appendix to this chapter.

Section 2. Frequency Distributions

It is of interest to investigate to some extent the *frequency distributions* generated by the interest rate series, even though our chief concern is with their cyclical properties. Frequency distributions are often neglected in cyclical studies, but they help us to gain a deeper insight into cyclical behavior by showing some basic properties, almost of an institutional character. We need, in any case, to know the average stand of the different rates, especially in Chapter IV, when the question of absolute levels of rates enters into the picture.

In this first instance we determine the frequency distributions for both the seasonally uncorrected and corrected series (Tables 9 and 10). This comparison itself brings out some interesting facts which otherwise might be overlooked. For the reader who is in-

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from country to country, though they may in each case relate to somewhat different institutional conditions.

[3] For the United States we shall even consider two interest rates, in order to check on a belief that one of them, the New York call money rate, should be chosen.

TABLE 9

Frequency Distributions
Short-Term Interest Rates Prewar Period, January 1876–July 1914, Seasonally Uncorrected Data
(per cent)

Class	N.Y. commercial paper rate	N.Y. call money rate	Great Britain open market discount rate	France open market discount rate	Berlin, Germany private discount rate
0– 0.39					
0.40– 0.79			17		
0.80– 1.19		21	34	7	
1.20– 1.59		36	51	32	23
1.60– 1.99		45	35	79	42
2.00– 2.39		59	55	100	50
2.40– 2.79	4	45	66	135	63
2.80– 3.19	17	40	40	52	84
3.20– 3.59	28	31	54	33	64
3.60– 3.99	69	22	57	17	32
4.00– 4.39	51	30	25	4	29
4.40– 4.79	57	27	11	1	45
4.80– 5.19	62	27	11	3	16
5.20– 5.59	68	15	1		9
5.60– 5.99	54	6	4		4
6.00– 6.39	30	14	1		
6.40– 6.79	8	3	1		1
6.80– 7.19	4	5			1
7.20– 7.59	3	6			
7.60– 7.99	2	7			
8.00– 8.39	3	3			
8.40– 8.79	1	3			
8.80– 9.19		1			
9.20– 9.59		2			
9.60– 9.99		1			
10.00–10.39		1			
10.40–10.79	1				
10.80–11.19	1	3			
11.20–11.59		1			
11.60–11.99		1			
12.00–12.39		2			
14.00–14.39		1			
14.40–14.79		1			
14.80–15.19		1			
15.60–15.99		1			
16.40–16.79		1			
20.80–21.19		1			
Total	463	463	463	463	463
Σfx	2242.685	1723.485	1241.085	1131.885	1464.685
Σfx^2	11425.521575	9346.233575	3955.217575	2972.629575	5145.621575
Arithmetic mean	4.84%	3.72%	2.68%	2.44%	3.16%
Median	4.83%	3.04%	2.63%	2.44%	3.05%
Standard deviation	1.10%	2.52%	1.17%	0.67%	1.05%
Coefficient of variation	0.23	0.68	0.44	0.27	0.34

TABLE 9, concluded

Postwar Period, January 1925–December 1938

Class	N.Y. commercial paper rate	N.Y. call money rate	Great Britain open market discount rate	France open market discount rate	Berlin, Germany private discount rate
0– 0.39		6	2		
0.40– 0.79	37	10	57		
0.80– 1.19	21	56	20	9	
1.20– 1.59	11	11	1	16	
1.60– 1.99	6			20	
2.00– 2.39	5	10	12	20	
2.40– 2.79	7	9	7	20	
2.80– 3.19	8	1		15	44
3.20– 3.59	4	2	1	23	9
3.60– 3.99	20	11	9	6	27[a]
4.00– 4.39	23	18	31	9	3
4.40– 4.79	7	8	14	3	18
4.80– 5.19	3	6	1	6	10
5.20– 5.59	8	2	8	4	3
5.60– 5.99	2	1	4	6	5
6.00– 6.39	6	2	1	6	9
6.40– 6.79		2		2	14
6.80– 7.19		4		2	8
7.20– 7.59		1		1	5
7.60– 7.99		1			5
8.00– 8.39		1			6
8.40– 8.79		2			1
8.80– 9.19		3			
9.20– 9.59		1			
9.60– 9.99					
10.00–10.39					
10.40–10.79					
10.80–11.19					
11.20–11.59					
11.60–11.99					1
Σ	168	168	168	168	168
Σfx	447.160	464.360	409.560	518.360	804.760
Σfx^2	1709.444200	2127.832200	1559.740200	1980.732200	4363.788200
Arithmetic mean	2.66%	2.76%	2.44%	3.09%	4.79%
Median	2.62%	2.04%	2.13%	2.78%	4.42%
Standard deviation	1.76%	2.24%	1.83%	1.51%	1.74%
Coefficient of variation	0.66	0.81	0.75	0.49	0.36

terested in it, this gives at the same time a check on the nature of the seasonals and on the consequences of their elimination.

Beginning with the New York commercial paper rate (prewar period), we find only slight differences between the arithmetic means—4.84 per cent (uncorrected) and 4.87 per cent (corrected)—and the medians—4.83 per cent (uncorrected) and 4.86 per cent

TABLE 10

Frequency Distributions
Short-Term Interest Rates Prewar Period, January 1876–July 1914, Seasonally Corrected Data

(per cent)

Class	N.Y. commercial paper rate	N.Y. call money rate	Great Britain open market discount rate	France open market discount rate	Berlin, Germany private discount rate
0– 0.39					
0.40– 0.79			13		
0.80– 1.19		12	29	2	2
1.20– 1.59		31	36	32	4
1.60– 1.99		48	47	84	40
2.00– 2.39		46	69	105	53
2.40– 2.79	4	35	59	125	51
2.80– 3.19	11	52	63	63	104
3.20– 3.59	25	37	53	28	79
3.60– 3.99	45	41	34	13	51
4.00– 4.39	66	33	31	9	34
4.40– 4.79	69	29	19	2	14
4.80– 5.19	75	22	6		15
5.20– 5.59	81	19	2		9
5.60– 5.99	39	11	1		7
6.00– 6.39	24	8	1		
6.40– 6.79	13	6			
6.80– 7.19	6	7			
7.20– 7.59	2	1			
7.60– 7.99		2			
8.00– 8.39		5			
8.40– 8.79		4			
8.80– 9.19		3			
9.20– 9.59	1	3			
9.60– 9.99					
10.00–10.39	1	1			
10.40–10.79					
10.80–11.19		1			
11.20–11.59		1			
11.60–11.99	1	2			
14.80–15.19		1			
16.00–16.39					
16.40–16.79		1			
19.60–19.99		1			
Σ	463	463	463	463	463
Σfx	2253.085	1717.085	1243.485	1132.285	1472.285
Σfx^2	11439.497575	8582.457575	3876.793575	2958.225575	5080.585575
Arithmetic mean	4.87%	3.71%	2.69%	2.45%	3.18%
Median	4.86%	3.28%	2.65%	2.42%	3.11%
Standard deviation	1.01%	2.19%	1.08%	0.64%	0.93%
Coefficient of variation	0.21	0.59	0.40	0.26	0.29

(corrected).[4] It is not of course to be expected that seasonal adjustment will affect the general level of the series; it may however reduce the series' variability, and the standard deviations indicate that this happens: they are 1.10 per cent (uncorrected) and 1.01 per cent (corrected). This reduction in variability is still more marked in the New York call money rate. The arithmetic means of 3.72 per cent (uncorrected) and 3.71 per cent (corrected) are substantially lower than those for the commercial paper rate. This is not surprising in view of the nature of the two rates (e.g., in the matter of collateral, duration of loans, etc.), but even this American rate is considerably higher than the average of the highest European rate. This point will reappear later (cf. Table 26).

The coefficient of variation[5] σ/X is almost three times as high for the call money rate as for the commercial paper rate (uncorrected data). With the elimination of the seasonals this difference becomes smaller. But it is true of all the rates in Table 9 that the elimination reduces the coefficient of variation, the standard deviation of which is 2.52 for the uncorrected series and 2.19 for the corrected series in Table 10. The New York call money rate and the Berlin private discount rate showed the greatest reductions.

Before the war the French open market discount rate had the lowest mean and median, the New York commercial paper rate the highest. In the interwar period, the British rate was the lowest, both the Paris and Berlin rates rising relative to prewar, the latter now becoming the highest. The two New York rates averaged lower than before the war.

The sensitivity of the rates, as indicated by the standard deviation and coefficient of variation, showed the New York call money rate the most sensitive before World War I, the French rate the least sensitive; this latter evidence of greater stability of the French economy will reappear frequently in this study. Even in the interwar period this relationship continued,[6] although all rates varied more than before 1914. The British rate was the second most sensitive in both periods, evidence of its central position in the international

[4] These are obviously very fine distinctions. Their value depends—as in the following instances—on the accuracy of the basic data. It is possible that it is not very good, but error estimates are not available.

[5] This coefficient is usually written $100(\sigma/X)$, i.e., expressed as a percentage, instead of a ratio. In order not to confuse this percentage with the unit of the interest rate, which is also a percentage, we use the ratio form.

[6] Except that the Berlin coefficient of variation became the lowest.

money market, as a focal point for major financial influences from abroad.

Section 3. Seasonal Variations

Now we turn to a brief examination of the *seasonal variations* of our interest rates. Here we touch upon an important and tricky question. There are many methods by which to calculate and eliminate seasonals. Frequently this is done in an altogether too mechanical way. Criteria of what constitutes a satisfactory smoothing are for the most part merely qualitative, even visual, which are quite inadequate in view of the deep-lying problems involved.[7] The merits of each method must be judged from the problem on hand and from the properties of the series. Sometimes it may be doubtful whether seasonals should be eliminated at all, depending on the use to which the corrected and uncorrected series are to be put.[8] If it is a question, e.g., of comparing the relation of turning points of various series, and if seasonal corrections shift the original turning points to different months as they often do, then a very troublesome situation may arise. It is hard to make general decisions, if not impossible.

For that reason we shall sometimes use corrected data, sometimes uncorrected, or even both. This will be determined by the needs of the occasion. An important aspect is also the *speed of the repercussions* which may occur between time series. Finally there is the vast and largely neglected field of the interdependence of seasonal variations of different activities. This is of importance in international financial affairs since, for example, the seasonal harvests of one country cause seasonal changes in the exchange rate and interest rate of another county, e.g., Argentina, Great Britain. Similar interdependence is found domestically.

The seasonal variations of our interest rates are best characterized by their indexes Chart 4 and Table 11. Considering first the prewar period we note a common property: The rates are generally highest during November and December, lowest in June and July. There are exceptions to this over-all picture which show at the same

[7] Cf. in particular the work by A. Wald, "Berechnung und Ausschaltung von Saisonschwankungen," in *Beiträge zur Konjunkturforschung*, Vol. IX, Vienna, 1936, which is the profoundest study of the subject yet. See footnote 34, Chap. I.

[8] Cf. O. Morgenstern, *On the Accuracy of Economic Observations*, Princeton University Press, 1950, for a discussion of the relation of computation and accuracy of the data.

time a certain amount of instability, provided the indexes are accurate. These are of two kinds. First, there is the exceptional July value for France for 1882–1898, the exceptional June value for Germany for 1884–1895, and the exceptional April value for the United States call money rate for 1898–1911; they might be due to an imperfection of the method or of the data. Second, there is the greater parallelism between the British and French and between the German and American indexes. The latter are frequently below 100 in the first three months of the year while of the first pair there is only one small instance (March for France, 1882–1898). There may not be anything deeper behind these relationships; at least we have not been able to find any clear reasons for the groupings, and the two correspondences may be due to chance.

However another phenomenon is definitely not random and of greater significance: it is the difference between prewar and postwar indexes for all countries. The change can be seen in the total deviations as well as in the distribution of the monthly deviations. We know what caused the shifts and—for Germany and the United States—even the entire disappearance of seasonal deviations after 1928 and 1929 respectively for the commercial paper rate (1931 for the call money rate): it is the greater control over the money market exercised by central banks and treasuries. This is achieved either by direct contraseasonal intervention, or by the deliberate creation of an abundance of short-term credit at certain periods of the year, or both. From then on these institutions could do as they pleased regarding seasonal variations, and since the latter are generally considered undesirable the decision was obvious.

It will be noted that the decrease in seasonals and their final disappearance in some instances coincides with the period of a weakened application of the principles of the gold standard (with the gold exchange standard in some cases) and their final abandonment from 1931 onward. But from this it does not follow that a strict gold standard requires wide seasonal fluctuations of interest rates. Agreements between central banks can easily be reached to abolish them within the given framework.

There exists a connection between the seasonals of these series and those of the exchange rates which ultimately reflect seasonal activities in foreign trade. This is particularly the case if we have an industrial country on the one hand and an agricultural one on the other and if these two are trading directly with each other (e.g., as mentioned above, Great Britain–Argentina). The extent

CHART 4

Seasonal Indexes of Short-Term Interest Rates, Prewar and Postwar, 1871–1939

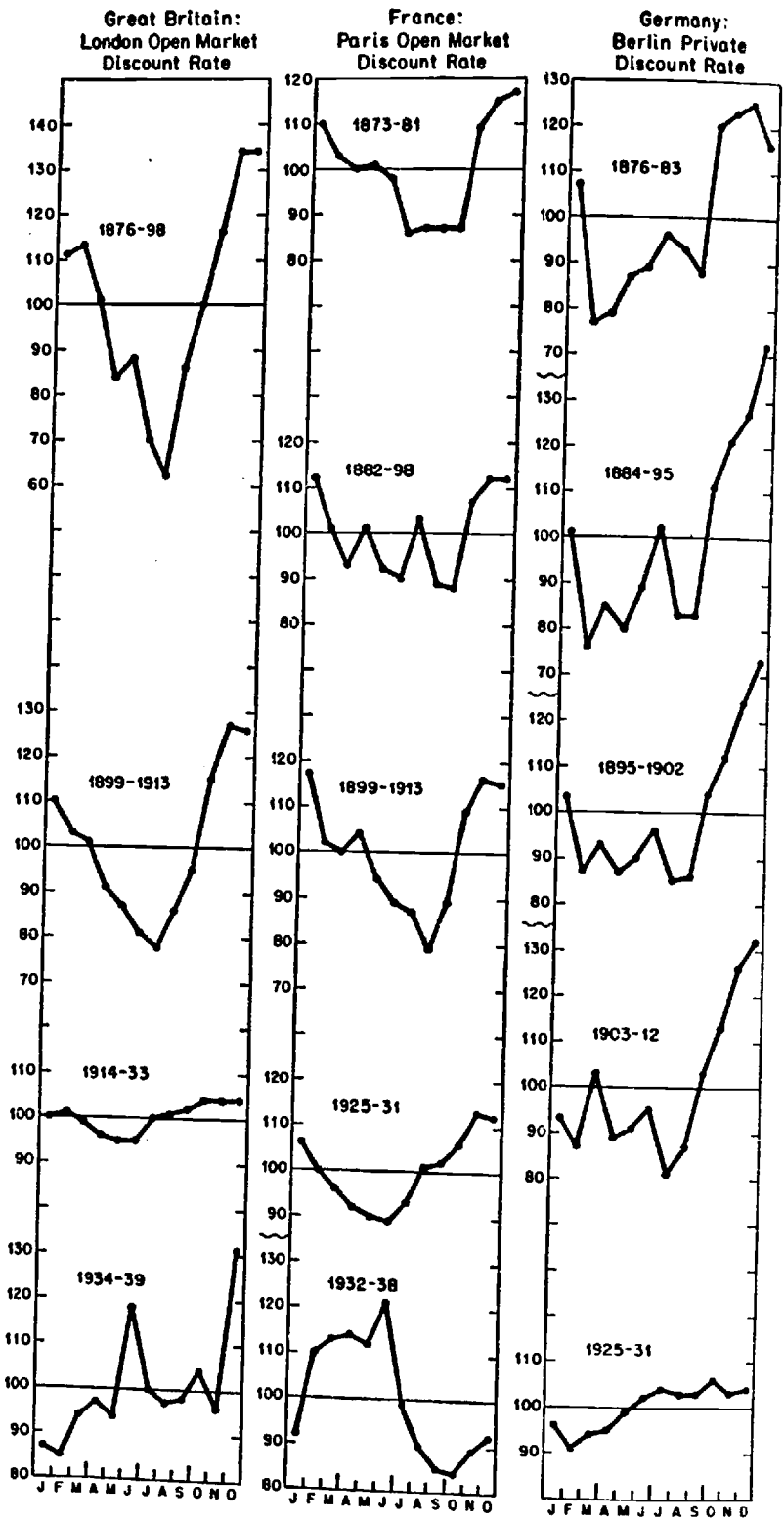
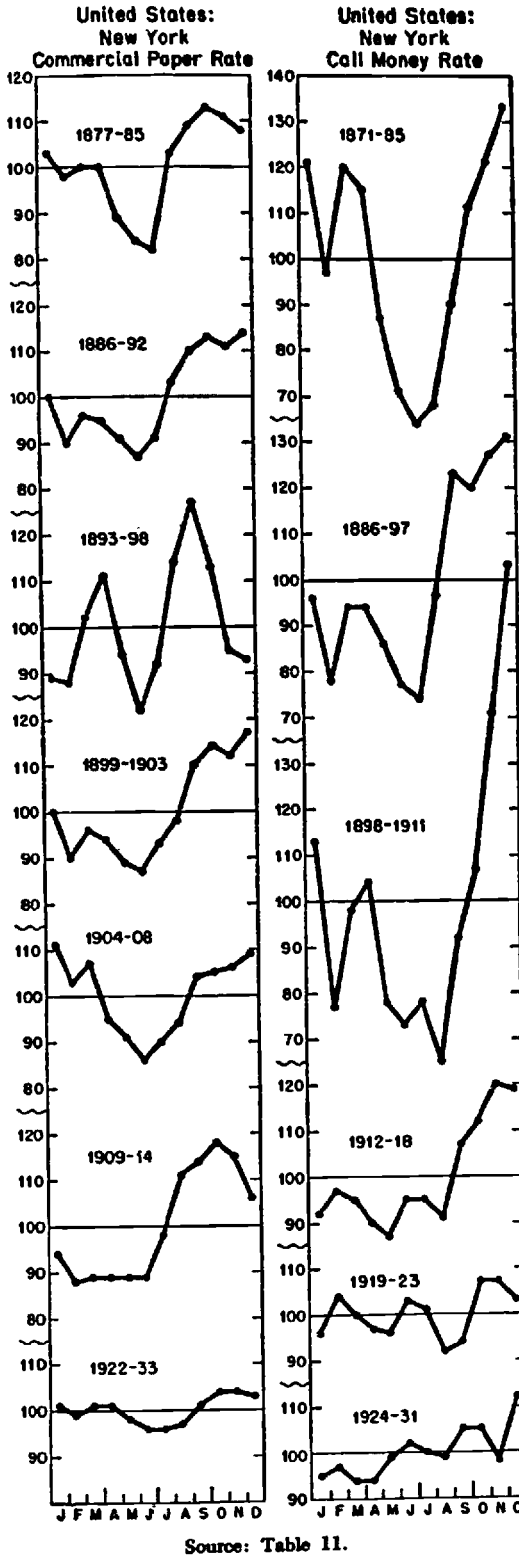


CHART 4, concluded



Source: Table 11.

TABLE 11

Seasonal Indexes of Short-Term Interest Rates

	GREAT BRITAIN		FRANCE			GERMANY			
MONTHS	*1876–1898*	*1899–1913*	*1873–1881*	*1882–1898*	*1899–1913*	*1876–1883*	*1884–1895*	*1895–1902*	*1903–1912*
Jan.	111	110	110	112	117	107	101	103	95
Feb.	113	103	103	101	102	77	76	87	87
Mar.	101	101	100	93	100	79	85	93	103
Apr.	84	91	101	101	104	87	80	87	89
May	88	87	98	92	94	89	89	90	91
June	70	81	86	90	89	96	102	96	95
July	62	78	87	103	87	93	83	85	81
Aug.	86	86	87	89	79	88	83	86	87
Sept.	100	95	87	88	89	120	111	104	103
Oct.	116	115	109	107	109	123	121	112	113
Nov.	134	127	115	112	116	125	127	124	126
Dec.	134	126	117	112	115	116	142	133	132
Total deviations	219	164	110	96	125	182	208	152	154

	1914–1933	*1934–1939*	*1925–1931*	*1932–1938*	*1925–1931*[a]
Jan.	100	87	106	92	96
Feb.	101	85	100	110	91
Mar.	99	94	96	113	94
Apr.	96	97	92	114	95
May	95	94	90	112	99
June	95	118	89	121	102
July	100	100	93	99	104
Aug.	101	97	101	90	103
Sept.	102	98	102	85	103
Oct.	104	104	106	84	106
Nov.	104	96	113	89	103
Dec.	104	131	112	92	104
Total deviations	31	95	60	137	50

[a] Uncorrected data used for 1932–1939.

TABLE 11 (concluded)

U.S. Commercial Paper Rate

MONTHS	*1877–1885*	*1886–1892*	*1893–1898*	*1899–1903*	*1904–1908*	*1909–1914*	*1922–1933*[b]
Jan.	103	100	89	100	111	94	101
Feb.	98	90	88	90	103	88	99
Mar.	100	96	102	96	107	89	101
Apr.	100	95	111	94	95	89	101
May	89	91	94	89	91	89	98
June	84	87	82	87	86	89	96
July	82	91	92	93	90	98	96
Aug.	103	103	114	98	94	111	97
Sept.	109	110	127	110	104	114	101
Oct.	113	113	113	114	105	118	104
Nov.	111	111	95	112	106	115	104
Dec.	108	114	93	117	109	106	103
Total deviations	94	101	134	106	89	128	29

U.S. Call Money Rate

	1871–1885	*1886–*[c] *1897*	*1898–*[d] *1911*	*1912–*[e] *1918*	*1919–*[f] *1923*	*1924–*[g, h] *1931*
Jan.	121	96	113	92	96	95
Feb.	97	78	77	97	104	97
Mar.	120	94	98	95	100	94
Apr.	115	94	104	90	97	94
May	87	86	78	87	96	99
June	71	77	73	95	103	102
July	64	74	78	95	101	100
Aug.	68	100	65	91	92	99
Sept.	90	123	92	107	94	105
Oct.	111	120	107	112	107	105
Nov.	121	127	141	120	107	98
Dec.	133	131	173	119	103	112
Total deviations	204	202	277	116	50	48

[b] Uncorrected data used for 1934–1943.
[c] Starting June 1885.
[d] Starting July 1897.
[e] Starting February 1912.
[f] Starting April 1919.
[g] Starting May 1924.
[h] Starting June 1931, the original data were used.

to which this is reflected depends on the quantities involved, i.e. on the degree to which their economies are interlocked.[9]

Section 4. Domestic Cyclical Behavior

After the elimination of their seasonal variations the *specific cycles* are determined for our four respective interest rates.[10] As can be seen from Chart 5 and Tables 12 and 13, there are marked cyclical fluctuations often with considerable amplitudes. They occur in all series, but the rhythm is different for the various countries. Before specific cycles are examined, the question must be raised whether there are fluctuations other than seasonal or cyclical.

First, there is the question of long-run *trends*. These are, as is well known, of great rarity in interest rates, but there is at least one instance here which will be more fully dealt with in Chapter IV, i.e., the United States commercial paper rate. The trend is a weak influence on monthly data, and if the specific cycles were determined from a series where the trend has been eliminated in the traditional manner,[11] it would probably have no influence upon the turning points of interest rate cycles, which are our only interest at present.

Second, random fluctuations are considered in the process of selecting specific cycle turning points. This is done in a qualitative way on the basis of knowledge about the institutional, historical background of the series. It must be admitted that sometimes, especially in a study of international relationships, random disturbances can be extremely important and more revealing than the ordinary cycles.

Third, there might conceivably be minor cycles, which are swallowed up by the specific cycles. According to the definition of a specific cycle[12] certain minor fluctuations are not taken into account. As a rule they are not very noticeable. So it is with these interest rates. Our purpose is to compare their cyclical behavior.

[9] The seasonal variations of our interest rates are many times as large as those of the six exchange rates between the four countries. Cf. Table 42 and the accompanying discussion.

[10] A discussion of the technique by which this is achieved is in Burns and Mitchell, *op. cit.*, pp. 56–71. The concept itself is simple; the technique involves a considerable amount of qualitative subjective judgment. This limits the value of all quantitative measurements based upon them.

[11] This is not the way in which specific cycles are obtained.

[12] Cf. Burns and Mitchell, *op. cit.*, pp. 57–58.

TABLE 12

Turning Point Dates of Specific Cycles of Short-Term Interest Rates, January 1876–July 1914; January 1925–December 1938, Seasonally Corrected Data

LONDON OPEN MARKET DISCOUNT RATE		PARIS OPEN MARKET DISCOUNT RATE		BERLIN PRIVATE DISCOUNT RATE		NEW YORK COMMERCIAL PAPER RATE		NEW YORK CALL MONEY RATE	
Peak	*Trough*	*Peak*	*Trough*	*Peak*	*Trough*	*Peak*	*Trough*	*Peak*	*Trough*
Aug. 1878	Oct. 1876	Jan. 1879	Feb. 1878	May 1877	Sept. 1876	Oct. 1877	Aug. 1876	Jan. 1876	Sept. 1876
July 1883	Sept. 1879	Jan. 1882	Sept. 1879	Feb. 1882	May 1879	May 1880	Aug. 1878	Jan. 1878	Sept. 1878
July 1890	Oct. 1885	Oct. 1888	June 1886	Apr. 1885	Feb. 1884	June 1883	June 1881	Aug. 1879	Oct. 1880
Aug. 1893	Sept. 1892	Mar. 1891	Apr. 1889	Feb. 1887	Sept. 1886	July 1887	Sept. 1885	Feb. 1881	May 1882
Dec. 1899	Oct. 1894	Aug. 1893	June 1892	Feb. 1890	Jan. 1888	Dec. 1890	May 1889	Sept. 1882	Jan. 1885
May 1903	Oct. 1901	Jan. 1900	Aug. 1895	Aug. 1893	May 1892	July 1893	June 1892	June 1887	Aug. 1888
Nov. 1907	Oct. 1904	July 1903	Sept. 1901	Aug. 1896	Dec. 1894	Oct. 1896	Oct. 1894	Aug. 1890	May 1892
Apr. 1910	Sept. 1908	Aug. 1907	Aug. 1904	Mar. 1900	May 1897	Apr. 1898	Apr. 1897	June 1893	Oct. 1894
July 1913	Mar. 1911	Aug. 1913	May 1909	Aug. 1903	July 1902	Mar. 1900	Jan. 1899	Oct. 1896	July 1897
				July 1907	Apr. 1905	Aug. 1903	Mar. 1901	Oct. 1899	Sept. 1900
				Aug. 1910	Nov. 1908	Dec. 1907	Jan. 1905	Sept. 1902	July 1904
				Feb. 1913	July 1911	June 1910	July 1909	Oct. 1907	Nov. 1908
					Apr. 1914	June 1913	Nov. 1911	May 1910	Nov. 1911
								Dec. 1912	
May 1925	July 1928	Aug. 1926	Nov. 1925	May 1929	July 1926	Oct. 1926	Nov. 1927	Feb. 1926	Sept. 1927
Oct. 1929	Oct. 1930	June 1929	Oct. 1927	Aug. 1931	Aug. 1930	Aug. 1929	Sept. 1931	Mar. 1929	May 1931
Dec. 1931	Aug. 1933	Jan. 1933	July 1932					Dec. 1931[a]	
Jan. 1934	June 1938	Dec. 1935	Nov. 1934						
		July 1937	Dec. 1936						

[a] After May 1931 original data used.

CHART 5

Timing of Specific Cycles of Short-Term Interest Rates,
Prewar and Postwar, 1876–1914, 1925–1938

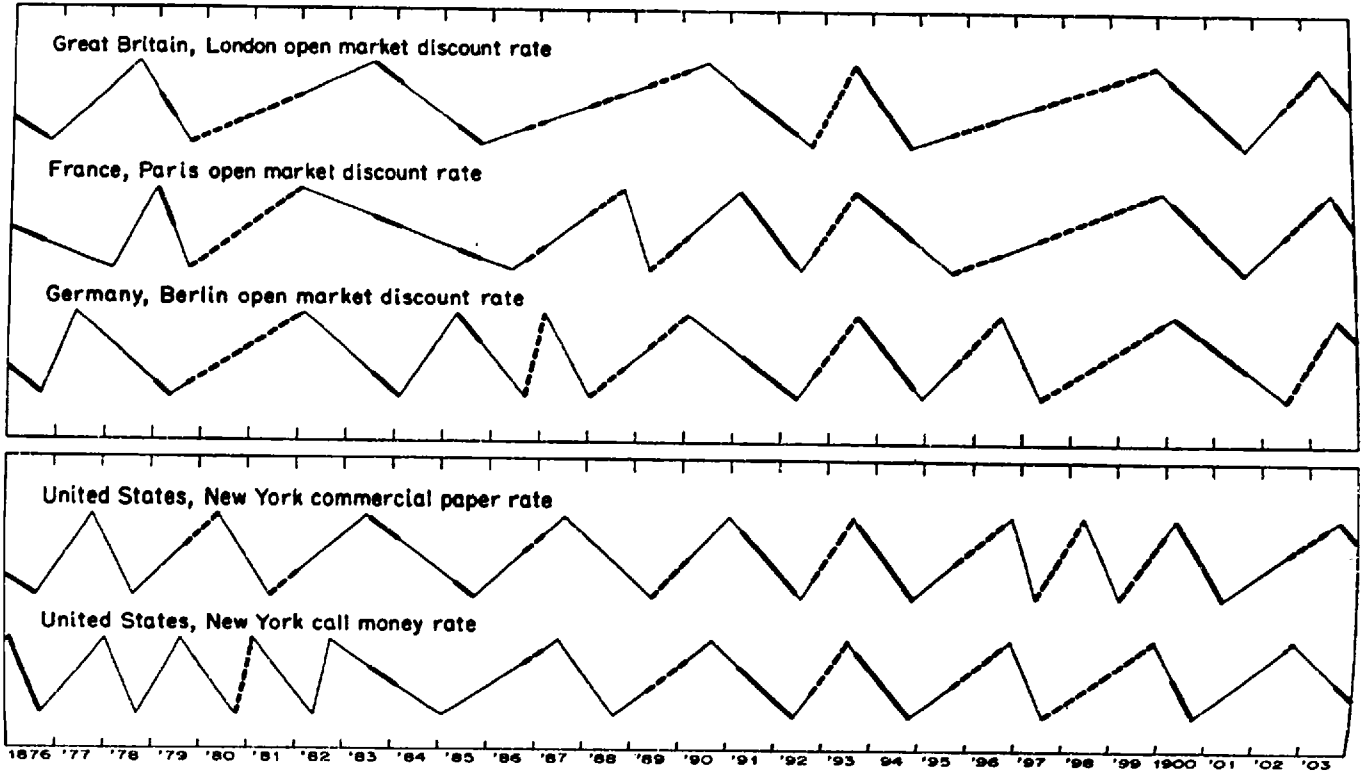
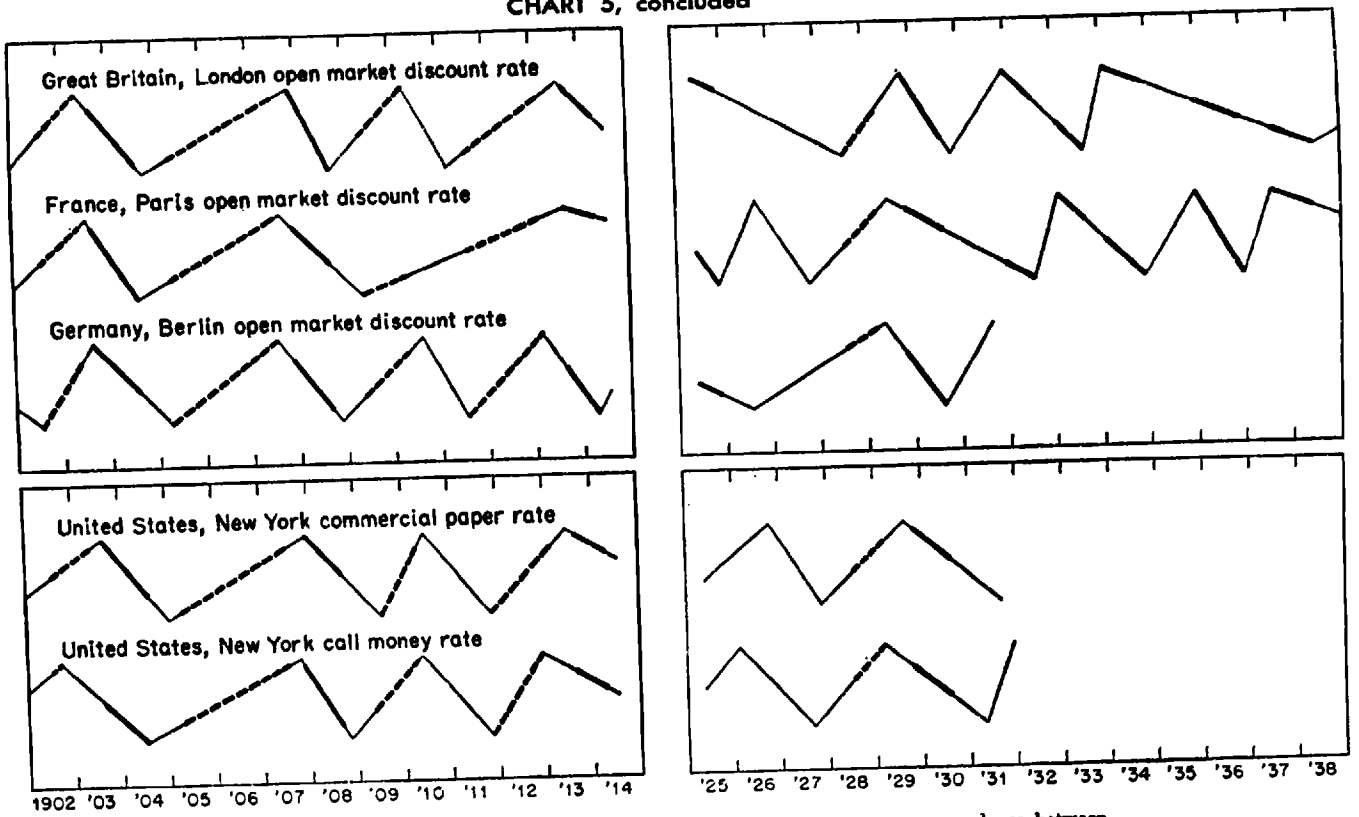


CHART 5, concluded



For the three European countries, the heavy solid line represents correspondence between three countries in contraction; the dash line, correspondence in expansion; and the fine solid line, no correspondence.

For the United States, the three types of lines indicate correspondence or no correspondence between the U.S. and all three European countries.

Source: Table 12.

TABLE 13

Number and Duration of Specific Cycles of Short-Term Interest Rates of Four Countries, Seasonally Corrected Data

	NUMBER OF:			AVERAGE DURATION OF[a] (*months*)			AVERAGE PER CENT DURATION OF SPECIFIC CYCLES	
	Expansions	*Contractions*	*Full cycles*[c]	*Expansions*	*Contractions*	*Full cycles*	*Expansions*	*Contractions*
Prewar, February 1878–August 1913, 426 months								
Great Britain	8	8	7	34.9	17.5	52.6	66.6	33.4
France	9	8	8	29.6	20.0	47.5	59.7	40.3
Germany	11	10	10	20.5	17.9	38.6	53.4	46.6
U.S. commercial paper rate	12	11	11	20.2	15.9	36.6	56.0	44.0
U.S. call money rate	12	11	11	19.1	16.5	36.2	53.7	46.3
Postwar, January 1925–December 1938, 167 months								
Great Britain	3	4	3	11.3	30.7	39.7	26.9	73.1
France	4	3	3	13.2	18.5	33.2	41.6	58.4
Germany	2	2	2	23.0	51.5	74.5	30.9	69.1
U.S. commercial paper rate	3	3	2	12.0	33.3	55.0	26.5	73.5

[a] Durations of only complete cycles, expansions, and contractions are included in their respective columns.

[b] The percentages are calculated from a base equal to the average duration of expansions plus that of contractions. This sum is equal to the average duration of cycles only when the number of full cycles is the same as the number of expansions and contractions.

[c] Only complete cycles are counted; parts of cycles at both ends of a series are dropped. Cycles are measured from trough to trough. Similarly only complete expansions and contractions are counted in their respective columns.

This means obviously those cycles which are related by duration to the ordinary business cycle. That is precisely what the specific cycles purport to be. Therefore there is no need to look for smaller cycles here. With this remark we do not rule them out altogether. On the contrary we shall introduce the notion of short cycles in another connection where it will prove helpful in elucidating certain possible causal relationships (cf. Chapter VI).

We begin the discussion of the specific cycles with a consideration of their *number* and *duration*, making separate statements about the prewar and post-World War I periods (Table 13). Since we have two American series we refer in the following to American

TABLE 14

Phase Comparison of Specific Cycles of Short-Term Interest Rates and Their Respective Reference Cycles

Four Countries

	SAME PHASE IN:			DIFFERENT PHASE	SAME PHASE IN:			DIFFERENT PHASE
	Expansions	*Contractions*	*Total*		*Expansions*	*Contractions*	*Total*	
	(*months*)				(*percentages*)			
Prewar, February 1878–August 1913, 426 months								
Great Britain	234	117	351	75	54.9	27.5	82.4	17.6
France	207	142	349	77	48.6	33.3	81.9	18.1
Germany	192	157	349	77	45.1	36,9	81.9	18.1
United States	155	106	261	165	36.4	24.9	61.3	38.7
U.S. call money	177	142	319	107	41.5	33.3	74.9	25.1
Postwar, January 1925–December 1932, 96 months								
Great Britain	10	50	60	36	10.4	52.1	62.5	37.5
France	35	41	76	20	36.5	42.7	79.2	20.8
Germany	33	39	72	24	34.4	40.6	75.0	25.0
United States	39	51	90	6	40.6	53.1	93.8	6.3
U.S. call money	28	47	75	21	29.2	49.0	78.1	21.9

call money rates in parentheses while the unbracketed figures refer to the commercial paper rate.

Beginning with the prewar period, we find notable differences for the four countries. There are 7, 8, 10, 11, (11) cycles respectively for Great Britain, France, Germany, United States. Their average duration necessarily varies, and in this case in inverse order to the number,[13] from the maximum of 52.6 months to 36.3 (36.2) months. There are more cycles than reference cycles (cf. Table 6), Great Britain and the United States each having one more full specific cycle, France two, and Germany four more than reference cycles. This does not mean necessarily that the correspondence between the specific cycles of the short-term rates with their own reference cycles would be found highest in the United States, and lowest in Germany (cf. Table 14).

The difference among countries in the average length of full specific cycles is considerable. It is therefore noteworthy that the differences among the duration of the contractions is not nearly

[13] This need not be so, of course, since the periods covered by complete cycles in each series are not precisely the same.

so great. It varies only between 15.9 months (United States) and 20.0 months (France), while the values for Great Britain and Germany are practically identical: 17.5 and 17.9 months. As a consequence the dispersion of the average duration of expansions is much greater. No relationship of this sort could be observed for the reference cycles of the various countries.

The average per cent duration of the two phases (adding up to 100), computed from the above figures, shows for Great Britain almost twice as long upswings as contractions of the short-term rates; this is a more marked version of the same relationship found in the British reference cycles. In all countries, however, the expansions were longer than the contractions. In the absence of trends this has to be interpreted as indicating that gradual rises of rates were briefly but sharply interrupted by steep falls of rates. The long rise and sharp fall (best seen from Chart 5) seems to be a characteristic of freely moving short-term rates.

The post-war situation is widely different. The period covered is much shorter, and the three full cycles for Great Britain and France and the two for Germany and the United States are too few from which to obtain significant averages. But in spite of the necessary caution we can point out that now the average per cent duration of contractions is larger than that of expansions. The figures for Great Britain and the United States (commercial paper rate only) are almost identical; both show the greatest proportion of contraction over expansion. It is clear what this general shift means: on the one hand there was a drop from the exorbitant high rates in a country like Germany as an after-effect of a lost war and inflation; on the other hand there was the deliberate policy of reducing interest rates, coupled with a genuine increase in liquid funds in the United States, especially in the 1930's, and a lack of demand for commercial paper. In some instances the policy of depressing interest rates was even internationally coordinated by understandings reached among central banks. While the postwar reference cycles had also shown significant changes in duration of the whole cycle or parts of it, they were not nearly as pronounced, and there the meaning is quite different.

France occupies a somewhat singular position in the general picture. Although there too the reversal of the relation between the average duration of the two phases took place, it was narrowly limited (41.6 per cent for expansion and 58.4 per cent for contraction). Even before the war there was comparatively little difference between the shares of the two phases (59.7 and 40.3

per cent). The French rate, as we know from the frequency distributions (cf. Table 9), had not only the lowest averages but also the second smallest coefficient of variation of all of them (in the prewar period) and this would tend to be reflected in our present statistics. We do not want to attribute too much significance to these figures, but it will be seen later again and again that French financial affairs in many ways showed greater autonomy of movement than those of other countries.

It is important now to study the behavior of the short-term interest rates relative to the reference cycles of the same country. We want to find out whether the conformity of movement, i.e., of turning points, is the same in all four countries or whether any significant differences emerge.

Table 14 contains the result of the comparison. The figures express, either in months or percentages, how the reference cycle and the short-term rate were or were not simultaneously in the phase of expansion or contraction.[14]

For the prewar data it is found that the three European countries show the greatest total covariation between the respective national reference cycle and short-term rate. The values, 82.4 per cent, 81.9 per cent, and 81.9 per cent for Great Britain, France, and Germany are almost identical. For the United States we get less correspondence: 61.3 per cent (74.9 per cent). That the call money rate has greater covariation is noteworthy especially since in the postwar period just the opposite was the case. The great role played by the call money rate in the United States before 1914 is well known and this is partly reflected in better correspondence of movement.

The *post-World-War I data* need be dealt with only briefly. This is partly justified by the much smaller sample,[15] although the results vary far more than could be attributed to this difference in samples. Very large changes took place, an indication of the enormous influence the war exercised. It seems safe to assume that it is not only a *post hoc* but a *propter hoc*.

The American commercial paper rate, which before the war

[14] In the following sections the correspondence of the movement of pairs of short-term rates will be investigated. It is clear that if two rates correspond well to each other and each shows a high degree of covariation with its respective reference cycle, then we have also high covariation between the first interest rate with the reference cycle of the second and vice versa, i.e., there is transitivity in these relationships.

[15] The significance test of section 2 in Chapter II applies the necessary changes to the present situation.

showed the least correspondence, afterward was in the same phase with American reference cycles in not less than 93.8 per cent of all months. For the call money rate the improvement in correspondence is minor.

Most interesting is the change for Britain after the war. There we find the lowest instead of the highest correspondence: 62.5 per cent, just slightly higher than the lowest prewar figure (61.3 per cent, United States commercial paper rate). But the interesting fact is that only 10.4 per cent (out of a total of 62.5 per cent) of all the months for which the British short-term rates and British reference cycles were in the same phase, were they both expanding (before 1914: 54.9 per cent out of a total of 82.4 per cent). This is in agreement with all other series: while before 1914 expansion dominated without exception, contraction now dominated. The most even distribution of the correspondence between the two phases is for Germany.

To some extent leads and lags affected the degree of agreement. The New York commercial paper rate tends to lag behind the United States reference cycle. The New York call money rate showed some tendency to lag at the peaks before 1914, whereas after World War I it tended to lead at the peak. In the pre-World-War I period the London short-term rate tended to lead the reference cycle at the trough, while the Paris rate lagged at the peak.

It would be interesting to discover whether the complete reversal between agreement in expansions and contractions was due to central bank policy aiming at reducing interest rates during business depressions (at least doing so faster or earlier than before) and keeping them stable during business expansions. This would tend to loosen the connection between reference cycles and these specific cycles.

As pointed out elsewhere, short-term interest rates have played a large role in most business cycle theories and are still considered of importance, though decreasingly so. For the period of the classical gold standard they were often held to be of primary significance, notably in the earlier writings of R. G. Hawtrey. Now it is clear that during the prewar period in similar countries, similar interest rates behaved differently at different times and in respect to the national business cycles.[16] Increasing the number of cycles

[16] If we had taken the amplitudes into account, the diversity would have shown up still more. The coefficients of variation make this clear. Cyclical amplitudes would show the same.

generally available for establishment of a theory to 36 (before 1914 but 46 up to 1938) does not make easier theoretical interpretations.

On p. 52 it was pointed out that a strong probability of international transmission of the fluctuations as shown by reference cycles might be inferred from the maintenance of a high degree of parallelism when there was an alternation between short and long cycles. This worked only for the European countries.

The same question arises now about specific cycles. Chart 5 and Table 12, showing the specific cycles of short-term interest rates, indicate the same conclusion, with certain limitations. To begin with, the good correspondence does not really set in before 1892. Then the first trough of a short specific cycle begins, the cycle lasting to the next trough in 1894–1895. In this case even the American cycle is in step. The next cycle is long, lasting to 1901–1902; the three European countries are again in high correspondence. Then a short specific cycle is followed by one more long specific cycle. When the American cycle is in agreement with the others, it is quite clearly a phenomenon of mere coincidence, because in general it seems to follow its own, quasi-independent rhythm.

The measures of concentration and dispersion of turning points below (pp. 110 ff.) make these statements sufficiently accurate, without however showing fully the change in pattern here mentioned. The case is not nearly so clear as for the reference cycles; this is an interesting observation, in consonance with the fact that the international covariation of short-term rates is not so marked as that of the reference cycles. Apparently these rates are very delicate and therefore sensitive to many different influences which come both from several other countries and from purely local conditions. Thus they do not give much indication of any direct influence of one national rate on another. There may however be a very powerful interaction working through a separate medium and involving other economic quantities. If this be the case it may even be unwise to look for repetition of the pattern of the reference cycles, because dissimilarity rather than similarity, or at least systematic displacement in time, might have to be expected among these rates.

This concludes the comparison of the cyclical behavior of short-term interest rates with the reference cycles of their respective countries. A certain degree of covariation was to be expected,

because interest rates in general should be given some weight in obtaining the average which constitutes the reference dates. But the covariation is high, though it differs among the countries and was subject to sharp modification after the war. The differences were probably much larger than could be attributed to differences in the institutional setup. There remains the possibility that these interest rates in the various nations were not independent of each other. There may have been influence of one on the other and vice versa. Such international transmission is not obvious, i.e., it cannot simply be read off from our charts. On the other hand we know in a general way about the interlocking of money and capital markets.

The reader will recall what was said in Chapter I, section 6 about the possibility that some parts of the national economy are more closely related to the same or other parts of other economies than to different spheres of the national economy. This possibility will be explored now; it will crop up repeatedly in later chapters.

Section 5. International Covariation

We now take up the direct phase comparison of the cycles of our short-term interest rates, first for groups of countries and then for the six pairs, in the same manner in which reference cycles were compared in Chapter II. Our discussion should be read in the light of the results obtained there and with the significance test of section 2 in mind. Just as was then the case, high or low covariation does not in itself mean anything for the wider question of transmission. There could simply be parallelism without interaction of any kind. Clearly even if purely random factors could produce a high parallelism of the reference cycles of two countries, we would be bound to get some parallelism of the constituent series, if these move at all in correspondence with their reference cycles. That they do so move was just demonstrated. So our subsequent analysis neglects at first the problem of transmission. But it will then have to be decided whether we have independent but similar movements or not.

The measurements are contained in Tables 15 to 19. There is less cyclical parallelism in the movement of our interest rates than in that of reference cycles, i.e., Tables 3, 4 and 5. But the covariation still remains high and, subject to the above qualification, can hardly be considered random. Some new and rather peculiar

features emerge which, while difficult to interpret, are unmistakable. They possibly point toward elements of a structural relationship which only a very extensive statistical study could fully reveal. This feature lies, as we shall see, in the great uniformity of the percentage of the number of months in which some of the countries are simultaneously in the same phase, notably in contraction. Our measurements so far are insufficient to elucidate fully such a possible structural relationship, since they have not taken care of amplitudes nor sufficiently of the difficult problems of the absolute levels of interest rates in different countries.[17]

The total phase correspondence—as shown in Table 15, which is based on Table 12—is definitely high. The four countries taken together are in the same phase in 48.6 per cent of all prewar months. If the call money rate is used, the figure drops to 42.7 per cent. Omitting the United States altogether, the percentage

[17] As stated before, we shall return to these matters, especially in Chapter IX.

TABLE 15

Phase Comparison of Specific Cycles of Short-Term Interest Rates

	PREWAR PERIOD[a]		POSTWAR PERIOD[b]	
	Number of months	*Per cent of total*	*Number of months*	*Per cent of total*
Three European countries				
1. All three expand	173	40.6	10	6.6
2. All three contract	85	20.0	50	33.1
3. All three in same phase (1 + 2)	258	60.6	60	39.7
4. In different phase	168	39.4	91	60.3
Total	426	100.0	151	100.0
Four countries				
5. Three European countries expand, United States expands	134	31.5	10	6.6
6. Three European countries expand, United States contracts	39	9.1	0	0.0
7. Three European countries contract, United States expands	12	2.9	8	5.3
8. Three European countries contract, United States contracts	73	17.1	42	27.8
9. Three European countries in same phase, United States in opposite phase (6 + 7)	51	12.0	8	5.3
10. Four countries in same phase (5 + 8)	207	48.6	52	34.4
11. Four countries in different phase (4 + 6 + 7)	219	51.4	99	65.6
Total	426	100.0	151	100.0

[a] February 1878–August 1913, 426 months.
[b] November 1925–June 1938, 151 months.

TABLE 15, continued

Phase Comparison of Specific Cycles of Prewar Short-Term Interest R for Groups of Countries, February 1878–August 1913. 426 month

	SAME PHASE IN:			DIFFERENT PHASE	SAME PHASE IN:			DIF P
	Expansions	*Contractions*	*Total*		*Expansions*	*Contractions*	*Total*	
	(months)				*(percentages)*			
Great Britain–France	232	107	339	87	54.5	25.1	79.6	
Great Britain–Germany	194	109	303	123	45.5	25.6	71.1	
France–Germany	183	117	300	126	43.0	27.5	70.4	
U.S.–Great Britain	205	103	308	118	48.1	24.2	72.3	
U.S.–France	186	103	289	137	43.7	24.2	67.8	
U.S.–Germany	158	115	273	153	37.1	27.0	64.1	
	United States call money rate							
Four countries	120	62	182	244	28.2	14.6	42.7	
U.S.–Great Britain	187	97	284	142	43.9	22.8	66.7	
U.S.–France	164	95	259	167	38.5	22.3	60.8	
U.S.–Germany	153	123	276	150	35.9	28.9	64.8	
U.S. call money–U.S. commercial paper	178	131	309	117	41.8	30.8	72.5	

rises to 60.6. Of this, 20.0 per cent is accounted for by contraction. This agreement was somewhat lower than that for the reference cycles (cf. Table 3).[18]

In the postwar period radically different results obtain. Taking first the period November 1925–December 1931, all four countries are in the same phase 27.4 per cent of the months and the three European countries show the same correspondence, 27.4 per cent. This percentage is the sum of equal components, of expansion and contraction 13.7 per cent, in both instances. Use of the call money rate weakens the correspondence still further to 24.7 per cent. If the postwar period to June 1938 is used, the correspondence rises for all four to 34.4 per cent and for the three European countries to 39.7 per cent.

The percentages compared by pairs of countries in the prewar period vary from the maximum of 79.6 per cent for Great Britain-France to the minimum of 64.1 per cent for the United States-

[18] There was no observable pattern in the leads and lags among the four interest rates, which also accounts for the relatively high agreement.

Germany.[19] In view of the generally known interaction of the British and French money markets this high percentage might be expected. We would hardly assume a similarly close connection between the American and German money markets. In the first case there may have been much interaction, with sufficiently rapid transmission of effects between the two centers to cause parallel movements. In the second case we have no particularly good intuitive reasons to assume a similarly high degree of interaction. There would therefore simply be the expectation of a parallelism based on the belief that parallel movements occur in similar countries. Such a view would seem natural because of the already noted similarity of the reference cycles of these two countries.

For the longer postwar period, up to June 1938 (151 months), the size of the sample is twice that of the shorter period through December 1931, though even the larger sample is not much more than one-third of the prewar. The changes from prewar to postwar are so considerable that they can be attributed to influences other than the size of the sample; they are furthermore consonant with the preceding discussion.

The total covariation was considerably less—taking the smaller sample first—than in the prewar period, except for the United States–France, where it is 87.7 per cent (Table 16), or 19.9 points higher than prewar and thus not only the highest postwar covariation (even if the longer period up to 1938 is also considered) but the highest in all periods. We have pointed out a similar phenomenon for the reference cycles of this pair of countries (cf. Table 4) and have noted that there was little known about post-World-War I economic relations, which would account for a highly parallel movement between them. This holds for the general business cycles. But short-term interest rates are presumably highly susceptible to international influences, so that the repetition of the correspondence here is noteworthy. The correspondence between Great Britain and France on the other hand, which with 79.6 per cent was the highest before 1914, fell after the war to the second lowest and insignificant position of 50.7 per cent, only somewhat better than the United States–German covariation of 45.2 per cent, which is below the 50 per cent probability level. It is not difficult to attribute to this change a real meaning in the light of the reasons for the high prewar correspondence and its profound disturbance

[19] Contrast this, however, with the quite divergent ranking of the correlation coefficients of Table 21.

TABLE 16

Phase Comparison of Specific Cycles of Short-Term Interest Rates, Postwar for Groups of Countries, November 1925–December 1931, 73 months

	SAME PHASE IN:			DIFFERENT PHASE	SAME PHASE IN:			DIFFERENT PHASE
	Expansions	*Contractions*	*Total*		*Expansions*	*Contractions*	*Total*	
	(*months*)				(*percentages*)			
Four countries	10	10	20	53	13.7	13.7	27.4	72.6
Three European countries	10	10	20	53	13.7	13.7	27.4	72.6
Great Britain–France	11	26	37	36	15.1	35.6	50.7	49.3
Great Britain–Germany	20	18	38	35	27.4	24.7	52.1	47.9
France–Germany	20	18	38	35	27.4	24.7	52.1	47.9
U.S.–Great Britain	16	26	42	31	21.9	35.6	57.5	42.5
U.S.–France	27	37	64	9	37.0	50.7	87.7	12.3
U.S.–Germany	20	13	33	40	27.4	17.8	45.2	54.8
	United States call money rate							
Four countries	8	10	18	55	11.0	13.7	24.7	75.3
U.S.–Great Britain	15	31	46	27	20.5	42.5	63.0	37.0
U.S.–France	20	36	56	17	27.4	49.3	76.7	23.2
U.S.–Germany	21	20	41	32	28.8	27.4	56.2	43.8
U.S. call money–U.S. commercial paper rate	21	32	53	20	28.8	43.8	72.6	27.4

after the war. The cooperation of these two money markets apparently suffered more than might have been inferred from the drop in covariation in general, as shown by the reference cycles.

For the longer postwar period there was an improvement over the shorter in the covariation in four cases, a deterioration for United States–Great Britain and practically no change for France–Germany. Great Britain–Germany is in the lead with 73.5 per cent. There was a very close financial contact between London and Berlin, namely the huge British short-term investments in the Reich and then the great efforts to extricate them again immediately before and after German exchange control was introduced. Clearly high covariation under such conditions has a different significance than in other cases. Up to December 1931 (six months beyond German introduction of exchange control!) the correspondence was only 52.1 per cent or virtually nil and before the war 71.1 per cent.

TABLE 17

Phase Comparison of Specific Cycles of Short-Term Interest Rates, Postwar for Groups of Countries, November 1925–June 1938, 151 months

	SAME PHASE IN:			DIFFERENT PHASE	SAME PHASE IN:			DIFFERENT PHASE
	Expansions	*Contractions*	*Total*		*Expansions*	*Contractions*	*Total*	
	(*months*)				(*percentages*)			
Great Britain–France	15	66	81	70	9.9	43.7	53.6	46.4
Great Britain–Germany	20	91	111	40	13.2	60.3	73.5	26.5
France–Germany	20	59	79	72	13.2	39.1	52.3	47.7
U.S.–Great Britain	16	86	102	49	10.6	57.0	67.5	32.5
U.S.–France	32	69	101	50	21.2	45.7	66.9	33.1
U.S.–Germany	20	78	98	53	13.2	51.7	64.9	35.1
U.S.–Great Britain–May 1920–June 1938 (217 mos.)	23	108	131	86	10.6	49.8	60.4	39.6

Extending the postwar period of observation to 151 months thus leads in general to more parallelism, though not as much as for the prewar period. However, the improvement over the results for the 73 months must not be attributed to the size of the sample, because of the obvious break in the institutional background against which our statistics must be seen. We do not know whether there were similar but hidden events during the prewar periods, which we consider homogeneous. At present we shall continue to assume homogeneity, which we infer principally from the fact that the principles of the gold standard were applied and were violated only to minor degree (chiefly by the central banks through application of the "small means" of gold policy, see Chapter VIII).

In one respect the extension of the postwar period is genuinely revealing. That is the change in distribution of the total percentages between expansion and contraction. Contraction is without exception overwhelmingly predominant, even more so than was the expansion in the prewar period. It is questionable that this is due merely to the fact that the depressions averaged longer after World War II.

There remains a remark on the substitution of the American commercial paper rate for the New York call money rate. We note first the covariation between these series themselves. It is not very high (for these interest rates) though practically identical in prewar

and postwar: 72.5 and 72.6 per cent. The great interdependence of interest rates in the *same* money market (especially when both are short-term) would have led one to expect much higher percentages. In the light of this the values for the rates of markets of different nations assume greater importance.[20] If the call money rate is included in the four-country comparison, values decrease. The same was true before the war for the covariation of France and Great Britain; also in the postwar period. The relationship (and its change) between the two phases is maintained. We add the measures for the call money rate because of a need for it later (cf. Chapter V) when, in the study of the interaction of money markets, we come across the argument that this rate rather than the commercial paper rate provided the link with foreign markets.[21]

From seasonally uncorrected data we have computed the *correlation coefficients* for the short-term interest rates of our six pairs of countries (Table 18).[22] Uncorrected data may be expected to give higher correlation coefficients than corrected data (if very successfully corrected), if the seasonal movements affect the two time series similarly. This need not be the case, e.g., when the seasonal movements of one series are the exact opposite of those of the other. Table 11, which shows the seasonal indexes for our series (which we know must be cautiously used) should be consulted in conjunction with Table 18. The long period covered and the fairly frequent changes of the indexes probably reduce the significance of the seasonal movement.

Another point of much wider interest deserves mention here. Seasonally corrected series sometimes show peaks and troughs in places differing by one to several months from those of noncorrected series. This may occur for two series inversely if their

[20] Besides, the rates of different countries are not strictly identical, in regard to the type of transaction to which they relate, but only similar; this would reduce parallelism.

[21] Part of the different results for the call money rates arises from its lead over the commercial paper rate, particularly at the peak.

[22] The time covered is slightly different from that used earlier. But this is immaterial. The number of months, 403, is a little larger than the other, which is 426. These are, indeed, very large numbers for correlation coefficients and such differences disappear fully. At any rate we have determined the confidence limits in all these cases. For methods used, cf. H. Cramér, *Mathematical Methods of Statistics*, 1946, esp. pp. 402–407 for an explanation of confidence limits for correlation coefficients, and R. A. Fisher, *Statistical Methods for Research Workers*, 10th Ed., 1948, Chapter VI, Table IV for t-distribution and Table V-B for transformations between f and r.

TABLE 18

Correlation between Short-Term Interest Rates, Seasonally Uncorrected Data

	RATE	CONFIDENCE LIMITS* Lower	Upper
Prewar Period, January 1876–July 1914, 463 months			
London open market rate–Berlin private discount rate	+0.73	0.67	0.78
London open market rate–Paris market discount rate	+0.67	0.60	0.73
Berlin private discount rate–Paris market discount rate	+0.62	0.54	0.69
N.Y. commercial paper rate–London open market rate	+0.45	0.35	0.54
N.Y. commercial paper rate–Berlin private discount rate	+0.40	0.29	0.49
N.Y. commercial paper rate–Paris market discount rate	+0.36	0.25	0.46
Postwar, January 1925–December 1938, 168 months			
London open market rate–Berlin private discount rate	+0.84	0.77	0.89
London open market rate–Paris market discount rate	+0.34	0.15	0.50
Berlin private discount rate–Paris market discount rate	+0.13	−0.07	+0.32
N.Y. commercial paper rate–London open market rate	+0.93	0.90	0.95
N.Y. commercial paper rate–Berlin private market rate	+0.77	0.68	0.84
N.Y. commercial paper rate–Paris market discount rate	+0.34	0.15	0.50
N.Y. call money rate–London open market rate	+0.84	0.77	0.89

* For confidence coefficient of 99 per cent.

peaks or troughs are very near but do not coincide. In that case there would be a considerable shift and less phase correspondence than if the uncorrected data had been taken. If a comparison is made between the covariation of phases on the basis of seasonally corrected data, and correlation coefficients are computed from uncorrected data, the correlation coefficient may give a different result because of the absence of such shifts (aside from other influences operating toward variation of results). The seasonal correction of our short-term rates has, to be sure, frequently led to temporal shifts in peaks and troughs, but mostly in those minor fluctuations which occur *between* the turning points of specific cycles. Thus there would be no influence on covariations of cyclical phases. The issue becomes of importance only when highly sensitive actions and reactions are studied.

The correlation coefficients provide an ordering of the various pairs of money markets. In view of the length of the series each one must be considered significant, and a significance test for their mutual comparison would not upset the ordering of Table 18. On

top of the scale for the prewar period we find Great Britain–Germany with +0.73, followed by Great Britain–France with +0.67. This sequence is the inverse of that found by our phase covariations (Table 15). This is repeated for the next two countries. Here we have Germany–France, +0.62, followed by United States–(commercial paper rate only)–Great Britain, +0.45, which is a wide gap. The total phase correspondence shows much less variation. The smallest degree of relationship is indicated for United States–France, +0.36.

For much of the time after World War I there are no seasonal movements in our series, so the considerations above concerning their common influence do not apply. The order of the coefficients now change, placing New York–London (for the commercial paper rate) definitely first with 0.93. The main result is that the London–Paris relation has fallen very low, the other coefficients showing lack of correspondence.

Table 19 gives a *sign correlation* of the same series. The technique used in the following correlations amounts essentially to a

TABLE 19

Sign Correlation: Short-Term Interest Rates of Four Countries Correlated, Prewar and Postwar

Period	*Pairs of countries*	*N*	*Z*	*p*	*C*	*Rank according to C*
Dec. 1871–July 1914	Great Britain–France	511	283.5	$0.02 < 0.03$	0.110	3
Jan. 1876–July 1914	Great Britain–Germany	462	271.0	$0.00 < 0.0001$	0.173	1
Jan. 1876–July 1914	France–Germany	462	257.5	$0.02 < 0.03$	0.115	2
Dec. 1869–July 1914	United States–Great Britain	535	296.0	$0.02 < 0.03$	0.107	4
Dec. 1871–July 1914	United States–France	511	274.5	$0.12 < 0.13$	0.074	6
Jan. 1876–July 1914	United States–Germany	462	251.5	$0.08 < 0.09$	0.089	5
Jan. 1925–Dec. 1938	Great Britain–France	167	92.5	$0.21 < 0.22$	0.108	5
Dec. 1924–Dec. 1938	Great Britain–Germany	168	93.5	$0.18 < 0.19$	0.113	4
Jan. 1925–Dec. 1938	Germany–France	167	85.0	$0.83 < 0.84$	0.018	6
Dec. 1924–Dec. 1938	United States–Great Britain	168	96.5	$0.08 < 0.09$	0.149	3
Jan. 1925–Dec. 1938	United States–France	167	102.0	$0.01 < 0.001$	0.222	2
Dec. 1924–Dec. 1938	United States–Germany	168	107.0	$0.01 < 0.001$	0.274	1

N = number of pairs of differences observed.

Z = number of times change in each series showed same sign (a zero change is counted as one-half).

p = probability that an observed deviation from the expected value as great or greater is due to chance.

C = coefficient of covariation.

modified form of the familiar chi-square test. It was developed for the purpose of this investigation by A. Wald and has a number of advantages over the ordinary chi-square test, chief among which is that of easy computation. The method is described in the footnote.[23]

[23] Let n be the number of time points at which two economic variables x and y are observed, i.e., we have the observations $x_1, \ldots, x_n$ and $y_1, \ldots, y_n$. Consider the two sequences of differences:

$$(1) \qquad \begin{matrix} x_2 - x_1,\ x_3 - x_2,\ \ldots,\ x_n - x_{n-1} \\ y_2 - y_1,\ y_3 - y_2,\ \ldots,\ y_n - y_{n-1} \end{matrix}$$

From (1) we derive the sequence

$$(2) \qquad z_1 \ldots, z_{n-1}$$

where $z_i = 1$ if signum $(y_{i+1} - y_i) =$ signum $(x_{i+1} - x_i)$. If this does not hold, then $z_i = 0$. (We exclude the case that any of the differences $y_{i+1} - y_i$ and $x_{i+1} - x_i$ might be zero.)

$$\text{Let } Z = \sum_{i=1}^{n-1} z_i.$$

For large n the statistic z is normally distributed if the observations on x and y form two independent random series.

$$\text{Since } Ez_i = \frac{1}{2} \text{ we have } EZ = \frac{n-1}{2}.$$

If $i - j \geq 2$, then z_i and z_j are independent. Hence the variance σ^2 of Z is given by

$$\sigma^2 = (n-1)\ \sigma_{z_1}^2 + 2(n-2)\sigma_{z_1 z_2},$$

$$\sigma_{z_1}^2 = \frac{1}{4},$$

$$\sigma_{z_1 z_2} = Ez_1 z_2 - \frac{1}{4} = \frac{10}{36} - \frac{1}{4} = \frac{1}{36}.$$

Hence

$$\sigma^2 = \frac{n-1}{4} + \frac{2(n-2)}{36} = \frac{11n-13}{36}.$$

$$EZ = \frac{n-1}{2},$$

$$\sigma^2 = \frac{11n-13}{36},$$

$$C = 2\left(\frac{Z}{n-1} - \frac{1}{2}\right),$$

$$\sigma_C^2 = \frac{11n-13}{9(n-1)^2}.$$

It can easily be shown that our *coefficient of covariation* C is closely related to the familiar measure

$$T = \frac{\sqrt{X^2}}{N},$$

where N is the number of observations[24] of differences between successive original data, i.e., exchange rates and differentials. C can vary from -1 to 1. T is a frequently used convenient measure of contingency (T^2 is known as the mean square contingency) developed by Tschebycheff and Yule.

It should be noted that, since both the sign correlation and the phase comparison measure only the direction of the movement of a series, they are more closely related than either is to the coefficient of correlation, which compares corresponding absolute figures of two series, regardless of the direction of the movement.

As can be seen from a comparison of Tables 18 and 19, the agreement is about the same for the two correlation measures, the only significant shift being in the New York relationships and to a lesser extent the Paris rate for the prewar years.

We shall have further occasion to discuss some correlation coefficients and compare them with other measures of certain time series—some like those employed here. The latter topic is more vital to our theme since it more directly involves probable causal relationships between interest rates. Here the interdependence between the series is assumed to be a possibility without any hypothesis as yet concerning how it operates. The question must be left open, whether the determination of cyclical covariation, which stresses only turning points and duration of cycles and phases, necessarily leads to more divergent results than does ordinary correlation. If such a disparity does arise, as is the case here, a decision must be made as to which of these measures to prefer. Clearly we are more interested in the cyclical aspects and must therefore be inclined to view these measures as more adequate. This refers to *specific* cycles, i.e., fluctuations more nearly of the length and amplitude of the general business cycle. Correlation analysis on the other hand takes into consideration also those possibly minor cycles which by the definition of the specific cycle are discarded. Two series may have strong opposite trends but closely harmonious phase correspondence. This would reduce the correlation coefficients but

[24] The $n - 1$ in footnote 23 equals N in the formula for T, since n refers to the original series.

TABLE 20

Summary of Reference Cycle and Short-Term Interest Rate Correlations

	London–Berlin	*London–Paris*	*Berlin–Paris*	*New York[a]–London*	*New York[a]–Berlin*	*New York[a]–Paris*
Reference cycle phase comparison—prewar[b]	90.2	86.2	89.7	64.9	62.3	61.1
postwar[b]	60.5	68.8	61.1	65.6	55.4	70.1
Short-Term interest rate: phase comparison—prewar[b]	71.1	79.6	70.4	72.3	64.1	67.8
postwar[b]	73.5	53.6	52.3	67.5	64.9	66.9
Sign correlation—prewar	0.173	0.110	0.115	0.108	0.089	0.074
postwar	0.113	0.108	0.002	0.149	0.274	0.222
Correlation coefficient—prewar	+0.73	+0.67	+0.62	+0.45	+0.40	+0.36
postwar	+0.84	+0.34	+0.13	+0.93	+0.77	+0.34

	Three European countries	*Four countries*
Reference cycle phase comparison—prewar[a]	83.1	53.5
postwar[a]	45.2	35.7
Short-Term interest rate: phase comparison—prewar[a]	60.6	48.6
postwar[a]	39.7	34.4

[a] Commercial paper rate.
[b] Per cent in agreement.

yield good covariation percentages. Or, the specific cycles may be similar, but one series alone may have a trend.

The matter of trends is of some importance here, especially for those pairs where the American rate enters. Table 18 shows that the three prewar correlation coefficients involving the United States are substantially lower than those for the three European pairs. This may be attributed to the fact that there is a downward trend in the American series and nothing like it in the European data. This then may explain why we have the lowest correlation coefficient for the pair United States–France (less than one-half of the highest coefficient) but a phase correspondence (for both phases) of 67.8 per cent, which compares with the highest percentage of 79.6 and is higher than the lowest of 64.1 per cent.[25]

For the sake of convenience some principal measurements made thus far, including some of Chapter II, are summarized in Tables 20 and 21. They require no further comment since they give a com-

[25] The French rate showed the least regularity in its downward movement, experiencing many upward movements while the United States rate was dropping, thus making for a low coefficient of conformity.

TABLE 21

Summary of Rank Ordering, of Reference Cycle, and of Short-Term Interest Rate Correlations

	1879–1914				1925–1938				IMPROVEMENT (+) OR DETERIORATION (−) IN CORRELATION, 1879–1914 AND 1925–1938			
	Ref. cycle phase comparison	SHORT-TERM INTEREST RATE			*Ref. cycle phase comparison*	SHORT-TERM INTEREST RATE			*Ref. cycle phase comparison*	SHORT-TERM INTEREST RATE		
		phase comparison	*sign corr.*	*corr. coeff.*		*phase comparison*	*sign corr.*	*corr. coeff.*		*phase comparison*	*sign corr.*	*corr. coeff.*
London–Berlin	1	3	1	1	5	1	4	2	−	+	−	+[a]
London–Paris	3	1	3	2	2	5	5	4.5	−	−	−	−
Berlin–Paris	2	4	2	3	4	6	6	6	−	−	−	−
New York–London	4	2	4	4	3	2	3	1	+	−	+	+
New York–Berlin	5	6	5	5	6	4	1	3	−	+	+	+
New York–Paris	6	5	6	6	1	3	2	4.5	+	−	+	−[a]

[a] Not significant (0.99 confidence regions overlap).

prehensive picture of the pairwise behavior of the four great financial centers with which this work is concerned. It will gradually become clear how difficult it is to establish a ranking of the degree of interaction between money markets.

The final measurement is the determination of the *dispersion and concentration of specific cycle turning points* (Tables 22 and 23). The method used was explained in Chapter II, pages 65 ff., where it was applied to reference cycles; our present measurements should be compared with those of Table 7. The calculations covering the period July 1876–September 1913 are for the four countries, twice using the two American rates, and for the three European countries. The period is substantially the same as that of the other

computations. Such differences as there are arise from the fact that turning points are not necessarily found at the very first or very last months for which we have data.[26]

In interpreting Tables 22 and 23, the reader is reminded of the discussion in Chapter II, pages 53 ff. It is important to guard against excessive interpretation, especially regarding the possibility of deriving international turning points of short-term interest rates. On the other hand the tables reveal a considerable amount of information, especially if viewed together with those for the reference cycles. We can also reconsider some questions that were raised in Chapter II, merely on the basis of general expectations, about the greater or smaller concentration and dispersion of peaks and troughs. It will furthermore be desirable to compare the incidence of the average peaks and troughs with that observed before.[27] We shall consider only the prewar conditions, there being too few cycles after World War I.

The comparison for all four countries is made *twice*, because of the substitution of the American commercial paper rate for the call money rate in the second case.

In the first case we have an unbroken sequence of average peaks and troughs from October 1882 to June 1913. The first peak in October 1882 shows the highest dispersion (even including reference cycles of Table 7) with 8.50 months. The following average trough of February–March 1886 has a mean deviation of 5 months, the largest of that group and the second largest mean deviation of both peaks and troughs (for the commercial paper set of data). The smallest mean deviation for all extrema is for August 1893 with 0.38 months. This is a date and even a year that does not occur as a reference cycle date in Table 7, but there is no doubt that in 1893 there was a very sharp international financial crisis which shows up well here. The same observation must be made for other dates and this leads us back to the argument, tentatively expounded in pages 96 ff., of the possibility of some autonomy of both financial and international peaks and troughs which are not revealed by the reference cycle dates. The year 1893 is certainly often mentioned by historians of business cycles and not only in relation to the solitary American peak of January of that year.

[26] Note in particular the slight difference in regard to Table 7. We hope the reader will concur with us that it is not material.

[27] This will supplement our study of the covariation of the interest rate specific cycles with their respective reference cycles, carried out above.

TABLE 22

Short-Term Interest Rates, Concentration and Dispersion of Specific Cycle Turning Points, July 1878–September 1913, 422 months

	Average peak[b]	Mean deviation (months)	Average mean deviation (months)	Percentage coinciding
COINCIDING PEAKS[a]				
Four countries—including United States commercial paper rate	Oct. 1882	8.50	2.79[c]	68
	Sept. 1890	4.50		
	Aug. 1893	0.38		
	Feb. 1900	1.25		
	July 1903	1.00		
	Sept.–Oct. 1907	2.00		
	June 1913	1.87		
Four countries—including United States call money rate	Aug. 1890	3.50	2.36	59
	July–Aug. 1893	0.75		
	Dec. 1899–Jan. 1900	1.50		
	Apr. 1903	3.63		
	Sept. 1907	1.50		
	Apr. 1913	3.25		
COINCIDING TROUGHS[a]				
Four countries—including United States commercial paper rate	Feb.–Mar. 1886	5.00	3.50	62
	June–July 1892	1.25		
	Jan. 1895	3.63		
	Oct. 1901	4.38		
	Dec. 1904	2.75		
	Feb. 1909	4.00		
Four countries—including United States call money rate	June 1892	1.38	3.20	51
	Jan. 1895	3.38		
	Sept. 1901	5.88		
	Oct. 1904	2.88		
	Dec. 1908	2.50		

Average mean deviation of coinciding peaks as per cent of corresponding average for troughs

Four countries—including United States commercial paper rate	80%
Four countries—including United States call money rate	73%

[a] Coinciding turning points: no opposite turning point within the range of turning points.

[b] The arithmetical mean of the coinciding turning points is computed. If the average falls exactly between two months, both are reported. If the average falls more closely into one month, only this month is reported.

[c] Excluding 1886, average mean deviation = 3.20.

TABLE 23

European Short-Term Interest Rates, Concentration and Dispersion of Specific Cycle Turning Points, July 1878–September 1913, 422 months

	Average peak[b]	Mean deviation (months)	Average mean deviation (months)	Percentage coinciding
	COINCIDING PEAKS[a]			
Three European countries	July 1882	7.78	2.67	72
	Aug. 1890	4.67		
	Aug. 1893	0		
	Jan. 1900	1.11		
	July 1903	1.11		
	Sept. 1907	1.56		
	June 1913	2.44		
	COINCIDING TROUGHS[a]			
	Average trough[b]	Mean deviation (months)	Average mean deviation (months)	Percentage coinciding
Three European countries	Aug. 1879	1.78	3.21[c]	78
	Apr. 1886	4.22		
	July 1892	1.56		
	Feb. 1895	4.00		
	Jan. 1902	4.67		
	Nov. 1904	3.11		
	Dec. 1908	3.11		
	Average mean deviation of coinciding peaks as per cent of corresponding average for troughs			
Three European countries	83%			

[a] Coinciding turning points: no opposite turning point within the range of turning points.

[b] The arithmetical mean of the coinciding turning points is computed. If the average falls exactly between two months, both are reported; if it falls more closely into one month, only that month is reported.

[c] Excluding 1879, the average mean deviation = 3.44.

The mean deviations of other average peaks are likewise small, July 1903 (1 month) and February 1900 (1.25 months). These values are notably less than those for reference cycles, and from 1895 on each one is smaller than the deviation of the corresponding trough. Thus we have for the entire series $\overline{D_p} = 2.79$ months and $\overline{D_t} = 3.50$ months. This bears out an expectation raised on page 68, when discussing reference cycles, which was then not

confirmed, i.e., that there would be greater dispersion around the troughs than around the peaks. The opposite was true of reference cycles, but the proposition holds for short-term interest rates.

This is of considerable interest because it is plausible to assume that interest rates of different countries react more sharply on each other when there is financial tension, i.e., when rates are high, than in times of low activity. The lower turning points may therefore depend much more on domestic business conditions (and domestic economic policies, if any) than the upper turning points. If we exclude the somewhat exceptional values for 1882 and 1886, we obtain $\overline{D_p} = 1.83$ and $\overline{D_t} = 3.20$, a more marked ratio than before.

There is at least one drawback to this besides the obvious one of smallness of numbers: there are the low values of $p/P = 68$ per cent and $t/T = 62$ per cent. The latter is identical with the respective figures for reference cycles, the former reference cycle ratio was 71 per cent. No correction or addition of any sort is possible of course, since this is merely a question of the wealth and poverty of data.[28] Yet we can make a test, by looking at the second set of figures, computed for the call money rate.

This gives one average peak and trough less. There is an unmistakable tendency for the average peaks to occur earlier than when the commerical paper rate was used. The average mean deviation for peaks is now only 2.36 months, for troughs 3.20 months, which is identical with the previous figure after elimination of 1886; otherwise it is 10 per cent smaller. From this and the other data of Table 22 (notably the low value $p/P = 59$ per cent) it cannot be decisively argued that the substitution of the call money rate improves the picture very much. As mentioned elsewhere we would not have made this substitution had it not been for the contention that the call money rate was—before 1914—more important for the regulation of flows of short-term funds to and from the United States. If this were true we would expect to find a higher cyclical correspondence for it—provided that short-term rates between countries where the proper rates have been chosen do show high cyclical correspondence. The one need not entail the other.

In the prewar period the peaks and troughs of the four short-term interest rate cycles always followed those of the four reference cycles. This lag, however, was less marked for the three European countries, particularly in the troughs.

[28] The absolute number of turning points is larger in the case of interest rates.

We have, however, one more argument in favor of the assumption of a genuine interaction between our interest rates, made on page 52. There it was stated that, if there is invariance of a high degree of covariation between two or more time series against an alternation of short and long cycles in any or several of the many combinatorial complications, then there is every reason to exclude the possibility that this covariation was not due to interaction. Inspection of Charts 4 and 5 will show conditions here. We do not establish a particular measurement of the degree of this occurrence. We have it in the measure of coinciding peaks and troughs. If it is high, and if at the same time short and long cycles alternate as the dates of turning points of the specific cycles (Table 12) disclose, then the conditions for making our claim are given.

Such alternation of short and long specific cycles exists: those from 1892 to 1897 were shorter than those following, up to 1908, when at least one more short cycle occurred. As usual the length of the American cycles is much steadier, i.e., they are generally shorter than the European. So the alternation of short and long specific cycles is again chiefly a European affair. Hence the transmission hypothesis looks more acceptable for these three than for all countries or for any pair which includes the American rates of interest.

As to the satisfactory expression of the phenomenon just mentioned by our measures, a qualification is needed: if we have high concentration of turning points with low mean deviations, there might still be exceptions which could fall precisely in those regions, where a change over from short to long cycles (or vice versa) occurred. The ratios p/P and t/T assume therefore added significance. The higher they are the better is our argument supported.[29] Tables 22 and 23 have shown fairly good values for these ratios and better ones still for the European countries. However we still need further evidence for interaction.

The alternation of short and long cycles for our interest rates should be compared with that of the reference cycles. If it occurs in both instances, it need not be in the same order. Not even the exhaustion of all peaks and troughs by the average peaks and troughs is a guarantee for that. So we can make sure only by actually comparing the years in which the various turning points fall. Much has been said about this implicitly already on p. 96 when comparing our interest rates with their respective reference cycles.

[29] There was complete exhaustion of all available peaks and troughs for the three European reference cycles.

We conclude this chapter by making five separate remarks which either take up points already raised or point to subsequent investigations which will subject our data to different approaches and place them in close relationship with data of other activities in the international financial sphere.

First. At the beginning of this chapter we raised the important question, for the first time,[30] whether the absolute level of short-term interest rates, its changes, or its cyclical behavior were more strongly subjected to *domestic or to foreign influences*. It was then stated, on general credibility grounds, that the domestic factors might be the more important. In this most economists would probably concur, although perusal of the literature does not disclose anything decisive. There is one important exception in the literature—though it does not cover the entire range of this problem—that is, the study of the interdependence of short-term interest rates with exchange rates. This subject will occupy us more fully than in any previous discussion (cf. Chapters V and VIII).

Second. There is the larger question of *institutional homogeneity* throughout the period covered, that is, the question whether the behavior of the data shows significant variation revealing such changes in the institutional background as were not already taken into account in the selection of the particular interest rates, and discounted in our continuous use of them. Such a break actually occurs and conforms with that observed for the reference cycles. It happens after World War I. The break exists, however, whether the observations are restricted to the short period of the continued application of the principles of the gold standard or are extended beyond that period. The causation is naturally complicated, the war as such having little to do with it directly. In fact it was more the emergence of state intervention with interest rates and all those international factors in the field of capital movements and foreign trade which produced less synchronized cyclical behavior. This craving for greater autonomy on the part of many states has become a permanent feature of the years since World War I and will have to be referred to repeatedly.

For that reason our study must place chief emphasis upon the period up to 1914. The implications of this institutional change for the validity of the various theories of the business cycle and of

[30] Cf., however, page 24 ff. where the problem of separating domestic and foreign influences was put in general terms and where certain deep-lying methodological difficulties were pointed out.

international trade are clear. Further reference to this is made in the fifth remark.

Third. There is the question of the *absolute levels of the interest rates.* Tables 9 and 10 disclosed considerable differences in their absolute levels and in their variability. The problem is whether these differences—chiefly of the absolute levels—have any close bearing upon their covariation. Again this question cannot yet be answered. There is however an interesting phenomenon to note: the American call money rate is more nearly at a level corresponding with that of the other (foreign) rates. Yet its agreement with the three European rates over the cycle is decidedly less than that shown by the commercial paper rate, as far as covariation is concerned. But this complex of questions awaits study of the amplitudinal behavior and in every way transcends, at the level at which it has to be carried out, the scope of this investigation. Some aspects of the question whether the principles of interdependence of interest rates, both short-term and long-term, require that they vary only within certain rigid limits are dealt with extensively below, especially in Chapters V and IX.

Fourth. Closely connected with these points is the set of problems arising from the study of *the differences between short-term interest rates.* Realizing that the rates will not in general be identical with each other, it might be possible to assign to their differences certain maximum values. If there is to be interaction between the rates, it would have to take place through shifts within these maximal ranges. All this would further be tied up with induced and autonomous movements of other factors, such as capital transfers, exchange rates, etc. These latter in their turn depend in the range and frequency of their fluctuations upon limits imposed by the rules of the gold standard to the extent to which they are or are not adhered to. All this will form the substance of a large part of the subsequent investigations, which will throw some light upon the problems of covariation and transmission.

Fifth. On page 21 ff. we have touched upon the question whether the cyclical behavior of economic activities in various countries is sufficiently similar to warrant the establishment of a *uniform theory of economic fluctuations* applicable to any or all countries. Whether the answer is yes or no in general will not depend entirely on one field alone. As far as interest theory is concerned, we should like to question whether such a theory exists in the shape compatible with the facts described above. There is a large field of verbal, even

quasi-metaphysical, discussion above the "nature" of interest, etc., and there is a very much smaller number of investigations showing the behavior of the principal rates over long periods in the leading countries.

It may be helpful at this point to summarize the more important specific findings of the chapter.

As a general rule, the international peaks and troughs indicated by the reference cycles are present in the short-term interest rate cycles, although for each of the four countries there tended to be more cycles in the interest rate series. Unlike the reference cycles however, the short-term interest rate peaks tend to show less dispersion than the troughs. The four countries do not have the same number of cycles, the United States having the greatest number.

Before World War I the British rate showed the best phase correspondence with its reference cycle whereas after the war it was the poorest, the United States commercial paper rate now showing the best correspondence. The British rate also showed the best phase correspondence with the rates in the other three countries before the war although not in the interwar period. Before World War I the United States rate showed the least agreement with the two continental centers, much less than did the three European centers with each other. Expansions were longer than contractions before 1914 whereas they were shorter in the interwar period.

Using frequency distributions to gauge the relative stability of the rates, the variation for the United States call money rate was much greater than that of the commercial paper rate, particularly before World War I. The British rate was the most unstable of the European rates, and this instability, i.e., variability, increased in the interwar period, evidence of the tension under which that economy was laboring. The stability of the French economy before 1914 was reflected in its short-term interest rate showing a variance less than that of Great Britain and Germany. In general seasonal variations decreased after World War I.

Before 1914 the United States rate was the highest of the four whereas in the interwar period it was the lowest.

Appendix. Description of the Monthly Data

United States. Here we choose the *commercial paper rate.*[31] This

[31] *Sources:* Secondary source, Macaulay, *op. cit.*, Table 10; primary sources, *Financial Review* and *Commercial and Financial Chronicle.* Macaulay states that these two sources are practically identical.

was one of the most important American short-term rates, at least up to 1914, at which a large volume of domestic and foreign business was transacted. The term applies to promissory notes "on which merchants and manufacturers borrow money for use in the ordinary course of their business. No stock or bond collateral is deposited to secure the loan."[32] After 1914 the notes were admitted to rediscount at the Federal Reserve banks under certain conditions. Up to 1923 the rate applies to endorsed commercial paper ("prime double-name paper"); in the late 1920's the endorsement dropped out of use.

The maturity of the paper was, up to December 1923, sixty to ninety days and thereafter the rate relates to paper having a maturity of four to five months. The tendency was toward paper with longer maturities.[33, 34]

The commercial paper rate is what its name implies. It has decreased in importance in the course of time, but more so in the post-World-War I period rather than before 1914, toward which our main interest is directed. It would be most important for us to know what the share of international transactions out of the total was. Unfortunately no data at all exist about this. We return to this matter below (cf. Chapter V).[35]

Besides the commercial paper rate, we shall also consider to some extent a second American short-term rate, the *New York call money rate*. The reasons lie in the disagreement as to whether this rate or the commercial paper rate was of greater international significance for the shifting of funds, chiefly between New York and London,

[32] Macaulay, *op. cit.*, p. A-344.

[33] This point may seem of small significance in the characterization of our series, but it will be seen below, Chapter V, that it assumes great importance. In order to have the characterization in one place, we mention this fact here, though it is not immediately significant.

[34] *Statistical procedure:* the monthly rate is in general the average of the weekly rates. If a Saturday occurred on the first or second of the month, the week ending on that Saturday was considered as entirely in the preceding month. If a Saturday occurred on the fourth, fifth, or sixth, the week was considered as entirely in the later month. If it occurred on the third, the week's average was considered a quotation for half a week in the earlier month and half a week in the later month.

In times of major disturbances the average monthly rate is an average of daily rates rather than of weekly averages. Cf. Macaulay, *op. cit.*, p. A-350.

[35] As for the *literature*, we mention besides Macaulay and the standard descriptions of the New York money market such as M. G. Meyers, B. H. Beckhart, J. G. Smith, and W. A. Brown jun, *The New York Money Market*, 4 vols., New York, 1931–1932, the work by Albert O. Creef, "The Commercial Paper House in the United States," *Harvard Economic Studies*, Vol. LX, Cambridge, 1938, a thorough study with an almost exhaustive bibliography.

and even in the prewar period. The call money rate[36] is much more closely related to the stock market, which sets it apart from the rates chosen for the other countries where there is less doubt as to their international, commercial significance. The rate covers "loans to stock or bond brokers, or to investment bankers who place in the hand of the lenders stocks or bonds, or both, as collateral. The rate relates to a mixed collateral which includes industrial as well as government securities."[37]

Those loans are made for indefinite periods,[38] to be repaid "at call." The rate is an official renewal rate made by the money commission of the New York Stock Exchange Clearing Corporation. In ordinary times some 95 per cent or more of the call loans, new and renewed, carry the renewal rate.[39] The statistical procedure is the same as for the commercial paper rate (cf. footnote 34).

The call money rate was always a very important rate on the New York money market. The much greater significance of events on the New York Stock Exchange as compared with any European country accounts for this. Also it cannot be doubted that many movements of funds from Europe across the ocean were oriented by these events. But this is not the same as being attracted or repelled by the changes and relative positions of the call rate. In the late 1920's the influx of European funds to New York was motivated by expected capital gains on the stock exchange rather than by a differential of European rates and the call rate. Before 1914 there were occasionally still different institutions, notably the *joint accounts.*[40]

Great Britain. Here we chose the *London open market discount rate.*[41] This rate is charged for the discount of bank bills, i.e., a bill of exchange issued or accepted by a bank. The discount rates for bank bills are less than the rates charged for fine trade bills. The

[36] *Sources:* secondary source, Macaulay, *op. cit.*, Table 10 and Appendix E.; primary sources, 1876–1889, *Commercial and Financial Chronicle:* 1890–1919, *Financial Review* and *Commercial and Financial Chronicle;* 1923–1938, *Federal Reserve Bulletin.*

[37] Macaulay, *op. cit.*, p. A-337.

[38] Cf. footnote 33.

[39] Macaulay, *op. cit.*, p. A-339.

[40] These were accounts owned jointly by the London and New York banking houses belonging to one and the same financial interests. Movements of these accounts were very important. No material is available concerning the volume of transactions, interest charges, etc., except that participating firms attested to the great significance of the operations. No statistics of capital movements could safely neglect this institution.

[41] *Sources:* primary source, *Economist.*

discounting is done by special discount houses, most of very old standing. The official rediscount rate of the Bank of England, briefly called "bank rate," applies to the same paper. A very large volume of business was transacted at this open market rate and the share of international transactions was always very large and continued to increase in the period before 1914 in conformity with London's dominant position in international finance. In the post-war period the rate was still of great importance, although London's position was no longer of this dominant nature.

The maturity of the paper varied somewhat. The *Economist* indicates usually that its data relate to three months bank bills; but in other instances the heading reads: two to three months bank bills. This uncertainty about the actual or most frequent maturity does not deprive the data of their value; but it introduces, as was noted before (cf. footnote 33, a factor which will assume some importance later.[42]

France. Here we chose the *Paris open market discount rate* ("Escompte hors Banque").[43] This rate is charged for the discount of bank bills, i.e., a bill of exchange accepted by the bank. It is very similar to the British open market discount rate. But there were no special discount houses in Paris; this was and is a peculiarity of the London market.[44, 45] Direct accommodation of business by banks also played a large role.

[42] The *literature* about the London money market is enormous. We indicate here some important sources, where not only descriptions of this money rate may be found but also the general setup of the market is analyzed. The order in which the books are listed indicates their more direct relation to the descriptive side, while from the analytical point of view it might be quite different.

George Clare, *A Money Market Primer*, London, 1891, 2nd ed., 1923.

Ellis Thomas Powell, *The Evolution of the Money Market (1385–1915)*, London, 1915.

F. Lavington, *The English Capital Market*, London, 1921.

E. G. Peake, *An Academic Study of Some Money Market and Other Statistics*, London, 1923, 2nd ed., 1926.

W. T. C. King, *History of the London Discount Market*, London, 1936.

Richard Sidney Sayers, *Bank of England Operations, 1890–1914*, London, 1936.

[43] *Sources:* 1876–1888, *Economist;* 1889–1908, *Statistics for Great Britain, Germany and France*, U.S. National Monetary Commission, Vol. 21, 1910, and *Economist; Annual Reports*, 1925–1938, Federal Reserve Board.

[44] The *literature* about the Paris money market is large but not nearly as informative as that for other centers. That is a general experience relating to French monetary and other economic statistics. They are either completely lacking when they are available in other countries, or often of very doubtful quality without any possibility of checking and improving them. On the other hand there sometimes exist statistics in fields where, in other countries, it is

Germany. Here we chose the *Berlin private discount rate* ("Privatdiskontsatz").[46] This rate is charged for loans, i.e., discount, on prime bills, that is, on those of "recognized solid banks and bankers. They must be payable at a bank place, i.e., in Berlin or some other town with a branch of the Reichsbank. They must call for at least 5,000 Marks."[47] This characterization has remained essentially true since 1910 but as in other countries the role of the bills of exchange has decreased in Germany. This was associated with the rise of the large enterprises in industry and banking and the more direct accommodation of business, especially big business, by the banks. The private discount rate is comparable to the French and British rates to a greater extent—in that order—than to the commercial paper rate at New York. But this holds respectively true for the three European rates. The volume of transactions carried out in Germany with bills of exchange was considerable and a fairly high percentage of the bills either referred to international transactions arising from international trade or became instruments of capital movements. A frequently used practice of German banks was to rediscount these bills in Paris when the rate there was lower and to repatriate them just before they fell due. This was the so-called "pensioning" of bills.

The duration of the loans varied from fifty-six days to three months. This variation is similar to that found above for the other

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impossible to obtain any reliable information at all. Seen against the general background, this makes them very suspect. Fortunately interest rates (and later exchange rates) are generally accurate, but see Chapter V, section 7. Here are some important works:

Alfred Neymarck, *De l'Organisation des Marchés Financiers en France et à l'étranger*, Paris, 1884.

A. Aupetit, and co-authors, *Les Grands Marchés Financiers, France (Paris et Province), Londres, Berlin, New York*, Paris, 1912.

Pierre Costes, *Les Grands Marchés Financiers*, Paris, 1922.

H. Fischer, *Die Statistik des französischen Kreditmarktes*, Berlin, 1934.

[46] *Statistical procedure:* for 1876–1888 and 1909–1914 the average monthly rates were computed by the National Bureau of Economic Research: the monthly average is the average of as many weekly quotations as there are Fridays of the month. For 1889–1908 the monthly averages were computed by the National Bureau: for January 1889–February 1905 the number of Thursdays in the month determined the number of weekly quotations averaged; for March 1905–December 1908, it was the number of Saturdays. For 1925–1938 the monthly averages were computed by the Banque Nationale Suisse.

[47] *Sources:* 1876–1910, *Die Reichsbank 1876–1910*, Berlin, 1911; 1911–1933, *Statistisches Jahrbuch für das Deutsche Reich;* 1934–1938, *Wirtschaft und Statistik.*

[48] *U.S. National Monetary Commission, op. cit.*, Vol. 21, p. 201.

countries. We have not been able to ascertain what the average duration was, certainly not the average weighted for the volume of transactions.[48, 49]

[48] *Statistical procedure:* The monthly average rate is computed on the basis of average daily quotations from the various sources. The latter is the average of quotations for long-term and short-term paper, i.e., within the above limits. If more than one quotation occurred, either for short-term or long-term paper, then the highest quotation was used.

[49] The *literature* about German monetary organization since 1879 is ample and generally accurate. We shall name only a few works that relate directly to our topic:

E. Voye, *Über die Höhe der verschiedenen Zinsarten und ihre wechselseitige Abhängigkeit*, Jena, 1902.

Paul Homburger, *Die Entwicklung des Zinsfusses in Deutschland von 1870–1903*, Frankfurt, 1905.

H. Albert, *Die geschichtliche Entwicklung des Zinsfusses in Deutschland von 1895 bis 1908*, Leipzig, 1910.

Paul Wallich, "Beiträge zur Geschichte des Zinsfusses von 1800 bis zur Gegenwart," *Jahrbuch für Nationalökonomie*, Vol. 42, 1911, pp. 289–312.

L. Pohle, *Die neuere Entwicklung des Zinsfusses und der Einfluss des Weltkrieges auf seinen Stand*, Frankfurt, 1915.

M. Palyi and P. Quittner, *Handwörterbuch des Bankwesens*, Berlin, 1933.