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CONTRIBUTIONS OF THE THREE DETERMINANTS TO THE RATE OF CHANGE IN THE MONEY STOCK

ALTHOUGH the three determinants of the money stock—high-powered money, the currency ratio, and the reserve ratio—are not mechanically related to each other, historically they have varied in common at certain times, and this may reflect either parallel behavior of the factors affecting the determinants or a direct relation between the determinants. Much of the covariation seems to stem from cyclical fluctuations in business activity. Yet, even in such short-run movements, the determinants display much divergence. Their effects on the money stock are therefore not the same, and an examination of the behavior of each determinant is relevant and helps to isolate the main sources of variations in the money stock.

The analysis here is based on the contribution of each determinant to the rate of change in the money stock rather than to its absolute level, for the reasons given in Chapter 1. The rate of change directly attributable to changes in each of the three determinants can be derived from formula 1 (p. 12). That formula can be expressed in terms of rates of change by first taking natural logarithms,

$$\log_e M \equiv \log_e H - \log_e\left(\frac{C}{M} + \frac{R}{D} - \frac{C}{M}\frac{R}{D}\right), \tag{1}$$

and then differentiating with respect to time,

$$\frac{d \log_e M}{dt} \equiv \frac{d \log_e H}{dt} + \frac{M}{H}\left(1 - \frac{R}{D}\right)\frac{d\left(-\frac{C}{M}\right)}{dt} + \frac{M}{H}\left(1 - \frac{C}{M}\right)\frac{d\left(-\frac{R}{D}\right)}{dt}. \tag{2}$$

The left-hand side represents the rate of change in the money stock. The three terms on the right-hand side give the contribution to that

rate of the rate of change in high-powered money, in the currency ratio, and in the reserve ratio, respectively.

Since the data exist only for discrete points in time, the instantaneous rates in formula 2 must be approximated by average rates over a period. The factors $(M/H)(1 - R/D)$ and $(M/H)(1 - C/M)$ in the second and third terms can also be approximated by their average values over each period for which the rates are computed or, as here for ease of computation, by an average of their values at the beginning and end of the given period. Approximating the terms in this way, however, introduces an error or "interaction" term and thereby destroys the equality. If we express the approximations to the four terms in formula 2 for a given period by m, h, c, and r, respectively, the equation may be written:

$$m = h + c + r + \epsilon, \tag{3}$$

where ϵ is the approximation error. This error is usually small and can be ignored. We may for convenience sometimes refer to the values of m for a succession of periods as the "money series."

The contributions are discussed first in terms of secular growth and then of cyclical movements.

1. Contributions of the Determinants to Secular Growth of the Money Stock

Table 2 presents averages for the years 1875–1955 of the contributions in percentage rates of change and in relative terms. For the relatives, the contribution of each determinant was divided by the average rate of change of the money stock. Almost any other terminal dates, either a few years later or earlier, would give substantially the same results. The years encompassing U.S. participation in the two world wars have been segregated in a breakdown of the full period because of their special character. The table also gives the figures for two subperiods of about equal length before and after World War I. This is a convenient point at which to separate the earlier period, in which the monetary system depended on the gold-standard mechanism, from the later period, in which that dependence diminished.

The dominant role of high-powered money in the secular growth of the money stock, indicated by the top three lines of the table, was

suggested earlier by the graph of the three determinants in Chart 1. We can now quantify the earlier impression. Increases in high-powered money accounted for nine-tenths of the growth of the money stock. The growth of high-powered money occurred chiefly through growth of the gold stock and, later, after the founding of the Federal Reserve Banks, also through credit extended by them (Chapter 3). Particularly large contributions by high-powered money (average

TABLE 2

SOURCES OF THE RATE OF CHANGE IN THE MONEY STOCK: AVERAGES FOR SELECTED PERIODS, AUGUST 1875 TO DECEMBER 1955

Period	Average Rate Contributed[a] by: (per cent per year)				Relative Contribution[b] of: (per cent)			
	Total[c] (1)	High-Powered Money (2)	Currency Ratio (3)	Reserve Ratio (4)	Total[c] (5)	High-Powered Money (6)	Currency Ratio (7)	Reserve Ratio (8)
All years	5.7	5.2	0.5	0.1	100	91	9	2
War years[d]	16.0	16.3	-5.5	6.0	100	102	-34	37
Nonwar years	4.9	4.3	1.0	-0.3	100	88	20	-6
Pre-Mar. 1917	6.3	4.3	1.6	0.6	100	68	25	10
Post-Nov. 1918	3.2	4.4	0.2	-1.4	100	138	6	-44

Source: Same as for Table F-1.

[a]Computed by an approximation to formula 2 (hence the rates are compounded instantaneously). The factors in the terms for c and r were approximated by averages of the beginning and ending values of the factors for each subperiod in the table. The approximations for each subperiod were also used in computing the contributions for all years and for the post-1918 nonwar years.

[b]Cols. 1 to 4 divided by col. 1.

[c]Lines may not add exactly to total because of rounding and approximation error.

[d]Covers the two world wars, Mar. 1917-Nov. 1918 and Nov. 1941-Aug. 1945.

annual rate of 16.3 per cent) occurred during the two world wars, when government expenditures were partly financed on Federal Reserve credit; contributions were lower in the nonwar years, both in absolute and relative terms (average annual rate of 4.3). If we exclude the first few years of the Federal Reserve System, the growth of high-powered money was also considerably lower in the earlier period (from August 1875 to June 1914, not shown in the table, average annual rate of 3.7 per cent).

The contributions of the two ratios largely offset each other over most of the periods shown and so produced a combined contribution of small size. In addition, each ratio separately tended to move in

different directions in successive periods. This is one reason their contributions, in absolute amount, were smaller for all years than for most of the subperiods. The currency ratio declined steadily during the pre-1917 period; it declined also during the nonwar years after 1919 but by a smaller amount than in the earlier period, primarily because of a rise during the 1930's. Its contribution to the nonwar years was therefore positive, though lower in the later than the earlier period. The declines were largely offset, however, by sharp increases during the two world wars, so that the over-all contribution of the currency ratio from 1875 to 1955, while positive, was small. The reserve ratio declined sharply after about 1900 and thereby contributed to the pre-1917 growth of the money stock. That movement was more than offset for all nonwar years by a later rise and hence a negative contribution by the reserve ratio to monetary growth during the 1930's. The subsequent decline of the reserve ratio during World War II contributed to the wartime growth of the money stock. Because neither the currency nor the reserve ratio had large declines in the post-1918 period—whereas both did earlier—the growth of the money stock was greater in the earlier period, even though the growth of high-powered money was lower.

What if either or both of the ratios had been constant? Their relative contributions then show either the fractional reduction in the growth of the money stock or the fractional increase in the growth of high-powered money, or some combination of the two, that would have occurred. The money stock alone might not have had a different growth rate if the two ratios had been constant, because there is a mutual dependence between it and high-powered money. Under the gold standard, changes in income and prices are required by the balance of international payments. Given the factors determining output and velocity of money, the change in the money stock was then a residual: what did not occur through the two ratios, occurred through high-powered money. Although the dependence was likely to be strongest under the unfettered gold standard before World War I, it also operated to some extent afterwards under the Federal Reserve System. The mutual dependence may have played a weak role in short-run movements because of long lags, but it surely had a very important role in most secular movements (see Chapter 3 for discussion of the evidence). On the other hand, the evidence on the two ratios (Chapters 4 and 5) suggests that they were not affected in the long

run by the particular secular rate of growth of either the money stock or high-powered money; therefore, a different growth rate for high-powered money, however produced, would have made a corresponding difference in the growth rate of the money stock.

Aside from the complications of mutual dependence, movements in the determinants give clues to the sources of change in the rate of growth of the money stock. Many of those movements raise questions which an analysis of factors affecting each determinant will help to answer: Why did high-powered money grow on the average more slowly before the founding of the Federal Reserve System than after? (Actually, its faster growth appears to have begun around 1897, as Chart 1 shows.) To what extent was the growth rate independent of or a reaction to concurrent movements in the two ratios? Why was the steady decline in the currency ratio during earlier decades interrupted by sharp increases in the early 1930's and the two world wars? Why did the reserve ratio decline around 1900 and rise so sharply during the 1930's? The movements are discussed at length in the subsequent chapters on the determinants.

2. *Contributions of the Determinants to Cyclical Movements in the Rate of Change in the Money Stock*

Specific cycles in the rate of change in the money stock, derived by Friedman and Schwartz, are listed in Table 1.[1] All but a few of the expansions and contractions of specific cycles can be matched with corresponding phases of reference cycles. The cycles in the money series that do not match reference cycles have small amplitude and appear on other grounds to be spurious.[2] For this reason and also in order to analyze the cycles that correspond with business fluctuations, the unmatched phases have been suppressed in the subsequent analysis.

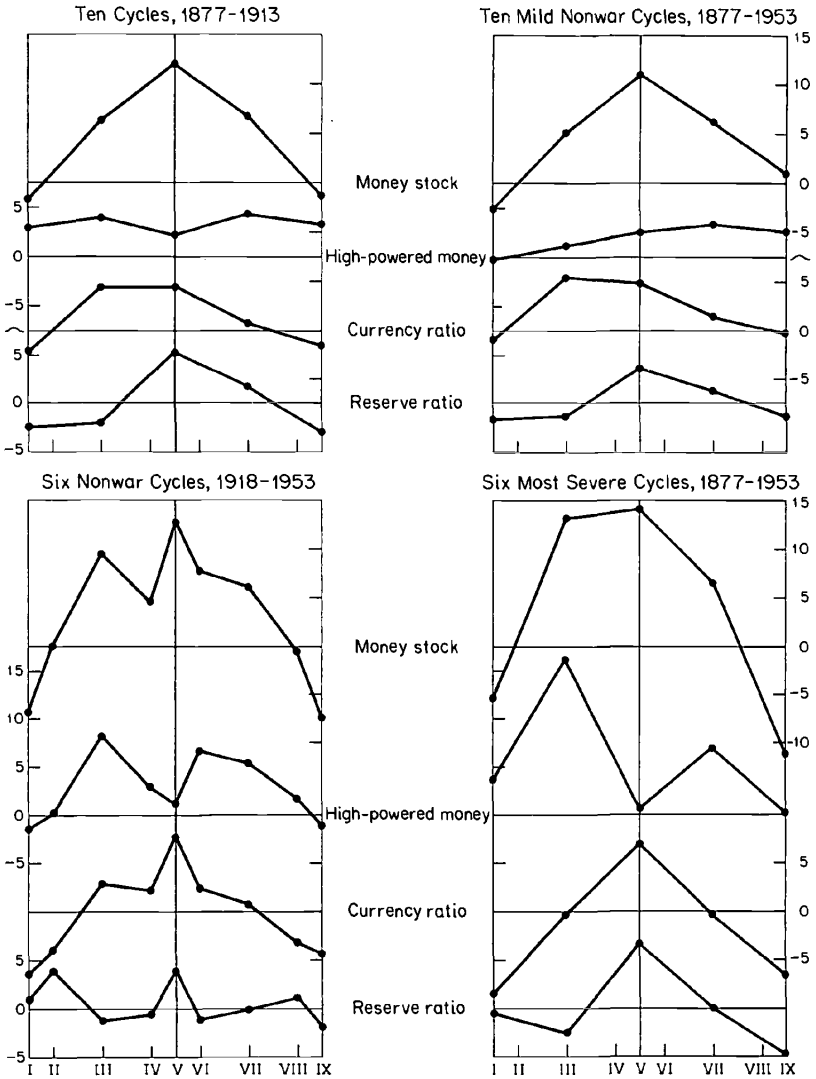
The specific cycles were divided into stages by the National Bureau procedure. For the monthly data since May 1907, nine stages were used; for the preceding annual and semiannual data, five stages, or fewer when a standing could be computed only by averaging adjacent stages. The stage omitted was typically VII, in brief contractions for

[1] The specific cycle dates used for the subsequent analysis are based on a slightly different earlier version of Table 1 (see notes to Table F-1).

[2] See Milton Friedman and Anna Jacobson Schwartz, "Trends and Cycles in the Stock of Money in the United States, 1867–1960," a National Bureau study, in preparation.

CHART 2

Average Contributions of the Three Determinants to Specific Cycles in the Rate of Change in the Money Stock (per cent per year)



Source: Table F-1.

which the annual data available provided only a peak standing in one year and in the next a trough standing.

Specific cycles emphasize the points of highest and lowest rates of change, whereas the periods of higher and lower average rates of change may be more relevant. To allow for this possibility, Appendix A includes an analysis of step cycles, which mark off periods of higher and lower average rates of change, constituting expansion and contraction phases not further subdivided into stages. Step cycles give the same results as specific cycles do, so far as the relative importance of the three determinants is concerned.

SPECIFIC CYCLE PATTERNS

Average patterns are presented in Chart 2 for two pairs of subgroups of the nonwar cycles—a time grouping segregating the cycles before and after World War I, and an amplitude grouping segregating the cycles that are matched to mild and to the six most severe contractions in aggregate business activity. For each stage, the sum of the contributions of the determinants (the three lower series in each group in Chart 2) equals, except for the slight approximation error, the top series which shows the rate of change in the money stock. Some of the patterns lie mostly above zero because of intracyclical trend in the determinants, not eliminated. The patterns differ from patterns that would show the first differences in each ratio, because formula 2 multiplies the negative of the differences in each ratio by two positive factors to derive the ratio's contribution to the money series. Nevertheless, if the patterns shown for each ratio were inverted, they would provide a fairly good approximation to patterns of its first differences.

Chart 2 reveals a high degree of similarity among the four cycle groups in the average pattern for each determinant. The post-1918 pattern for the reserve ratio seems at first sight to differ from its earlier pattern, but that is partly due to the extra stages. If these are excluded, the pattern is more nearly the same as that for the pre-1914 group. The similarity is surprising, considering the major developments in our monetary institutions since World War I. It merits our attention in subsequent chapters as much or more than the minor changes in the cyclical behavior of the series over time. While the patterns for the later subgroup have the larger amplitude, most of the difference probably reflects the finer measurement provided by the monthly data

and the greater frequency of severe cycles in the later period. One notable difference, not explained by the distribution of severe cycles over time, is the somewhat greater amplitude of fluctuation in the contribution of the reserve ratio in the earlier subgroup. It can be attributed to monetary developments since the turn of the century that have reduced fluctuations in that ratio (discussed at length in Chapter 5). Effects of those developments on the cyclical pattern of the money series over time, however, are noticeably absent. Institutional developments have affected in varying degrees the nature and relative importance of cyclical fluctuations in the three determinants but, to a much smaller degree, the pattern of fluctuations in the money series itself.

The expansions and contractions in the contributions of the two ratios roughly parallel those in the money series. The pattern for high-powered money, on the other hand, differs considerably from those of the other series. In mild cycles its pattern hardly deviates from trend, while in severe cycles it displays two steep peaks. Its large drop from stage III to stage V in severe cycles accounts for the rounded peak in the money series. From stage V to stage VII in those cycles, the decline in the patterns for the two ratios overcomes the concurrent upswing in the pattern for high-powered money and accounts for the drop in the money series. In the mild cycles, the configuration at the peak is slightly different, in that the combined contribution of high-powered money and of the currency ratio is almost constant from stage III to stage V, and the contribution of the reserve ratio alone is mainly responsible for carrying the money series to a peak.

High-powered money is largely responsible for the sharp movements of the money series in severe cycles from stage I to stage III and from stage VII to stage IX. The greater amplitude of the severe-cycle group over the mild-cycle group reflects those movements and also larger contributions of the two ratios. It should be noted that the difference in amplitude between severe and mild cycles is not an arithmetical consequence of the definition of severe cycles; these are defined on the basis of the corresponding reference cycles independently of the amplitude of variation in the money series. The average patterns for all three determinants have larger fluctuations in the severe-cycle group than in the mild-cycle group. Nevertheless, the association

between the amplitude of variation in the money series from its peak to its trough stages and the severity of corresponding business contractions reflects primarily the contributions of the two ratios; high-powered money has roughly the same average contribution in the peak and trough stages.

RELATIVE CONTRIBUTIONS OF THE DETERMINANTS TO THE RATE OF CHANGE IN THE MONEY STOCK

Table 3 gives the relative contributions of the three determinants. The average contribution of each determinant, adjusted to have an

TABLE 3

RELATIVE CONTRIBUTIONS OF DETERMINANTS TO FIVE STAGES OF NONWAR SPECIFIC CYCLES IN THE TREND-ADJUSTED RATE OF CHANGE IN THE MONEY STOCK, 1877-1953
(per cent)

Specific Cycle Stage		Total[a]	High-Powered Money	Currency Ratio	Reserve Ratio
I	Trough[b]	100	23	59	18
III	Expansion	100	86	70	-54
V	Peak	100	-14	59	53
VII	Contraction	100	63	3	32
IX	Trough[b]	100	17	44	38

Source: Derived from Table F-1 after adjusting for intracyclical trend by subtracting from each series in every stage of a given cycle its average value over the five stages of that cycle.

Note: Relative contributions computed as follows: Averages of the trend-adjusted contributions of each determinant in the nonwar cycles were divided by the corresponding average for the money series. Some of the expansion and contraction stages of the pre-1907 cycles are omitted because of the limitations of the annual data.

[a] Lines may not add exactly to total because of rounding and approximation error.

[b] Stages I and IX differ only because of their respective inclusion or exclusion of stage I of the first cycle and stage IX of the last cycle, and stages I and IX of the war cycles.

average level of zero in each cycle, was divided by the corresponding average rate of change in the money stock for each of five stages of the nonwar specific cycles.[3] The measures pertain, therefore, to cyclical fluctuations about the average level. The third line shows, for example, that the currency ratio accounted, on the average, for 59 per cent of

[3] Chart 2 shows the average contribution to each stage. If we represent these after adjustment for trend by $\bar{m}_s$, $\bar{h}_s$, $\bar{c}_s$, and $\bar{r}_s$, where s denotes the stages from I to IX, the relative average contributions to each stage shown in Table 3 are $\bar{h}_s/\bar{m}_s$, $\bar{c}_s/\bar{m}_s$, $\bar{r}_s/\bar{m}_s$.

TABLE 4

RELATIVE CONTRIBUTIONS OF DETERMINANTS TO SPECIFIC CYCLES IN THE TREND-ADJUSTED RATE OF CHANGE IN THE MONEY STOCK, 1877-1953
(per cent)

	Specific Cycles	Total[a]	High-Powered Money	Currency Ratio	Reserve Ratio
1.	All 18, 1877-1953	100	27	46	26
2.	2 war, 1913-18 and 1937-48	100	51	24	25
3.	16 nonwar, 1877-1953	100	21	53	26
4.	10, 1877-1913	100	3	48	47
5.	6, 1918-53	100	37	56	7
6.	6 most severe, 1877-1953[b]	100	25	53	22
7.	3, 1877-1913	100	19	36	45
8.	3, 1918-53	100	27	60	12
9.	10 mild, 1877-1953	100	15	52	31
10.	7, 1877-1913	100	-6	56	48
11.	3, 1918-53	100	65	44	-8

Source: Same as for Table 3.

Note: Relative contributions computed as follows: Weighted averages of the amplitudes of the average trend-adjusted contributions of each determinant to five stages of cycles in the group were divided by the corresponding weighted average for the money series. The weights were the fractional number of cycles used in computing the average contributions for each stage. The weighting is appropriate because expansion or contraction stages are absent for some of the pre-1907 cycles due to the limitations of the annual data.

Amplitudes were the values of the average trend-adjusted contributions to each stage, taken positively if the same sign as the corresponding value for the money series, and negatively if the opposite sign. The amplitudes for the money series were simply its trend-adjusted levels without regard to sign.

In terms of the symbols used in footnote 3, an algebraic formula of the measure, disregarding the weights, is

$$\frac{\sum_s \bar{h}_s \ (\text{sign of } \bar{m}_s)}{\sum_s \left| \bar{m}_s \right|},$$

and similarly for $\bar{c}_s$ and $\bar{r}_s$.

[a] Lines may not add exactly to total because of rounding and approximation error.

[b] Severe cycles are those corresponding to the six most severe business contractions by the ranking in Table 1. Mild cycles comprise all other nonwar cycles.

the trend-adjusted rate of change in the money stock at peak stages. The three relative contributions for each stage add up to unity except for omission of the small approximation error.

The table highlights some features of the cyclical patterns evident graphically in Chart 2. First, the small contribution of high-powered money on the average to peak and trough stages; this is a reflection of its double-peak pattern, in which its contribution to stages V and IX is small, and to stage V opposite in sign to the money series. Second, the large contributions of the two ratios to the peak and trough stages, though the currency ratio contributes importantly also to the expansion stage and the reserve ratio also to the contraction stage.

The relative contribution for one or two of the determinants can be and sometimes is negative. When the contribution of a determinant for a stage has a sign opposite to the rate of change in the money stock, division of the former by the latter gives a negative number. For example, if high-powered money declines and the money stock rises, the relative contribution of high-powered money is negative, as in stage V. When the contributions of all three determinants do not have the same sign, the sign of the money series is determined by the sign of the larger contributions; the smaller contribution, if it has an opposite sign, is offset and becomes a negative relative contribution. The relative measures therefore indicate the degree of association between the contributions of each determinant and their sum, the money series.[4]

Table 3 brings out the variability of the relative contributions to cycle stages. Table 4 suppresses this variability among stages by first averaging together the contributions to the five stages. The measure in Table 4 can be interpreted as a numerical analogy of Chart 2: the trend-adjusted contributions of the determinants approximately equal the areas formed between each pattern in Chart 2 and its average level. The contributions would exactly equal these areas if Chart 2 were a bar chart instead of having lines connecting the points for each stage. Areas for each stage on the side of its average level opposite the money series areas are counted as negative contributions

[4] When the money series is zero, the relatives are infinite and hence undefined. Though finite, they may be very large in absolute value when the contributions are large and also of different signs, because the money series may then have a comparatively small value. Since the money series actually has no average values close to zero for the stages examined, this is not a problem.

and, on the same side, as positive contributions. To obtain a relative measure for each determinant, its contributions with appropriate sign were first weighted and summed over the five stages, then divided by the corresponding weighted sum for the money series. The weights are described in a note to the table. An alternative procedure is first to divide the contribution in each stage by the value of the money series in that stage, and then to average over the five stages. This variant, presented in Appendix A, gives largely the same results.

In terms of Table 4, the currency ratio is the proximate source of almost one-half the amplitude of all specific cycles in the money series, and high-powered money and the reserve ratio are each the source of about one-fourth. The relative contribution of high-powered money in all cycles is somewhat enlarged by the inclusion of the wartime cycles. While the contributions of all three determinants were exceptionally large during the war cycles, those of high-powered money were twice those of the two ratios, which is almost the reverse of the relative contributions of high-powered money and of the currency ratio for all cycles. The currency ratio accounts for slightly more than one-half the nonwar cycles and high-powered money, for only one-fifth; the reserve ratio has a relative contribution of one-fourth and does not differ significantly between the war- and nonwar-cycle groups. The primary importance of the currency ratio as the proximate source of all nonwar cycles in the money series holds also for most of the subgroups, while the relative contributions of the other two determinants vary considerably among the subgroups.

These results could be unduly influenced by extreme values in a few stages of particular cycles, which could swamp the typical values of many stages. That can be checked by excluding some of the extreme values. From a frequency distribution of the trend-adjusted contributions of each determinant, I selected for exclusion the three most extreme values.[5] They all occurred in severe cycles after World War I and exceeded in absolute value 25 per cent per year—a much greater rate than that of any other contribution of the determinants to the five stages of nonwar cycles. The excluded three stages were replaced by an average of the contributions of the determinants in the same

[5] One was a very large rate of increase in high-powered money during stage III of the 1918–21 specific cycle in the money series (see Table F-1). One occurred in stage IX of the 1927–31 cycle and another in stage I of the 1931–37 cycle; both stages cover the same period and contain a sharp rise in the currency ratio.

stage of the two remaining post-1918 severe cycles. The revised relatives are presented below[6] for the two subgroups mainly affected. As predictable from the nature of the exclusions, the revision raises the relative importance of the reserve ratio at the expense of high-powered money and the currency ratio (compare with Table 4). The amount of the revision, however, is not large, and any further revisions of this kind, whether or not proper, would have considerably smaller effects. Hence, extreme values do not account for the over-all results presented in Table 4.

The relative contributions of high-powered money and the reserve ratio changed appreciably over time. In the pre-1914 period, high-powered money had a small relative contribution and the two ratios were the proximate source of nearly all the cyclical variations in the money series. In the later period, the relative contributions of high-powered money and the reserve ratio were reversed. The reversal can be attributed partly to smaller fluctuations in the reserve ratio, starting around 1900 and continuing after World War I. The change in behavior of bank reserves apparently resulted from an improvement in the stability of the monetary system, which involved for commercial banks less danger from financial crises—notwithstanding the panics of 1907 and 1933. The improvement did not affect the average amplitude of fluctuations in the money series, however, which remained as large as ever until the end of World War II. While the amplitude of variations in the contribution of the reserve ratio diminished from the earlier to the later period, that of high-powered money increased and helped to maintain the cyclical amplitude of the money series. The change in behavior of high-powered money after 1914 resulted chiefly from the addition of Federal Reserve operations to changes in the gold stock—the other main source of variations in this determinant.

[6] Addendum to Table 4:

Line	*Nonwar Specific Cycles*	*Total*	*High-Powered Money*	*Currency Ratio*	*Reserve Ratio*
5.	6 cycles, 1918–53	100	36	51	13
6.	6 most severe cycles, 1877–1953	100	21	47	32

Source and computations are the same as for Table 4, except that contributions of the determinants to the stages listed in footnote 5 were replaced by an average of contributions to the same stage of the remaining two post-1918 severe cycles.

Surprisingly little difference in the contributions of the determinants is shown between cycles corresponding to severe and mild contractions in business activity. While the contribution of each determinant fluctuated, on the average, more in severe than in mild cycles, the increases of all three were of the same order (Chart 2). The increases reflect in part sharp reactions to banking panics, which occurred in four of the six severe cycles. Panics enlarged the amplitude of the cyclical patterns of the determinants but did not greatly alter their shape. The determinants typically rose in response to a panic reflecting, for high-powered money, gold inflows or Treasury or Federal Reserve operations; for the currency ratio, conversion of deposits into currency by the public; and for the reserve ratio, contraction of loans by the banking system. The response of high-powered money therefore typically contributed to a rise in the rate of change in the money stock, and that of the two ratios, to a fall, with the latter always predominating. The chief difference in relative contributions between mild and severe cycles is the somewhat greater value for high-powered money and lower value for the reserve ratio in severe cycles, and even that difference for the reserve ratio is entirely eliminated by the exclusion of a few extreme values.[7]

The reaction of the reserve ratio to severe cycles, however, was more pronounced than the figures indicate because of its slow response to panics. In a panic, the public demands currency immediately, which depletes bank reserves and reduces the reserve ratio. Since time is required to contract loans and sell bonds, the largest increases in the ratio come later, very often after increases in the currency ratio have subsided and after the specific cycle in the money series. Panic-induced increases in the reserve ratio therefore have often appeared in the initial stages of the subsequent specific cycle rather than the severe cycles. Without this delay, the relative contribution of the reserve ratio to the severe cycles would probably have been greater.

For severe and mild cycles separately, as well as for all nonwar cycles, high-powered money rose in importance from the earlier to the later period, and the importance of the reserve ratio declined. Both changes were much smaller for severe than for mild cycles,

[7] This can be shown by adjusting the post-1918 severe cycles for extreme values (see footnote 5). The adjusted figures for this subgroup in line 8 of Table 4, reading left to right, are 22, 54, and 23.

however, owing to the behavior of the currency ratio, which rose in importance from the earlier to the later period for severe cycles and fell in importance for mild cycles. The important differences in behavior between the two periods were therefore not characteristic of severe cycles alone, nor do they result from the accidental representation of the very severe 1929–33 contraction in the subgroup for the later period, but were even more characteristic of the mild cycles.

The diversity among individual cycles raises a question about the significance of these results, especially for small subgroups. In Appendix A the results are compared with several alternative measures to appraise the importance of particular methods of measurement. Such a comparison also reveals other characteristics of the cyclical behavior of the determinants. None of the other measures, however, contradicts the foregoing observations.

AMPLITUDE OF FLUCTUATIONS IN THE CONTRIBUTIONS OF THE DETERMINANTS

Although the relative contribution of the currency ratio was, roughly speaking, twice that of the other two determinants, the amplitude of cyclical variations in its contribution was not twice as large. The relative contributions are a function both of average amplitude and of conformity to the amplitude of the rate of change in the money stock. By the previous measures, the relative contributions of a determinant, even though individually large in amplitude, will, if half are positive and half negative, average close to zero. Table 5 gives the average amplitudes, computed as follows: The average contributions of the determinants to each of the five stages, displayed in Chart 2, were first adjusted for intracyclical trend, and the signs dropped to give absolute amounts; the data were then averaged for the five stages.

These measures of amplitude show that the contribution of the currency ratio had the largest fluctuations, but not by much. It was exceeded in amplitude by the contribution of the reserve ratio in the earlier period and almost equaled by that of high-powered money in both periods. The reserve ratio made smaller contributions in the later than in the earlier period, both absolutely and relative to the amplitude of the money series. High-powered money and the currency ratio had larger contributions in the later period, which accounts for the greater amplitude of the money series in that period.

TABLE 5

AVERAGE AMPLITUDE OF CONTRIBUTIONS OF DETERMINANTS TO SPECIFIC CYCLES IN THE TREND-ADJUSTED RATE OF CHANGE IN THE MONEY STOCK, 1877-1953
(per cent per year)

Specific Cycles	Money Stock	High-Powered Money	Currency Ratio	Reserve Ratio
16 nonwar, 1877-1953	6.6	4.4	4.7	3.3
10, 1877-1913	5.3	2.9	3.1	3.7
6, 1918-53	8.5	6.7	6.9	2.6

Source: Same as for Table 3.

Note: Average amplitude computed as follows: The trend-adjusted contributions of each determinant in absolute value to five stages of specific cycles in the group were averaged. Symbolically,

$$\frac{\sum_s \sum_c \left| h_{sc} \right|}{\sum_s \sum_c N_{sc}},$$

where h is the contribution of high-powered money, N is the number of stages; the subscript c enumerates the cycles covered from 1877 to 1953 and s the five stages; and similarly for the other series.

How would cycles in the money series have been affected if any two of the determinants had been constant and only the third had made contributions? The answer is that the amplitudes of the cycles would have been reduced, though not by as much as the relative contributions suggest. Such statements implicitly assume, of course, the independence of movements in the determinants, discussed shortly.

REGULARITY OF FLUCTUATIONS IN THE CONTRIBUTIONS OF THE DETERMINANTS

One other aspect of the cyclical behavior of the series may be examined—regularity. By how much do patterns for individual cycles deviate from their average pattern? Table 6 gives such measures of regularity and their ratio to the corresponding average amplitudes in Table 5. To compute the measures, the trend-adjusted contribution of a determinant in each stage was subtracted from its average contribution in that stage among cycles. These deviations were then averaged without regard to sign. Average deviations for cycles in the money series were derived in the same way.

For all nonwar cycles together, the contributions of the reserve ratio had the smallest average deviation and hence the greatest regularity,

though not as a percentage of average amplitude. The greater over-all regularity of the reserve ratio reflects its regular behavior in severe as well as mild cycles. In the severe cycles, high-powered money and the currency ratio often fluctuated violently and, as might be expected, irregularly from one cycle to the other. The main response

TABLE 6

REGULARITY OF CONTRIBUTIONS OF DETERMINANTS TO SPECIFIC CYCLES IN THE TREND-ADJUSTED RATE OF CHANGE IN THE MONEY STOCK, 1877-1953

Specific Cycles	Average Deviation of Contributions from Stage Averages[a] (per cent per year)				Average Deviation as a Percentage of Amplitude[b]			
	Money Stock (1)	High-Powered Money (2)	Currency Ratio (3)	Reserve Ratio (4)	Money Stock (5)	High-Powered Money (6)	Currency Ratio (7)	Reserve Ratio (8)
16 nonwar, 1877-1953	4.3	4.4	4.0	2.9	65	100	85	88
10, 1877-1913	2.9	2.7	2.3	2.9	55	93	74	78
6, 1918-53	5.9	7.8	7.0	3.7	69	116	101	142
6 most severe, 1877-1953[c]	5.7	5.5	6.5	2.8	n.c.	n.c.	n.c.	n.c.
10 mild, 1877-1953[c]	2.4	3.7	2.1	2.7	n.c.	n.c.	n.c.	n.c.

Source: Same as for Table 3.
Note: n.c. = not computed.

[a]Computed as follows: Differences in absolute value between trend-adjusted contributions of each determinant to five stages of cycles in the group and average contribution of the determinant for each stage were averaged. Symbolically (see note to Table 5 for explanation of notation),

$$\frac{\sum_s \sum_c \left| h_{sc} - \bar{h}_s \right|}{\sum_s \sum_c N_{sc}},$$

and similarly for the other series.

[b]Cols. 1-4 divided by the corresponding cols. of Table 5.

[c]Same as Table 4.

of the reserve ratio to those cycles, as suggested earlier, occurred later during the succeeding specific cycle, always mild except in the 1930's. For the mild cycles, the currency ratio had the most regular patterns.

The contributions of the reserve ratio became less regular after World War I. In view of their reduced amplitude in the later period, the small decline in their regularity probably stemmed entirely from the greater frequency of severe cycles in the post-1918 group, which also partly explains why the contributions of the other two determinants became less regular in the later period. This explanation does not help much with high-powered money, however. The regularity

measure for this determinant was less for pre-1914 cycles than for all mild cycles, and excluding severe cycles from the pre-1914 figure would reduce it. The higher figure for all mild cycles means, therefore, that the measure would be higher for mild cycles after World War I than before. Such comparisons of the contributions of the two ratios, on the other hand, suggest little change in their regularity for mild cycles before and after World War I.

The regularity of cycles in the money series reflects the regularity of cycles in the three determinants—though not additively, since movements in the determinants partly offset each other. The money series had less regularity in the latter period, in part because severe cycles were relatively more numerous, and in part because the contribution of high-powered money was less regular even in mild cycles. Since the table covers only three mild cycles for the latter period, this result cannot be taken to indicate a trend. Indeed, so far, cyclical variations in the money series since World War II have been fairly moderate.

INTERDEPENDENCE OF FLUCTUATIONS IN THE CONTRIBUTIONS OF THE DETERMINANTS

Movements in the determinants could be directly or indirectly related, as noted. We need to consider how strong such interrelations are. One indication is provided by the correlation coefficients presented in Table 7 between the contributions of the determinants. The observations are for the cycle stages covered by the preceding tables,

TABLE 7

CORRELATIONS BETWEEN THE CONTRIBUTIONS OF THE DETERMINANTS TO FIVE STAGES OF SPECIFIC CYCLES IN THE TREND-ADJUSTED RATE OF CHANGE IN THE MONEY STOCK

Specific Cycles	Product-Moment Correlation Coefficients		
	R_{hc}	R_{hr}	R_{cr}
All 18, 1877-1953	$-.33^{s}_{s}$	$-.20_{s}$	.03
16 nonwar, 1877-1953	$-.34^{s}$	$-.32^{s}$	.07
10, 1877-1913	-.30	$-.50^{s}$	.15
6, 1918-53	-.34	-.30	.02
6 most severe, 1877-1953[a]	$-.35_{s}$	$-.26_{s}$	.13
10 mild, 1877-1953[a]	$-.32^{s}$	$-.40^{s}$	-.04

Source: Same as for Table 3.

[s] Significantly different from zero at the .01 level.

[a] As defined in Table 4, footnote b.

usually five stages per cycle (three or four for some of the earlier cycles). The coefficients show no significant covariation between the contributions of the two ratios but do show a small but significant inverse covariation between their contributions and those of high-powered money. Since contributions of the two ratios to the money series are inverse to their first differences, the correlations indicate a tendency of high-powered money to move in parallel with the two ratios.

This correlation is subject to various interpretations. It may reflect a direct relation between the determinants in one or both directions or a similar response to other economic variables. Of the many possibilities, the least likely is a dependence of the two ratios on high-powered money. No evidence of it can be found in the analyses reported in later chapters. One widely alleged kind of such dependence concerns the reserve ratio: when high-powered money declines and the money market tightens, banks may be pressed for funds, and they may allow their reserve ratios to fall, at least temporarily.[8] Thus there might be an inverse relation between the contributions of high-powered money and of the reserve ratio to the money series. This implies that the reserve ratio is affected by interest rates, discussed at length in Chapter 5. Despite much attention in the literature, the relation is not supported by the data examined later.

An appealing explanation of the observed intercorrelation is that high-powered money has a direct dependence on the two ratios. As indicated in Chapter 1, the gold-standard mechanism and central-bank actions to stabilize the economy might be expected to produce such a dependence. Since this explanation implies that high-powered money depends on the *combined* contribution of the two ratios, Table 8 presents correlation coefficients between their combined contribution and that of high-powered money and—to study the relationship closely—separately for each stage of the nonwar specific cycles before and after World War I. Measuring the correlation among cycles for each stage separately avoids all spurious intracyclical covariation that exists between stages. Stages II, IV, VI, and VIII, excluded from the previous tables, are included here for the latter period. The adjustment of the data for trend used previously has been omitted here on the ground that any interdependence may apply to trend as well

[8] They may also (since 1914) apply to Federal Reserve Banks for loans, which would offset some of the contraction in high-powered money.

TABLE 8

CORRELATIONS BETWEEN THE COMBINED CONTRIBUTION OF THE CURRENCY AND RESERVE RATIOS AND THAT OF HIGH-POWERED MONEY TO VARIOUS STAGES OF SPECIFIC CYCLES IN THE RATE OF CHANGE IN THE MONEY STOCK

Stage of Specific Cycle	Product-Moment Correlation Coefficient		Regression Coefficient
	$R_{h,c+r}$	Level of Significance[a]	$R_{h,c+r}\frac{\sigma_h}{\sigma_{c+r}}$
10, 1877-1913			
Troughs[b]	-.63	.05	-.43
Expansions	-.80	.05	-.56
Peaks	-.36	n.s.	-.48
Contractions	-.88	.05	-.68
All stages	-.49	.01	-.26
6 nonwar, 1918-53			
Troughs[b]	-.66	n.s.	-.35
Expansions			
II	-.31	n.s.	-.29
III	-.97	.01	-2.32
IV	-.70	n.s.	-.99
Peaks	-.89	.05	-.53
Contractions			
VI	-.82	.05	-.93
VII	+.23	n.s.	+.80
VIII	+.69	n.s.	+.40
Stages III-VI	-.74	.001	-.89
Stages VII-II[b]	-.37 (-.51)[c]	n.s. (.05)[c]	-.28 (-.25)[c]

Source: Table F-1; no adjustment for trend.

[a].05 or lower.

[b]Each trough in the cycle group included once.

[c]Excluding 1918-21 cycle.

n.s. = not significant.

as to cyclical elements in the series. The coefficients in Table 8 are generally greater than those in Table 7 because they are a weighted sum of the corresponding correlation coefficients between the contributions of high-powered money and each ratio individually.[9]

Though many are fairly high, the correlations in Table 8 for individual stages cover a small number of cycles (10 before World

[9] Specifically,

$$R_{h,c+r} = R_{h,c}\frac{\sigma_c}{\sigma_{c+r}} + R_{h,r}\frac{\sigma_r}{\sigma_{c+r}},$$

where

$$\left(\frac{\sigma_c}{\sigma_{c+r}}\right)^2 + \left(\frac{\sigma_r}{\sigma_{c+r}}\right)^2 = 1 - 2R_{c,r}\left(\frac{\sigma_c}{\sigma_{c+r}}\right)\left(\frac{\sigma_r}{\sigma_{c+r}}\right).$$

If

$$R_{c,r} \cong 0 \text{ and } \sigma_c \cong \sigma_r, \qquad R_{h,c+r} = .7R_{h,c} + .7R_{h,r}.$$

War I and 6 after), and many of the coefficients are insignificant at the 0.05 level. The significant coefficients do not occur all in the same stages of the later and earlier cycles. For the earlier cycles, the correlation is significant in all but the peak stages; for the later cycles, in stages III, V, and VI only, covering the middle part of each specific cycle in the money series (unless the 1918–21 cycle is excluded). In the bottom two lines of the table, stages of the later cycles are combined into two groups. The group of four stages III through VI has a substantially larger negative regression coefficient than the group of other stages has.

For the later cycles, the results are heavily influenced by Federal Reserve credit outstanding. It is plausible, as an explanation of the particular pattern of the correlation coefficients, that the Reserve Banks typically took more vigorous action to dampen variations in the rate of change in the money stock in its expansion and peak stages than in its contraction and trough stages. It is consistent with what is known of Federal Reserve policies during much of the 1920's and 1930's, the periods mostly covered by the calculations. After being criticized for its part in the World War I inflation, the Federal Reserve Board was for many years highly sensitive about doing anything that might contribute to inflation; its steps to counteract speculation in the 1928–29 stock market boom, for example, are well known. In contrast, the idea that vigorous monetary expansion should accompany business contractions has developed slowly and has gained wide acceptance only since World War II. The results in Table 8 throw together diverse cycles, of course, and do not distinguish possible differences in Federal Reserve behavior over the period. That the money series has displayed less fluctuation since World War II suggests that the Reserve Banks have offset the two ratios more completely since then than previously, though a detailed analysis of more postwar cycles would be necessary to confirm it.

For the pre-1914 cycles, a similar explanation would emphasize the offsetting effects of gold flows and, to a lesser extent, of Treasury operations. The regression coefficient is much lower for all stages together than for each of the stages individually, because the constant term of the regression differs among stages. This means that the offset is probably lower computed from stage-to-stage variations than from cycle-to-cycle variations for a given stage.

If we accept the regression coefficients at face value, they imply that the dampening effect of gold flows before 1914 and Federal Reserve actions thereafter did not prevent the two ratios from independently affecting the money stock.[10] For the earlier cycles, variations in the combined contribution of the two ratios were offset by one-fourth, and for the later cycles also by one-fourth in stages VII through II and by nine-tenths in stages III through VI. Hence, the Federal Reserve Banks appear to have increased the offset materially, but for one part of each specific cycle only. The fact that the offset varied in relative amount among different stages of the cycle, particularly in the later period, is perhaps one reason the contribution of high-powered money appears to be so erratic.

That the Reserve Banks were responsible, through control of high-powered money, for all variations in the money series is possible but very unlikely. If a particular pattern were to be produced in the money series through high-powered money, the desired pattern would be superimposed on the contributions of the two ratios. The contribution of high-powered money would then be composed of two parts, an offset to the two ratios and the desired pattern, and the total would not necessarily be closely related to either. Its relative contribution might even be low and the (negative) correlation with the combined contribution of the two ratios less than perfect, just as we find. But, if so, the regression coefficient would be unity or approximately so, which it is not for all stages, and the average cyclical pattern of the money series would bear little resemblance, except by accident, to the contributions of the two ratios. As shown by Chart 2, however, the patterns of their contributions and of the money series are similar.[11] We may tentatively infer that the two ratios played an important independent role in the specific cycles of the money series. As measures of that conformity, their relative average contributions are relevant;

[10] The regression coefficients are an understatement of the offset, only if the other factors determining high-powered money left out of the regression (defined to affect it positively) are positively correlated with the combined contribution of the two ratios. This seems unlikely for offsets due to policy, in view of the out-of-phase relation between variations in the money series and business activity.

[11] Conceivably, this could result, not from the effect of the currency ratio on the money stock, but from a dependence of the currency ratio on the money stock owing to temporary redistributions of money balances, when new money enters the economy, between sectors that maintain different currency ratios. This possibility is examined in Chapter 4 and found unimportant.

though, in view of the offsetting effects of high-powered money, the measures overstate in varying degrees the role of the two ratios.

Indeed, in view of Federal Reserve pronouncements during much of the period that it was not concerned solely with what happened to the money stock and was not to be considered fully responsible for it, the correlation coefficients for the later period may not reflect predesigned Federal Reserve policies at all. The correlations for both periods may reflect, instead, a similar response of high-powered money and the two ratios to business cycles. Such an indirect relation does not require or imply any direct dependence of the determinants on each other. Indirect relations clearly affected the regression coefficient for stage III, because deliberate offsetting movements would not produce a regression coefficient greater than unity. Although both kinds of influence imply interdependence, they lead to quite different interpretations of the sources of change in the money stock. Unfortunately, there is no simple way to measure the relative importance of the two kinds of interdependence.

Other considerations do not resolve the ambiguity of the available evidence. First, the correlation coefficients between the concurrent contributions of the two ratios in Table 7 are all virtually zero. This implies that the two were not affected in a common way by business cycles. It is therefore unlikely that either ratio and high-powered money were affected in a common way, unless possibly the effects had lags of quite different lengths. Barring that, the correlations in Table 8 seem to reflect (except stage III of the later cycles) a direct dependence of high-powered money on the two ratios.

Yet, the implication of this inference conflicts with our understanding of how such a dependence would operate. The inferred dependence might be expected to operate sluggishly and with considerable delay, which casts doubt on the foregoing interpretation of Tables 7 and 8. We may perhaps be willing to accept the implication of small delay for Federal Reserve operations in the later cycles, but what about the earlier ones? Did gold flows and Treasury actions offset *concurrently* one-fourth of the combined contribution of the two ratios? That gold flows could work so rapidly is questionable, since they respond to changes in the money stock by way of induced changes in prices and the balance of international payments. Treasury operations were too small and erratic to account all alone for the

correlation. We seem to face a dilemma. If we interpret the correlations for the later period as reflecting Federal Reserve actions to offset movements in the two ratios, it seems only reasonable to attribute a corresponding role to gold flows (and in part to Treasury operations) in the earlier period.

One way to resolve the dilemma is to attribute most of the correlation in the earlier period to parallel responses of the determinants to business cycles, and just the *increase* in the degree of correlation from the earlier to the later period to Federal Reserve actions. By this interpretation, one-fourth of the contributions of high-powered money and the two ratios offset each other because of their similar responses to business cycles. In the later period, that offset seems to account for all the correlation in stages VII through II and for part—a fourth to a third—of the correlation in stages III through VI. For the latter stages, the regression coefficient suggests that Federal Reserve Banks were responsible for offsetting an additional 65 per cent or so (nine-tenths minus one-fourth) of the movements in the two ratios, though this is overstated by the large regression coefficient in stage III. The part of the coefficient in excess of unity cannot in any meaningful sense be interpreted as an intended offset and probably reflects the common effects of business cycles.

Covariation among the determinants means that some of their contributions to the money series were offset and, in a sense, were not contributions at all. There is no entirely satisfactory formula for correcting their relative contributions for interdependence. One way to make a rough adjustment, however, is to use the figures in Table 8 to delete the part of the contributions of the determinants that was offset, which leaves the money series the same, and to recompute the relative contributions with the part not offset. If we assume that the covariation always added to the combined relative contribution of the two ratios and subtracted from the relative contribution of high-powered money, we may adjust the former downward and the latter upward. This assumption probably holds for most cycle stages, but it produces some overstatement of the true correction. To the extent that the covariation reflects the common effects of business cycles, the square of the *correlation* coefficient is an estimate of the fraction offset of cyclical variations in the contributions. To the extent that the covariation reflects a response of high-powered money to the contributions of the

two ratios, the *regression* coefficient is an estimate of the fraction offset of cyclical variations in the contributions of the two ratios.

In the earlier period, for which the tentative conclusion was that the covariation reflects the common effects of business cycles, we may in the foregoing manner adjust the relative contributions shown on line 4 of Table 4. The corresponding correlation coefficient in Table 8 is −0.49 and its square is 0.24. If we reduce the relative contributions of the currency and reserve ratios by 24 per cent, they both become 36 per cent. Their combined relative contribution is therefore 72 per cent (instead of 95 per cent as shown in Table 4), and the remaining 28 per cent is the contribution of high-powered money (instead of 3 per cent as shown in the table).[12]

For the later period, the conclusion was, again, that part of the cyclical variations in the contributions reflects the common effects of business cycles—perhaps one-fourth, as in the earlier period, perhaps less. If a fourth, the implied adjustment of line 5 in Table 4 lowers the relative contributions of the currency and reserve ratios to 42 and 5 per cent, respectively (from 56 and 7), and raises that of high-powered money to 53 per cent (from 37). In addition, an additional offset of about 65 per cent of the contributions of the two ratios to stages III through VI was perhaps due to actions of the Federal Reserve Banks, a total offset of nearly 90 per cent. This would further reduce the relative contributions of the two ratios in those stages to about 6 and 1 per cent, respectively, and raise that of high-powered money to 93 per cent. Although these adjustments for the earlier period do not change our previous ranking of the relative contributions of the determinants, the ranking for the later cycles is altered radically. The corrections imply that high-powered money was the primary contributor to the later cycles, and a moderate contributor to the earlier cycles, ranking

[12] It would understate the adjustment to estimate it as 24 per cent of the original relative contribution of high-powered money, 3 per cent, which is quite low because of the negative relative contributions of this determinant to the money series in certain stages. The procedure in the text assumes that the combined relative contribution of the two ratios was positive in all stages, which is true for the averages over the two periods discussed. Of course, the correlation coefficient is only an estimate of the average size of the correction, which theoretically is some function of the unspecified variables that produce the common fluctuations in the determinants.

A more accurate procedure than followed here would be to adjust the contributions in each stage of each cycle before computing the average relative contributions. This procedure would lend an appearance of detailed exactness to the results, however, that the general method does not justify.

third after the two ratios. While admittedly crude, the foregoing corrections may be taken as a rough (and probably exaggerated) indication of the part played by interdependence.

SUMMARY OF CONTRIBUTIONS OF THE DETERMINANTS TO CYCLICAL MOVEMENTS IN THE RATE OF CHANGE IN THE MONEY STOCK

The three proximate determinants of the money stock reflect the behavior of three sectors of the economy: high-powered money, the behavior of the government; the currency ratio, of the public; and the reserve ratio, of commercial banks. The formula presented at the beginning of this chapter defines the contribution of each determinant to the rate of change in the money stock. Although the formula can be approximated fairly closely for finite periods, there are many ways to compute the average relative contribution of the determinants over a period of time. The method adopted here was to use specific cycle stages of the money series and to compute various averages of the relative contributions. They bring out the relative importance of the channels through which cyclical variations in the money series occurred and provide a first step in identifying the factors responsible for those variations.

By these measures—and ignoring interdependence for the moment—the currency ratio is the chief contributor to specific cycles in the rate of change in the money stock, equaling the contributions of the other two determinants combined. The importance of its contributions reflects their large amplitude and their tendency to parallel those of the other two determinants; both attributes kept its contributions in conformity with the resulting cycles in the money series. The contributions of high-powered money, while just as large in amplitude, were very irregular and did not parallel the money series closely. The contributions of the reserve ratio had a fairly regular cyclical pattern but a comparatively small amplitude, though in the pre-1914 period its relative contribution rivaled that of the currency ratio.

The above statements should be amended to take account of interdependence among the contributions of the determinants. Interpretation of interdependence is hazardous, and the inferences made must be viewed as highly tentative. We found that perhaps 90 per cent of the combined contribution of the two ratios in stages III through VI of

the later cycles was offset by the contribution of high-powered money, presumably in large part a result of intentional Federal Reserve policy. The erratic contribution of high-powered money in those cycles may be explained in part by that dependence. A weaker correlation for the other stages and for the earlier cycles suggests an offset of 25 per cent with the same effect but for the different reason that the determinants responded in a similar way to business cycles.

There is no entirely satisfactory way to take account quantitatively of this covariation in the measures of relative contribution. The adjustment used here suggests that, after deleting the part offset of the contributions, each of the three determinants produced about one-third of the pre-1914 specific cycles in the money series, the two ratios accounting for slightly more than high-powered money did. For the post-1918 cycles, stages VII through II and III through VI should be treated separately. For stages VII–II we found, after adjustment, that high-powered money made the largest contribution, though it and the currency ratio each produced almost half the cyclical variations in the money series, and the reserve ratio the small remainder. For stages III–VI, high-powered money was responsible for nearly all the cyclical variations in the money series.

Although the corrected figures may overemphasize, if anything, the contribution of high-powered money, they may still seem surprising, because they do not attribute all variations in the money series in the later period to high-powered money, and because they attribute an important role to the currency ratio in both periods. High-powered money dominated secular movements in the money series. Even in discussions of cyclical movements, high-powered money and the reserve ratio have generally received all the attention, while the currency ratio has been little noticed. One reason for the differential treatment is that sources of variation in high-powered money and the reserve ratio involve activities of the government and banks—both easy to discuss (and exaggerate)—whereas sources of variation in the currency ratio involve actions of innumerable holders of money and are, except in panics, obscure. While many students of the money supply have been aware of variations in the currency ratio, the present results highlight their importance, not only in panics but also for all cycles in the money series.

The emphasis on panics in discussions of the currency ratio has

perhaps created the mistaken impression that the sources of change in the money series differ radically between panic cycles and mild cycles, whereas the difference is in fact small. The important differences among the cycles in the money series occur between those before and after the establishment of the Federal Reserve Banks; fluctuations in high-powered money became larger and a more important source of variation in the money series thereafter while, except for the 1930's, the reserve ratio lost much of its earlier volatility. Despite the occurrence of fewer panics after World War I, however, the cyclical behavior of the currency ratio has remained largely unchanged. In view of the changing sources of variations in the money series over time, it is remarkable that those variations have remained so similar both in amplitude and in their timing relation to reference cycles (a point taken up again in Chapter 6).