Volume Title: Determinants and Effects of Changes in the Stock of Money, 1875–1960

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Volume Publisher: NBER

Volume ISBN: 0-870-14097-3

Volume URL: http://www.nber.org/books/caga65-1

Publication Date: 1965

Chapter Title: The Cause-and-Effect Relation between Money, Prices, and Output

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Chapter URL: http://www.nber.org/chapters/c1645

Chapter pages in book: (p. 234 - 278)

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THE CAUSE-AND-EFFECT RELATION BETWEEN MONEY, PRICES, AND OUTPUT

ASSEMBLING EVIDENCE on the behavior of the three determinants of the money stock has taken us far afield—into details of financial history for high-powered money, into various aspects of consumer behavior for the currency ratio, and into many of the developments in banking and other financial institutions for the reserve ratio. Even though frequently tentative, the findings help to show how far changes in the money stock can be regarded as resulting from concurrent variations in prices and output and how far they occurred independently of such variations. In this respect, the findings bear upon the causal connection between the money stock, on the one hand, and prices and output, on the other.

Chapter 1 summarizes the evidence on the covariation of cyclical movements in money and economic activity; the first section of this chapter documents an equally close covariation over longer periods between changes in the money stock and in prices. The covariation was either accidental, which is hardly plausible, or reflected a one-way or mutual dependence between the variables. This chapter is concerned with the direction of influence: whether the dependence is mutual or runs primarily from money to prices and output or primarily from prices and output to money.

The method of inquiry will be to examine the effects of price and output movements on the three determinants of the money stock to see whether such effects are sufficient to explain the observed covariation. Insofar as these effects are not sufficient, the implication is that the covariation reflects in large part the reverse effect of changes in the money stock on prices and output. Directions of influence can thus be determined, at least to some degree, by extending the evidence of

previous chapters on the factors affecting the determinants of the money stock.

The radical difference between short- and long-run sources of change in the money stock advises a separate treatment, as in the preceding chapters, of secular and cyclical movements. In the discussion of secular movements, taken up first, changes in the rate of growth of real income and output are largely ignored and attention is confined to price changes, though a concluding section adds some remarks on variations in the secular growth of output.

1. Secular Movements in Money and Prices

THE EVIDENCE

If long-run price changes produced the variations in growth of the money stock, they must have done so through one or more of the three determinants. Accordingly, to determine whether the money stock or the price level is the independent variable in their long-run association, we may start by examining the possible effects of price changes on secular movements in the three determinants.

Identifying the source of secular movements in the money stock is greatly simplified by the dominant contribution of one determinant. Chapter 2 shows that changes in high-powered money accounted for nine-tenths of the over-all growth in the money stock from 1875 to 1955. In the first half of the period, from 1875 to 1917, this fraction was only 68 per cent, mainly because of a steady decline in the currency-money ratio, which accounted for most of the remaining growth of the money stock. From 1919 to 1955 and excluding World War II, the fraction attributable to high-powered money was more than 100 per cent. The currency ratio was slightly lower in 1955 than in 1919, the reserve ratio slightly higher; together, the changes in the two ratios alone would have produced a small decline in the money stock during that period. The expansion of high-powered money contributed over 100 per cent because it more than offset the negative contribution of the two ratios.

Table 28 indicates that the two ratios played a minor role in most subperiods as well. The table gives eighteen average rates of change in the variables between successive reference cycle bases from 1877 to 1954. The corresponding rates for wholesale prices are also shown

TABLE 28

SECULAR MOVEMENTS IN PRICES AND IN THE MONEY STOCK, AND SOURCES OF MOVEMENTS IN THE MONEY STOCK, 1877-1954: AVERAGE RATES OF CHANGE BETWEEN REFERENCE CYCLE BASES CENTERED AT PEAKS
(per cent per year)

Period Between Reference Cycle Bases, Centered at Peaks			Prices[b] (1)	Money Stock[c] (2)	AVERAGE RATE OF CHANGE IN MONEY STOCK ATTRIBUTED TO:[a] High-Powered Money		Currency Ratio (5)	Reserve Ratio (6)
					Total (3)	Gold Stock (4)		
Mar.	1882 - Mar.	1887	-3.3	5.0	2.8	6.2	2.4	-0.2
Mar.	1887 - July	1890	-0.3	4.9	2.6	2.8	1.1	1.2
July	1890 - Jan.	1893	-3.0	5.7	4.6	-3.6	1.1	0.1
Jan.	1893 - Dec.	1895	-3.5	0.9	-0.7	-2.7	1.9	-0.3
Dec.	1895 - June	1899	2.3	7.4	5.3	11.5	0.7	1.2
June	1899 - Sept.	1902	3.7	11.2	6.5	9.4	2.3	2.5
Sept.	1902 - May	1907	1.4	5.8	4.2	4.9	1.0	0.6
May	1907 - Jan.	1910	2.8	7.0	4.7	7.5	3.5	-1.4
Jan.	1910 - Jan.	1913	1.0	5.8	1.8	3.4	2.2	1.9
Jan.	1913 - Aug.	1918	7.1	6.7	6.4	4.7	0.0	0.4
Aug.	1918 - Jan.	1920	19.1	27.4	25.5	8.5	-4.1	5.3
Jan.	1920 - May	1923	-9.5	1.8	-1.7	8.9	2.7	0.8
May	1923 - Oct.	1926	0.5	5.7	2.5	3.7	2.4	0.7
Oct.	1926 - June	1929	-7.0	-0.2	1.2	-0.7	-1.6	-0.6
June	1929 - May	1937	-0.6	-1.1	5.7	10.1	-1.9	-4.8
May	1937 - Feb.	1945	2.0	8.6	11.3	10.2	-0.8	-2.1
Feb.	1945 - Nov.	1948	12.4	16.9	14.1	2.6	-1.7	4.7
Nov.	1948 - July	1953	3.5	2.4	1.0	0.7	1.1	0.5

Note: Rates of change between successive cycle bases. A cycle base is the average value of the series from the initial to the terminal trough of each reference cycle and centered at the reference peak.

Data for two earlier reference cycles which became available too late to be used in the analysis allow the following additions:

	(1)	(2)
June 1869 - Oct. 1873	-5.24	5.35
Oct. 1873 - Mar. 1882	-2.13	5.01

[a] Computed by formula 2 in Chap. 2. Source of data except gold stock, same as for Chart 2. Gold stock same source as for Chart 6.

[b] Wholesale prices, Historical Statistics, 1949, App. 23-24, p. 344.

[c] May not equal the sum of cols. 3, 5, and 6 because of rounding and approximation errors. Rankings (used later in Table 29) of the values for July 1890-Jan. 1893, Sept. 1902-May 1907, Jan. 1910-Jan. 1913, and May 1923-Oct. 1926 were based on three significant figures: 5.73, 5.79, 5.83, and 5.70, respectively.

TABLE 29

CORRELATION BETWEEN SECULAR MOVEMENTS IN PRICES AND IN THE MONEY STOCK AND ITS SOURCES, 1877-1954

Reference Cycle Bases Covered[b]	RANK CORRELATION COEFFICIENT[a] BETWEEN AVERAGE RATES OF CHANGE IN PRICES AND IN:				
			Money Stock, Attributed to:		
				Ratio of High-Powered Money to Gold Stock and to:	
	Money Stock (1)	Gold Stock (2)	Ratio of High-Powered Money to Gold Stock[c] (3)	Reserve Ratio (4)	Reserve and Currency Ratios (5)
All	$.81^{ss}$	$.24^{n}$	$.28^{n}$	$.31^{n}$	.34
Nonwar	$.82^{ss}$	$.25^{n}$	$.26^{n}$	$.24^{n}$	.37
Pre-1914	$.92^{ss}$	$.75^{s}$	-.52	-.62	$-.45^{n}$
Post-1919	$.79^{s}$	$-.14^{n}$	$.79^{s}$	$.79^{s}$	$.86^{s}$

[a]Significance levels are based, for top two lines, on the t test; for bottom two lines, on E. G. Olds, "Distributions of Sums of Squares of Rank Differences for Small Numbers of Individuals," Annals of Mathematical Statistics, June 1938, pp. 133-148, Table IV. Use of figures for two earlier reference cycles (see note to Table 28) in the rank correlations gives:

	(1)
All cycles	$.78^{ss}$
Nonwar cycles	$.75^{ss}$

[b]Same as in Table 28.

[c]That is, the average rate of change of high-powered money, minus the average rate for the gold stock.

s = significantly different from zero at .025 level or less.
ss = significantly different from zero at .001 level or less.
n = not significantly different from zero at .10 level.
No citation means significantly different from zero at a level between .05 and .10.

for comparison. The rates were computed from the average levels of the variables, trough-to-trough of each reference cycle, in order to eliminate cyclical variations. While no measure eliminates them entirely, this particular one is likely to be as effective as any. The importance of high-powered money is evident from the high fraction of the growth of the money stock attributable to it in most of the subperiods. When the fraction attributable to it was low, moreover, the growth of the money stock usually was comparatively small or negative. Put differently, variations in the growth of high-powered money and of the money stock were nearly proportional: the regression coefficient of column 3 on column 2 of the table is 0.88, and the square of the correlation coefficient is 0.84. Variations in the secular growth of the money stock have a much lower correlation with the contributions of the other two determinants.

Table 29 summarizes the evidence by means of some correlation coefficients derived from Table 28. They show that, before 1914 and for the period as a whole, price changes correlated with variations in the growth of the money stock much more closely than with any of the sources of those variations separately. All the correlations except that with gold after 1919 are positive. This is to be expected if the major direction of influence is from money to prices, since each determinant is then associated with price movements through its effect on money. Any discrepancies between changes in the money stock and in one of its determinants will tend to make the correlation between prices and that determinant lower than between prices and money. The higher correlation between money and prices might be consistent with the opposite direction of influence, from prices to money, if prices affected most of the determinants in a positive direction. The higher correlation between money and prices might then reflect a combination of the price effects on each determinant.[1] But prices affect the gold stock negatively, and probably did not strongly affect the other sources of change in high-powered money in a positive direction, either.[2] Any effects of prices on the money stock in a positive

[1] When the intercorrelation among the determinants is fairly low, the correlation coefficient between prices and money will exceed an average of the coefficients between prices and each determinant.

[2] The positive correlations in Table 29 are no indication of such effects. If changes in the money stock affect prices, then prices will for this reason alone show a correlation with components of the money stock, which may explain a large part, possibly all, of the correlation shown in cols. 2 to 5 in Table 29.

direction must have occurred entirely through the currency and reserve ratios or, at most, through all the nongold sources of change in the money stock. Yet, before 1914 and for the period as a whole, the correlation of prices with those nongold sources, singly or in combination, is substantially weaker than it is with the money stock itself, and is even negative for the pre-1914 period. An effect running primarily from prices to money would produce a higher (positive) correlation of prices with the nongold sources of change in the money stock than with the money stock itself; and it would produce a negative correlation of prices with changes in the gold stock. Neither is observed for the pre-1914 period.

The correlations for the post-1919 period, taken alone, are consistent with either or both directions of influence. The correlation of prices with the gold stock is moderately negative and yet strongly positive with the other determinants and with the total money stock—a result of the contribution of Federal Reserve credit. The correlation in column 5, higher than that in column 1, would point to an effect running primarily from prices to money if certain conditions prevailed: if the difference were large and significant—as it is not—and if the behavior of the determinants could be attributed to price effects. The preceding chapters provide no evidence, however, of such price effects. For that reason, the high correlation between prices and the money stock for the post-1919 period offers evidence for the importance of the opposite effect, running from money to prices, even though the observed correlations of prices with the determinants for that period offer no evidence either way. On this interpretation, the high correlations in columns 3 to 5 for the post-1919 period reflect primarily the effect of money on prices.

These comparisons are based on rank correlation coefficients. The differences between the coefficients are large and so appear significant, but unfortunately appropriate tests of significance do not exist. To conduct such tests, the product-moment correlation coefficients presented in the tabulation on p. 240 serve as an addendum to the table. They cover the period 1877–1954 for the three most relevant variables: prices, the money stock, and the nongold sources of change in the money stock. These coefficients are larger than the corresponding ones in Table 29, because the extreme values, which receive greater weight, lie near the same linear regression that fits the other values.

Reference Cycle Bases	PRODUCT-MOMENT CORRELATION COEFFICIENT BETWEEN AVERAGE RATES OF CHANGE IN PRICES AND IN: Money Stock	Money Stock Attributed to Ratio of High-Powered Money to Gold Stock and to Reserve and Currency Ratios
	(1)	(5)
All	0.88	0.69
Nonwar	0.90	0.71

By Hotelling's test,[3] the difference between the coefficients in the two columns for both lines is significant at the 0.025 level, thereby confirming the impressions derived from Table 29 for the whole period that the major direction of influence is from money to prices.

The implication of this evidence, even for the pre-1914 period, is not that prices had no effects on the determinants but that those effects are insufficient to explain the long-run covariation between prices and the total money stock. Such effects probably did occur, though usually not in the direction required to explain the covariation. Treasury operations and silver purchases tended at times to expand high-powered money, when the growth of the gold stock was low and prices were falling, and conversely. For example, the ratio of high-powered money to the gold stock, as shown by Chart 4, was higher in the 1880's and 1890's when prices were falling, than in the following two decades when prices were rising. The ratio was at its lowest point during the 1930's when the growth rate of the gold stock was highest. Treasury operations as a whole have blunted the impact on the money stock of changes in the rate of gold production, which may in part be the reason for the negative correlations for the pre-1914 period (columns 3 to 5 of Table 29). For the later period, that effect was either not strong or was more effectively counteracted by positive covariations reflecting the effect of money on prices.

[3] See Harold Hotelling, "The Selection of Variates for Use in Prediction with Some Comments on the General Problem of Nuisance Parameters," *Annals of Mathematical Statistics*, Sept. 1940, pp. 271–283. This test takes account of the association between the money stock and its nongold components; the correlation coefficient between them is 0.79 for nonwar and 0.77 for all cycles. The test is designed to answer the question: Which predicts prices better, the money stock or its nongold components? It is not entirely appropriate for use in this study, which asks a different question: Does the money stock predict prices better than prices predict the nongold components? How the different use may affect the results of the test is not apparent.

Insofar as movements in interest rates and prices were correlated, there was a tendency toward expansion of issues of national bank notes when prices and interest rates rose, and conversely. But that was a minor factor in the growth of high-powered money.

As for the currency and reserve ratios, analysis of their long-run behavior did not reveal a dependence on prices. To be sure, some of the largest deviations of the ratios from their long-run trends reflected financial panics, which were accompanied by sharp price swings. While temporary, those price swings often left an imprint on the data covering a longer period than the business cycles in which the swings originated. Since the greater part of the price swings came after rather than before each panic, however, the jump in the ratios, which was immediate, reflected the panic rather than the ensuing behavior of prices.

Interest rates had some effects on the two ratios. A rise in rates paid on time and savings deposits appears to reduce the demand for currency, though if general interest rates also rise, the demand for commercial bank deposits may decline, moderating the reduction in the ratio of currency to the money stock. A rise in interest rates also induces a shift from demand to time deposits, which reduces the required reserve ratio of banks and hence the total reserve ratio. These effects produce a slight positive relation between interest rates and the money stock (defined to include time deposits). No effect was found, however, of an effect of interest rates on the usable reserve ratio.

Insofar as prices and interest rates move together, prices can affect the money stock through these channels. The effects operate mainly in the long run, however, and shifts between demand and time deposits had little effect before 1914, when reserve requirements only for some state banks distinguished between the two kinds of deposits.

The behavior of Treasury operations and the two ratios, however interpreted, is largely irrelevant to the present discussion, since together they account for only a small part of the secular variations in monetary growth. If the effects of prices on money are to explain the long-run covariation between them, they must have occurred largely through high-powered money. It happens that two important components of high-powered money—the gold stock and Federal Reserve credit outstanding—are or might be thought to be dependent upon price movements. The evidence pertaining to these two components

should be reviewed, therefore, with a discussion also of some of the possible objections to the conclusions derived from Table 29.

The Gold Stock. The growth of the domestic gold stock (Chapter 3) was broken down into two parts: one, from growth of the world stock through production in excess of current consumption in industry and arts; and the other, from changes in the U.S. share of the world stock through international trade. Both made substantial contributions. How were they affected by price movements?

The growth of the world gold stock is closely affected by changes in commodity prices. So long as some governments commit themselves to the gold standard and exchange their currency for gold at a fixed rate, the production and nonmonetary uses of gold depend on the general level of prices in gold-standard countries. When that level falls, the real value of gold in terms of commodities rises. The rise enhances the incentive to find new mines and new means of refining gold-bearing ores and to substitute other metals for gold in industry and arts, leaving more of current world production to be added to the monetary stock. When prices rise, the reverse occurs: profits from mining gold fall, and output is curtailed, inducements to increase the sources of supply fade, and nonmonetary uses expand. That price changes affect world gold production and with varying lags is confirmed by the evidence examined in Chapter 3.

A given country's share of the world gold stock is affected by its balance of payments, which incorporates the trade and the capital balance and includes effects of changes in monetary standards and of foreign central bank actions. So long as its internal prices change in rough proportion to world prices and there are no drastic changes in either the pattern of international trade and capital flows or the quantity of domestic currency and deposits created per unit of gold by monetary institutions, its share will vary more or less in proportion to the size of its national output relative to world output. Changes in the purchasing-power parity of each country's currency also have an important effect on its share. A fall in the level of internal prices relative to world prices will ordinarily increase the gold inflow and the total stock—and conversely, if internal prices rise. In this respect, internal price movements affect domestic gold stocks in the same direction that world price movements affect the world gold stock.

Such effects on the secular growth of the U.S. gold stock and their

varying lags are discussed in Chapter 3.[4] A good example is provided by the well-defined turn during the mid-1890's in the long-run trend of prices. The cumulative effect of falling world prices from 1873 to the 1890's increased world gold production and eventually also the growth of the world and the U.S. gold stock—but not until the mid-1890's. A similar reaction occurred during the 1930's but much more rapidly. That is probably why concurrent changes in prices and the gold stock have even a slightly negative correlation in Table 29 for the post-1919 period, in contrast to the strongly positive correlation for the pre-1914 period.

It is important to note the lags in these effects, because the positive relation between concurrent changes in prices and the gold stock before 1914 is opposite to that produced by the lagged effects just described. To extend the foregoing example: when the growth of the gold stock finally responded in the mid-1890's to the long decline in world prices which had started in 1873, prices began a long-run rise. The coincidence of turns cannot be attributed to the effect of price movements on the gold stock; that effect is a lagged inverse relation between prices and the gold stock. Furthermore, if price movements had an entirely nonmonetary origin, they would not except by accident coincide with movements of the gold stock in the same direction. Yet, generally, the gold stock grew slowly during the latter 1800's, just so long as prices fell, and subsequently grew rapidly, just so long as prices rose. It seems far more plausible to attribute this positive correlation, not to chance, but to the effect of changes in the gold stock on the money stock and hence on prices.

If prices affected the gold stock with little or no lag, there would have been little long-run variation in prices before 1914 except as a result of autonomous changes in gold production, since changes in the gold stock accounted for most of the long-run changes in the money stock. Changes in the price level would have been limited by a tight feedback-control mechanism. The lagged reaction of the gold stock to changes in commodity prices, therefore, is what makes the gold standard a poor means of stabilizing the price level, rather than failure of gold-stock changes to affect prices—as often contended.

[4] That discussion is couched in terms of the commodity value of gold instead of commodity prices; the former moves inversely to prices and also takes account of changes in the gold content of the dollar.

After 1914, the long-run effect of prices on the gold stock appears to have had a much shorter lag. Yet, long-run variations in prices could and did still occur, because long-run changes in the gold stock were no longer the sole major determinant of secular growth of the money stock.

The preceding explanation of the lagged covariation between prices and the gold stock might be combined with one of two separate explanations for the concurrent covariation. (1) Whenever domestic prices rose (say), the rise was less rapid than the rise in prices abroad, and so domestic prices actually fell in relation to world prices. Then, gold would have flowed in and produced the observed rise in the U.S. stock; and conversely, for a decline in domestic prices. This explanation posits a relation between domestic and world price movements that would hold for no particular reason other than chance and so would be unlikely to prevail, except occasionally. Moreover, the available data for other countries, mainly Great Britain, do not show such behavior of relative price levels; and, contrary to this explanation, they do not show a concurrent covariation between the British gold stock and prices opposite to that for the United States.

(2) Another explanation of the concurrent covariation, intellectually more interesting but also unsatisfactory, starts with the assumption that long-run domestic price changes were accompanied, for various reasons, by movements of domestic interest rates in the same direction. If these movements were sufficient to produce corresponding movements in domestic rates relative to world levels, and if the resulting international rate differentials led to capital movements, gold would flow in a direction to produce the observed positive covariation between gold and prices. Bond yields, at least in this country and Great Britain, have moved in the same direction as prices have—the so-called "Gibson Paradox," discussed in detail later. The first part of this explanation, therefore, appears consistent with the facts. Beyond that, it encounters difficulties. To begin with, there is no indication that interest rate differentials here and abroad moved in the suggested manner.[5] Furthermore, what data we have on long-run capital movements, unreliable as they may be, indicate that capital

[5] See Oskar Morgenstern, *International Financial Transactions and Business Cycles*, Princeton University Press for National Bureau of Economic Research, 1959, Charts 18, 19, 20, 58, 60, and 61. Compare the periods before and after the upsurge of the U.S. gold stock in 1896.

was imported on a large scale into this country during the latter part of the nineteenth century, when domestic prices were falling and the growth of the gold stock was slower than its secular trend. They also indicate that the capital inflow fell off abruptly after the turn of the century, when prices were rising and the growth of the gold stock exceeded its long-run trend.[6] This explanation, however, would require the opposite relation in both cases.

Both these explanations pertain to movements in the U.S. share of the world gold stock and so imply opposite movements in the share of the rest of the world. Both overlook entirely, therefore, the general uniformity of long-run price movements for all gold-standard countries and the tendency of these movements to coincide with the growth rates of the world gold stock. Capital movements, in general, and those responding to international interest-rate differentials, in particular, have no doubt affected the distribution of the world gold stock. Nevertheless, interest rates cannot explain the *long-run* movements in the gold stock of the United States or of all countries together. We are therefore led to interpret secular movements in the traditional way: The growth of the U.S. gold stock was much slower in the first half than in the second half of the pre-World War I period for two reasons. Primarily, it was because the rate of world production was slower and, secondarily, because the required reduction in the growth rate of the U.S. stock was delayed for various reasons, the chief one being the preparations for resumption of convertibility in 1879. The domestic monetary disturbances over silver in the 1890's then carried the reduction, once begun, too far which, together with the rapid growth of the U.S. economy, led to a rise in the U.S. share in the second part of the pre-1914 period. By this interpretation, therefore, the effect of prices on gold flows and production cannot explain the positive correlation for the pre-1914 period, shown in column 2 of Table 29. Even if it could, such an effect certainly cannot explain the much higher correlation between prices and the money stock for that period, shown in column 1.[7]

[6] See Milton Friedman and Anna Jacobson Schwartz, *A Monetary History of the United States, 1869–1960*, Princeton for NBER, 1963, pp. 102 and 140 ff.

[7] Since capital movements can be expected to reflect opportunities for profitable investment, it is plausible that high growth of output which presses against capacity attracts capital from abroad. Hence, during a period of rapid growth (like the 1880's), induced capital movements may offset part of a trade deficit arising from high

Federal Reserve Credit Outstanding. Federal Reserve powers have sometimes been used to offset or reinforce the other determinants in order to achieve desired changes in the money stock. If price movements were relevant to the purposes for which these powers were used, such movements might have influenced the behavior of high-powered money. It is conceivable, therefore, that this influence has worked since the founding of the Federal Reserve Banks in the direction required to produce the observed correlation between long-run movements in prices and in the money stock. For example, Federal Reserve Banks might have extended credit in response to the market demand for loans. If so, they might have produced movements in high-powered money corresponding to those in prices and real output, which could account for the long-run correlation observed between money and prices. In that event, little of the correlation need necessarily be attributed to the effect of money on prices.

This or any similar explanation of the correlation nevertheless seems highly unreal. A central bank's freedom from the profit-and-loss restraints facing commercial enterprises and its dedication to the general welfare are expected to lead to just the opposite result. A central bank's credit policy is normally designed to counteract price movements, not to reinforce them. During the Reserve System's first three decades, of course, its officials did not fully accept that goal. At first, official explanations of its policy were tinged with the "real bills" doctrine, which required that credit be increased when

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merchandise imports; and, conversely, for slow growth (as during most of the 1890's). (See J. G. Williamson, "Real Growth, Monetary Disturbances and the Transfer Process: The United States, 1879–1900," *Southern Economic Journal*, Jan. 1963, pp. 167–180.)

It is conceivable also that the capital movements may dominate, thus causing the balance of payments to improve and gold to flow in when domestic output expands; and conversely. This might then explain an association between the money stock and prices.

It cannot explain the major movements over the pre-1914 period, however, although it might account for some of the shorter-run variations within those movements. In general, capital movements, whether or not influenced by the growth rate of output, did not completely offset the trade balance and, over the long run, gold flows reflected largely the movements in the trade balance. (Williamson's interesting and suggestive discussion cited above is handicapped by understating the importance of gold flows, which he found not closely related to changes in the money stock on a year-to-year basis. He overlooks the cumulative effect of gold flows.) That gold flows were sometimes offset temporarily by nongold sources of change in high-powered money does not mean that long-run changes in the money stock were determined by capital movements or the growth rate of domestic output. The offsets were not that important and, moreover, can be largely explained by other factors.

business, and so the "needs of trade," expanded—and conversely. In wartime it devoted itself to the Treasury's budgetary needs. Nevertheless, the historical record does not indicate that extensions of Federal Reserve credit were intended to conform positively to price movements. The record indicates the reverse, if anything. Federal Reserve policies seem to have reflected other, chiefly short-run considerations (see Chapter 3).

In part, of course, Federal Reserve policies took account of the level of employment, and it might be argued that dedication to the maintenance of "full" employment could link the money stock to prices and so account for the observed correlation between them. Post-World War II events have been widely interpreted along these lines, as follows: Because downward movements in prices and wages are impeded by rigidities which have become more entrenched in the last two decades or so, business recessions no longer produce as much deflation of prices as in the past, but mainly lead to reductions in output and employment. To maintain full employment, the Federal Reserve increases high-powered money and thereby the money stock until a revival in business activity promises to restore full employment, possible only if the money stock is increased enough to support the prevailing level of prices and wages. In the absence of decline during recession, the level reached by prices and wages in each boom is thereby sustained. Transitory upward impulses in the price level are made permanent, which puts it in a meta-stable equilibrium. Under such circumstances we have a modern equivalent of the old real bills doctrine, in which the needs of trade are replaced by the "inviolability of full employment."

The foregoing argument assumes that increases in the money stock are necessary to maintain each upward step of prices and so takes for granted that such increases affect prices. The argument could be modified, however, to contend that this Federal Reserve policy accounts for the long-run correlation between money and prices, but that the System's belief that it must increase the stock of money to promote recovery is mistaken. Even if the System did not respond as it is alleged to do, the long-run rise in prices would be the same, because it results from various pressures wholly unrelated to changes in the money stock. This reasoning is implicit in much literature and, for that reason at least, deserves consideration.

Although high-powered money and the money stock could at times be determined in the foregoing manner, it seems clear that they have not been for most of the period since the founding of the Federal Reserve Banks. Whatever the merits of the wage-price spiral as an explanation of changes in the money stock for some part of the period since World War II, it can hardly explain the experience of either the pre-World War II period (except perhaps 1933–37) or the major part of the period since. In the first place, prices and wages were not very rigid in previous periods; before World War II declines were frequent and sometimes of considerable size. More important, the largest historical changes in Federal Reserve credit outstanding were unrelated to insistence on full employment; they were the increases during wartime and the decreases in 1921 and 1931. The increase in Federal Reserve credit outstanding in 1950, when the outbreak of the Korean War created fear of shortages and produced scare buying, might be interpreted as a "passive response" to an upsurge in demand. The increase came, however, from sale of bonds by member banks to Federal Reserve Banks and was permitted, not to stimulate full employment, but to perpetuate the support of U.S. bond prices.

Although the evidence for the post-1919 period summarized in Table 29 neither proves nor disproves that changes in the money stock affected prices, it is hardly credible that the effect of money-stock changes was unimportant. First, the data before 1914 can be fully explained, as was shown, only by an effect of money on prices; if a 1 per cent change in the money stock had certain effects then, a 1 per cent change must have had largely the same effects after 1914. It is most unlikely that the economy underwent structural changes of a kind to alter those effects. One can imagine—though reasons are hard to find—that developments since 1914 in financial markets and emergence of assorted substitutes for money might have altered the speed with which those effects occurred, but not the ultimate result. Second, it is far-fetched to explain the over-all behavior of Federal Reserve credit outstanding in the interwar years or in the post-World War II period as rigidly tied to a full employment policy—and to argue that the Reserve Banks pursued such a policy without the means to implement it. In fact, their actions had varied purposes and results, none of which closely paralled a full-employment policy. On the whole,

price effects on Federal Reserve credit outstanding seem unable to account for the very high correlations for this period, shown in Table 29. Though covering only seven cycle-to-cycle changes, the rank correlation coefficient of 0.79 is highly significant. The most plausible explanation is that changes in the growth of the money stock produced most of the associated movements in prices.

SOME LONG-STANDING OBJECTIONS RECONSIDERED

The above interpretation of the U.S. data since the Civil War is the same, aside from details, as that adopted for England and Europe by many classical economists of the last century, though their data were inadequate to support a detailed analysis. Jevons' discussion was unusually explicit and may serve as one of the best examples:

> Between 1809 and 1849 we notice a vast decline of prices . . . . Since [1849] the course of prices seems to have been entirely altered, and a permanent rise has been established . . . . Even if it were [individual] commodities which were altered in their conditions of supply and demand, the result would not the less be an alteration in the purchasing power or value of gold. But considering that . . . a most extraordinary change has taken place in the conditions of supply, the probability is excessively great that we find the true cause in the gold discoveries.
>
> To complete the argument, I have only to ask those who think that the growth of population, the increase of demand, or the progress of trade is the cause of the rise of prices, whether population, demand, trade, etc., were not expanding before 1849, not so rapidly perhaps as since, but still expanding; and how it is that causes of the same kind have produced falling prices before 1849 and rising prices since? . . . I think that the growth of population and trade tend to lower prices by increasing the use of gold, and to this cause we may reasonably attribute the fall of prices before 1849. But to attribute to the same cause, as some do, the diametrically opposite change which has occurred since 1849, is illogical in the extreme. The normal course of prices in the present progressive state of things is, I think, downwards; but for twenty years at least this normal course has been checked or even reversed, and why should we hesitate to attribute this abnormal effect to the contemporary and extraordinary discoveries of gold?[8]

[8] W. Stanley Jevons, letter to *The Economist*, May 8, 1869, reprinted in his *Investigations in Currency and Finance*, London, 1894, pp. 155–158. Similar statements of other writers are too numerous to cite, though the very astute observations of John E. Cairnes should at least be mentioned: "Essay Toward a Solution of the Gold Question" in *Essays in Political Economy*, London, 1873. On the development of these ideas, see F. Hayek, *Prices and Production*, London, 1931, pp. 8–25.

Criticism of this view, widespread from the beginning, has intensified since the 1930's. An early and continuing objection has been that the data fail to show a very close association between movements in money and prices. Analysis of the U.S. data invalidates this objection. Although the association is not perfect, it is closer than is typically required in economics to confirm a relationship between variables. If one concludes from the evidence that price movements in the United States reflect primarily changes in the money stock, the same explanation must apply to all countries, including England, that were on the gold standard and had close commercial ties with the United States. There cannot be one explanation of major long-run price movements for this country and another for England, at least while both countries adhere to the gold standard. The objection that arose to Jevons' view is understandable, however. Early critics of the classical interpretation did not have good data. Until recently the U.S. data lacked complete coverage, with the relative importance of the missing parts unknown; and the accuracy of the data for other countries was even less. Worse still, their inaccuracy was not fully appreciated. The inadequate data for England then available were used to justify the contention of a poor association. New estimates of English bank deposits for the nineteenth century, though still far from satisfactory, suggest that the association was just as close during that period as it was in the United States.[9] In any event, the proponents and critics of classical monetary doctrines intended their arguments to apply to all gold-standard countries, including the United States, and for this country the critics were in error.

[9] See René P. Higonnet, "Bank Deposits in the United Kingdom 1870–1914," *Quarterly Journal of Economics*, Aug. 1957, pp. 329–367.

An article by J. T. Phinney in the early 1930's ("Gold Production and the Price Level: The Cassel Three Per Cent Estimate," *Quarterly Journal of Economics*, Aug. 1933, pp. 647–679, especially sect. IV) argued that the ratio of the money stock to the gold stock for each of several Western countries was not constant over the last half of the 19th century. The evidence refuted the views of Cassel and others that an appropriate constant rate of growth in the gold stock would produce "monetary equilibrium." Though Phinney drew no further conclusions, his results left the implication that the gold stock did not account for most of the growth of the money stock during that period. Such a belief could have reinforced the widespread view that gold production had little relation to money-stock changes and even less to price movements. It seems to have been implicitly assumed that nongold contributions to changes in the money stock, alleged by Phinney to be important, made the association between money and prices more tenuous than that between prices and the gold stock. Actually, the facts for the U.S. are just the reverse.

Aside from long-run movements, the monetary data for most countries were sufficient, at least for certain periods, to show short-run swings. Studying this evidence, many observers have denied that the money stock is closely associated with prices and output in the short run; on these grounds they have rejected the classical monetary theory, even though it pertained for the most part to long-run movements. Many concluded that periods of business stagnation and low prices often coincide with a money stock that is rising, sometimes faster than its long-run trend. Since the 1930's, the evidence on that decade has become Exhibit A of this argument. Aside from such extreme episodes, which usually followed banking panics and so may be interpreted as reflecting instead the aftereffects of severe monetary disturbances, the evidence as a whole does reveal a short-run association—not perfect but still fairly close—between output and the rate of change in the money stock (see Chapter 1 and the discussion below).

The important point, however, is that the short-run evidence, no matter how interpreted, is largely irrelevant to the long run. We are often told that the long run is composed of a succession of short runs, in supposed proof of the analytical equivalence of the two time spans. The proof is false, because what is true of the short run is not also necessarily true of the long run. Effects that are important in the short run may be relatively unimportant in the long run, and vice versa, for two reasons: First, nonmonetary factors may hide the effects of changes in the money stock over the duration of a business cycle. If such factors are entirely cyclical and are unrelated to the money-stock changes, they tend to cancel out in the long run. The long run should therefore be defined as a period long enough for any such shift in the relative importance of variables to show up. Second, changes in the money stock may induce offsetting variations in the demand to hold money. The effects of the money-stock changes are thereby halted, but only temporarily unless the variations in demand are permanent. When these offsets wear off, the monetary effects appear, though with a lag. The short-run effect of these changes is no evidence therefore of their long-run importance. The record of short-run movements, irrelevant as it is and misinterpreted as it has been in addition, has served in the past, probably more than any other consideration, to discredit the importance of changes in the money stock for the long run.

Another objection to the classical monetary theory for the long run was suggested by the Gibson Paradox—the observation that concurrent, secular movements in the price level and in long-term interest rates appear to be in the same direction.[10] This appeared to contradict the implications of the classical theory, because changes in the money stock might be expected to affect prices and interest rates in opposite directions. Under the institutional arrangements widely prevalent in commercial and industrial economies, changes in the money stock occur primarily through the banking system, and banks expand or contract credit by lowering or raising their interest rates on loans, which would induce similar movements in open-market rates. When prices are rising, therefore, interest rates should be low; and conversely. How explain the opposite behavior of interest rates? Since this behavior appears in the long run, it cannot be explained simply by the tendency of prices and interest to ride in the same direction up and down the business cycle.

An intriguing explanation of the paradox was offered by Wicksell and later by Keynes.[11] They advanced two propositions: (1) large and prolonged fluctuations in the demand schedule for loanable funds occur as a result of changes in the rate of return on producers' goods; and (2) bank rates on loans follow with a lag changes in the demand schedule for loans. In consequence, the supply of bank loans increases when the demand for loans rises and decreases when the demand falls. Such changes in the amount of loanable funds supplied reflect changes in the money stock, and, in terms of its three determinants, can be attributed to changes in the reserve ratio. When loan demand rises, banks raise their charges, but not sufficiently to prevent loans outstanding from increasing, thus allowing their reserve ratios to fall; and conversely, when loan demand falls. In Wicksell's terms, the bank rate lags behind the natural (i.e., equilibrating) rate of interest. The resulting changes in the money stock convert the fluctuations in demand for loanable funds into corresponding fluctuations in commodity prices. Thus is allegedly produced the association

[10] So named by John Maynard Keynes (see his *A Treatise on Money*, New York, Harcourt, Brace, Vol. II, 1930, p. 198) after A. H. Gibson, who wrote several articles on the phenomenon (see especially *Banker's Magazine*, London, Jan. 1923, pp. 15–34). It had been discussed by other economists earlier.

[11] See Keynes, *A Treatise on Money*, pp. 198–208; K. Wicksell, *Lectures on Political Economy*, London, Vol. II, 1935, pp. 190–208, and *Interest and Prices*, London, 1936.

between movements in money, prices, and interest, all following the independent, initiating fluctuations in the demand for loanable funds.

For Wicksell and Keynes, adaptation of the money stock to changes in loan demand is a necessary condition for the price movements, in the sense that, as both would have argued, prices could not, at least in the long run, fluctuate without supporting changes in the money stock.[12] Changes in the money stock and in prices both result from fluctuations in the demand for loanable funds or, more basically, from fluctuations in the rate of return on capital, reflecting nonmonetary ("real") developments in the economy. This interpretation is not simply the old classical theory in modern attire.[13] Although it recognizes that changes in the money stock are a necessary condition of price movements, this interpretation regards such changes as dependent on other factors that initiate the movements. The classical theory does not remain intact, but is undermined in two ways: First, since monetary institutions and the supply of gold do not produce independent changes in the money stock but respond to factors originating elsewhere in the economy, one does not look to these institutions and the gold supply for explanations of price movements but to the factors affecting the demand for loanable funds and the rate of return on capital. Second, if changes in the money stock are not independent of movements in prices and loan demand, how do we know such changes are in fact a necessary condition? After all, if the association between money and prices can be explained by a link running from loan demand to money to prices, there is no direct evidence that price movements depend on changes in the money stock. Perhaps if government measures broke the dependence, that is, kept the rate of growth of the money stock constant (say), prices and interest rates would continue their long-run fluctuations as before, without any important alteration. From this point, it is one short step to the assertion that changes in the money stock are not necessary for long-run price movements. All that needs to be proved is that historical price movements were produced by nonmonetary factors. The proof has never

[12] Both writers appear to have recognized that changes in the demand to hold money induced by interest-rate movements would not be large enough to account for long-run swings in prices.

[13] For the counter view, see Lauchlin Currie, *The Supply and Control of Money in the United States*, Harvard University Press, 1934, pp. 4–9.

been supplied, but candidates for such factors have abounded. In the reasoning of later writers, changes in the money stock, though not considered to be totally unimportant, receded into the background and were neglected; interpretation of the experience in the 1930's then cemented the position that major price movements often bear little relation to changes in the money stock.[14]

The Wicksell-Keynes theory implies particular routes whereby long-run changes in the money stock are brought about. Wicksell argued that variations in banks' reserve ratios would follow fluctuations in the natural rate of interest and so produce conforming movements in the money stock. Keynes argued that central banks and governments would perform the same function by allowing the ratio of their gold reserve to their monetary liabilities to contract when interest rates rose, and to expand when rates fell.[15] The facts for the United States before 1914, which provide the clearest evidence of the Gibson Paradox, correspond with neither of these patterns. Neither changes in banks' reserve ratios nor in the ratio of the domestic gold stock to high-powered money account for any sizable part of the long-run movements in the U.S. money stock before 1914. Moreover, the long-run movements that occurred in banks' reserve ratios can be better explained by changes in legal requirements and banking practices than by factors related to the long-run demand for loanable funds. Movements in the ratio of the gold stock to high-powered money can be better explained by the government's response to gold flows than to changes in interest rates. The U.S. monetary authorities cushioned the economy against variations in the growth of the gold stock. In the pre-1914 period, the cushioning was incomplete, and most of the variations in the gold stock were still transmitted to the money stock. Consequently, the gold ratio was lower before 1896 when prices were falling than from 1896 to World War I when prices were rising. That is the reverse of the relation implied by Keynes' argument.

[14] See, for example, E. H. Phelps Brown and S. A. Ozga, "Economic Growth and the Price Level," *The Economic Journal*, Mar. 1955, pp. 1–18, especially pp. 1–8. See also W. W. Rostow, "Explanations of the Great Depression" (of the 1890's), Chap. VII in his *British Economy of the Nineteenth Century*, Oxford, 1948; Wicksell, *Interest and Prices*, Appendix; and B. Ohlin, "On the Quantity Theory of Money" in *Money, Growth, and Methodology*, in Honor of Johan Åkerman, Sweden, 1961, especially pp. 113–120.

[15] Wicksell, *Interest and Prices*, Chap. 8; Keynes, *A Treatise on Money*, p. 205.

Wicksell and Keynes did not deny that changes in the rate of gold production have an independent effect on prices, but they did not believe that such changes account for much of the actual movements in prices.[16] Neither realized how fully the cumulative effect of changes in the U.S. gold stock accounted for the variations in growth of the money stock of the United States (and probably of all gold-standard countries) up to World War I, despite the sizable contributions of the other determinants. Slight modifications of their theory cannot render it consistent with the evidence. No theory of prices that ignores the importance of gold production can account for the behavior of the money stock in the early period, and there is no obvious way to link the rate of gold production to variations in the demand for loanable funds. Gold production itself was too small an operation to affect aggregate demand directly and could only do so indirectly through the monetary system. Even though one finds nothing seriously wrong with their theory on logical grounds, therefore, it is empirically irrelevant for long-run movements up to World War I.

In the later period, the contribution of the gold ratio to changes in the money stock correlated closely with price movements, as Table 29 indicates, because the cushioning of gold flows was carried to greater extremes. Federal Reserve credit outstanding and not the gold stock has accounted for most of the long-run changes in the money stock since World War I. Here Keynes' view is consistent with the sources of change in the money stock, but our interpretation above of the association between changes in Federal Reserve credit and price movements is different.

The Wicksell-Keynes theory may still be valid for short-run price movements. Since the theory is based on lags in the behavior of banks, it describes more appropriately short-run phenomena. Indeed, its extension to secular developments, where the time span is too long for most lags to be significant, was a bold step, taken partly to reconcile classical monetary theory with the Gibson Paradox. Yet, the long-run behavior of interest rates, while perhaps puzzling, does not alter the preceding interpretation of the evidence on the association between money and prices, for that interpretation does not rule out the influence of other factors on interest rates.

[16] Wicksell, *Interest and Prices*, p. 167, and *Lectures on Political Economy*, Vol. II, pp. 204–205; Keynes, *A Treatise on Money*, Vol. II, p. 206.

Since movements in interest rates do not explain the over-all behavior of the money stock—as they are supposed to do in the Wicksell-Keynes theory—what then underlies the Gibson Paradox?[17] Although no explanation can be firmly established here, one supplied by Irving Fisher merits attention: the effect of commodity price changes on the market value of assets, such as bonds, returns on which are fixed in money terms. A long-continued rise in commodity prices depreciates the real value of the principal and interest of bonds, and a long-continued fall appreciates them. Insofar as lenders and borrowers anticipate changes in the purchasing power of money, bond yields tend to move in the same direction as those changes, which helps preserve the real value of the principal and interest of bonds. Bond prices tend to be lower and nominal yields higher, therefore, when commodity prices are rising, and the reverse, when commodity prices are falling. In a perfect adjustment, bond yields in real terms would be the same as they would have been with expectations of no change in commodity prices. Because price movements are not anticipated, at least not always fully, the adjustment will, of course, usually not be perfect. When price movements have an almost unbroken trend for a long time, however, part of the adjustment seems likely to occur. Interest rates will tend to be higher when prices are rising and lower when prices are falling.

Such an effect still does not explain the Gibson Paradox, which is based on rising and falling interest rates accompanying like movements in prices. One further assumption, however, takes care of the discrepancy. Following Fisher, we may suppose that the adjustment of interest rates, just described, occurs with a lag. When prices are rising (say), interest rates eventually climb to and stay at a higher level, but get there slowly, so that for some time the rates rise together with prices. How fast and how long interest rates will rise depends on how quickly they react to a change in the trend of prices. The lag may be expressed mathematically by making the level of interest rates

[17] We may immediately dismiss one popular answer of long standing: that a rise in interest rates for whatever reason raises costs of production and so leads to a higher average level of product prices. This fallacy, prominently expounded by Thomas Tooke over a century ago, was laid to rest by Ricardo and Wicksell, among others (see Wicksell's *Lectures on Political Economy*, Vol. II, pp. 179–183). It nevertheless keeps reappearing, though now chiefly in the press and the *Congressional Record;* most economists have shunned it for some time.

a function of past rates of change of prices. Viewing this function as a weighting scheme, we may presume that it entails less emphasis on rates of change further back in time; if so, the function in many cases will more or less approximate the current level of prices. For this reason, movements in the level of prices and interest rates may appear to be related, though the true relation would still be described by the preceding function.[18]

There is no doubt this effect accounts in some measure for the Gibson Paradox. But to what extent? Fisher's explanation implies that turns in bond yields lag behind turns in an index of commodity prices, so far as long-run movements are concerned. It also implies that the yields should be more closely correlated with an average of past rates of change in prices (weighted in some way) than with the concurrent level of prices. Fisher computed such correlations, using British and U.S. data, and the results presented in his *The Theory of Interest* seem to substantiate his hypothesis. At the same time, his work raises some doubts. The lag implicit in the results of his correlations is distributed over decades; it is so long as to seem implausible. It seems too long when compared with the several years lag of major turns in bond yields behind those of prices. Fisher invariably displayed ingenuity in his empirical work but, to this reader's annoyance, he apparently did not consider the over-all plausibility of his results.

Misgivings about Fisher's empirical evidence have led me to try alternative tests of his hypothesis. One appealing direct test, now made possible by data on stock yields, not available when Fisher wrote, is a comparison of yields on common stocks and bonds. The return on common stocks is not fixed in money terms, and so their yield should not be affected by long-run price movements as that of bonds is presumed to be. According to the Wicksell-Keynes theory, on the other hand, all yields, including those on stocks and other assets, should

[18] Fisher did not explicitly introduce a lag into his analysis until he tried empirical verification, presented in his *The Theory of Interest*, New York, 1930, Chap. XIX. In his earlier work he seemed to realize the importance of a lag, however, and did refer to the imperfect adjustment of interest rates to price movements (see "Appreciation and Interest," *Publications of the American Economic Association*, Vol. XI, 1896, p. 76; and *The Rate of Interest*, New York, 1907, pp. 277–280).

Keynes did not distinguish between an equilibrium rate of interest and *movements toward* an equilibrium level. As a result, he overlooked the crucial part lags play in Fisher's explanation and concluded it could not account for the Gibson Paradox (see Keynes, *A Treatise on Money*, pp. 202–203).

follow movements in commodity prices. If we compare the money yield on bonds with that on common stocks, the expectation of Fisher's hypothesis is that the differential in favor of stocks should widen as prices fall, and by roughly the amount that bond yields decline; and the differential should narrow as prices rise by as much as it previously widened. Under the Wicksell-Keynes hypothesis, stock yields should behave as bond yields and prices do; what should happen to differential yields is not specified.

Such a test, using some U.S. data, is presented in Appendix B. The results are mixed. As I read the evidence, Fisher's hypothesis appears to explain the Gibson Paradox in part but may or may not in full. Whether this evidence shows, in addition, that real rates of interest were low when commodity prices declined and high when prices rose, as the classical monetary theory seems to imply, is uncertain. The question remains open.

One difficulty in judging classical monetary theory by this implication is that the required magnitude of interest-rate movements cannot be specified. Even granted the implication that real rates should ease when the money stock grows faster—and conversely—which is a far from certain proposition for our complex economy, the question of how much remains. The quantitative effect of changes in monetary growth depends on many factors, such as the long-run interest elasticity of demand for loanable funds, the repercussions on expectations, and so forth—not to mention the difficulty of translating the effect into specified changes in those interest rates that happen to be quoted and published. Conceivably, the effect on recorded bond and stock yields may usually be so slight that we should not expect to detect it.

Whatever the explanation of the Gibson Paradox, a theory based on the effect of changes in the demand for loanable funds on interest rates and prices is inadequate, because such an effect implies a behavior of the determinants of the money stock which conflicts with our data. Strictly speaking, therefore, the Paradox is irrelevant to a discussion of the long-run effects of the money stock on prices. While it neither proves nor disproves the importance of those effects, it has played an important part in the historical controversy over the relation between money and prices. If the past is any guide, the controversy over the relation between money and prices, even for long-run movements,

will not subside until the Gibson Paradox is settled to everyone's satisfaction.[19]

CONCLUDING REMARKS ON SECULAR MOVEMENTS IN MONEY AND PRICES

The evidence points to a strong effect of money on prices in the long run. This does not deny other effects. Many nonmonetary factors, of course, affect prices. Such effects can be interpreted as changes in the demand to hold money and measured by changes in turnover or velocity rates. The high correlation between prices and the money stock shown in Table 29 demonstrates that changes in velocity, whatever their explanation, have been comparatively small in the periods covered. Nonmonetary factors have doubtless affected prices, but as yet none has been shown to correlate as closely with long-run price movements as does the money stock.

This result is not surprising. After all, the dollar prices of commodities reflect the value of a dollar. Just as the supply of a commodity is one of the most important determinants of its value, so it would be strange if the supply of money did not have important long-run effects on its value. Yet, this proposition, once widely accepted as obvious, has come full circle in the work of many writers, who explain the supply of money by its value and its value by factors unrelated to its supply. The foregoing discussion has described the main steps of this doctrinal about-face.[20] The behavior of the determinants of the money stock favors the original proposition.

Furthermore, most of the nonmonetary factors affecting the value of money are probably independent of its quantity in the long run (even if not, perhaps, of its concurrent rate of change) and so would have behaved as they did, whatever had happened to the supply. The stronger proposition may therefore be warranted: long-run changes in the money stock have led *eventually* to a proportional change

[19] The Gibson Paradox seems to be still with us. For ten years or so following World War II, prices and bond yields rose. For a different interpretation of this phenomenon treating the postwar period as a special case, see John G. Gurley, "Liquidity and Financial Institutions in the Post-war Period," *Study of Employment, Growth, and Price Levels*, Joint Economic Committee, 86th Cong., 1st sess., Jan. 25, 1960, Study Paper 14.

[20] See also Rostow, "Explanations of the Great Depression."

in prices relative to the level that would otherwise have prevailed.[21] To that extent, one could predict the eventual effect on prices of changes in the money stock though not the exact level of prices on a particular date, since there will also be independent and unforeseen changes in velocity. Even such restricted prediction has great value. It is near-sighted to belittle monetary effects because they may be slow to appear. Granted that "in the long run we are all dead," we should also remember that every day is a long run which brings the consequences of past events.

These findings carry implications for the connection between secular movements in prices and aggregate real output. Indexes measuring the rate of growth of output and productivity in different sectors of the economy show unmistakable long-run swings, with turning points that tend to cluster within a few years. Rates of change in prices show the same tendencies at about the same dates.[22] The conformity of price movements is not perfect and may, of course, be accidental; the available data cover only a few long swings. Nevertheless, it is not out of the question that more than coincidence is at work. If so, the preceding conclusion that long-run price movements are primarily due to changes in the money stock suggests that any causal connection must run from prices to the output variables. The only alternative is that changes in the growth of output or of related variables influence prices by way of the rate of growth of the money stock—which the present study indicates is very doubtful.[23]

[21] The regression coefficients for the correlations reported in the addendum to Table 29 (p. 240) support this proposition. The regression function has a slope of 0.87 for all cycles (0.88 including the two earlier cycles reported in note to Table 28), and does not differ from unity at the 0.05 level of significance.

The proposition in the text differs from the quantity theory of money, as conventionally stated, by relating changes in money and prices rather than the levels of the two variables. The difference is more of empirical than of theoretical importance.

[22] See Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, New York, NBER, 1946, pp. 431–440. See also the material presented by Moses Abramovitz in *Employment, Growth, and Price Levels*, Part 2, Joint Economic Committee, Hearings, 86th Cong., 1st sess., Apr. 1959, pp. 411–466.

On the other hand, Friedman and Schwartz (*A Monetary History*, Chap. 13) find a relationship between the degree of stability in the money stock and in output, but not between their secular rates of change.

[23] If price changes do affect output in the long run, the question arises how the effect occurs. Appendix C reviews some of the ways that have been suggested.

2. *Cyclical Movements in Money, Prices, and Output*

The effect of changes in the money stock on prices in the long run means that such effects must also play a role in short-run business cycles. The long-run evidence implies little, however, about the importance of these effects in short-run cycles. Although the money stock sometimes fluctuates widely in the short run, the effect of these fluctuations could be swamped by other factors. The short-run covariation between the rate of change in the money stock and cyclical fluctuations in economic activity[24] (Chapter 1) is close, but it might result largely from passive movements in the money stock induced by fluctuations in activity, and only slightly from the influence of money on prices and output. There need be no contradiction in denying such passivity for long-run movements and affirming it for short-run fluctuations, nor in concluding that changes in the money stock are of primary importance in the long run but of minor importance in the short run.

Is the money stock in fact largely passive in the short run? One test of short-run passivity is similar to that just applied to long-run movements: whether the cyclical behavior of the three determinants can be fully explained by cyclical fluctuations in prices and real output. If not, the observed conformity of the rate of change in the money stock to reference cycles must be either accidental—which is unreasonable—or at least in part the result of its effects on the economy. Although the cyclical behavior of the three determinants is not easy to interpret, it seems safe to conclude that most of their short-run variations are closely related to cyclical fluctuations in economic activity—the opposite of the conclusion reached for the long run. Such effects provide a plausible explanation of recurring cycles in the money stock whether or not the reverse effect occurred.

Granted that the money stock is dependent on economic activity in the short run, does the evidence imply a mutual dependence? Although much evidence has accumulated, a full answer does not seem possible at present. Further evidence is provided, however, by a largely

[24] It should be emphasized that, in contrast with the comparison in the preceding section between long-run movements in the rates of change of both prices and the money stock, the comparison here for short-run cycles is between the rate of change in the money stock and the level of economic activity (including both prices and real output).

neglected part of the subject, the behavior of the determinants of the money stock. Two aspects of their behavior are relevant: large fluctuations, and changes in response to alterations in monetary institutions and practices.

LARGE FLUCTUATIONS: WAR AND SEVERE CYCLES

These fluctuations are important, not only because they occur in periods of especial interest, but also because they bring out in bold relief the relations between the variables. Random disturbances ordinarily hide these relations but recede into the background in times of drastic change.

The two major wartime periods of this century in the United States—World Wars I and II—saw large increases in the money stock and roughly proportional increases in price levels, if the changes are measured from the beginning of hostilities to the postwar year in which prices stopped rising. Nearly all the increases in the money stock were due to issues of high-powered money, which in turn reflected the wartime exigencies of government finance. Attempts to raise taxes failed to cover the sudden expansion of military expenditures, and the Treasury had to borrow. It sold bonds in large volume but never enough at the interest rates offered. Since the government felt that higher rates were undesirable, easing the Treasury's predicament and easing the bond market went hand in hand. The central bank's purchases of bonds amounted to financing part of the Treasury's budget deficit by issuing high-powered money. In view of wartime experiences the world over, such increases in the money stock were inevitable. The particular amount issued, however, was far from inevitable; the fraction of government expenditures financed by issuing money is variable. The association between percentage increases in the money stock and prices over each wartime period as a whole makes it reasonable to attribute the inflation primarily to increases in money. Yet, the associated movements in prices and money are often explained as common effects of nonmonetary factors.[25] It is true that wartime controls on prices and nonmilitary spending

[25] The contention is, in effect, that the price increases were as likely to be matched by permanent increases in velocity as by increases in the money stock. In fact, however, wartime price increases throughout the world were invariably accompanied, during the period as a whole, by large increases in the money stock; the net change in velocity, while sometimes of comparable magnitude, was often a decrease.

sometimes temporarily hide the usual indications of monetary expansion, which may not appear openly for a year or two after wartime controls have ended. Moreover, many nonmonetary factors add to inflationary pressures during wartime, though they are usually temporary and gradually disappear after war's end. To make nonmonetary factors paramount, one must contend that in some way they also produce the increases in the money stock and do so in rough proportion to the over-all rise in prices. This implies that these factors closely determine the issue of high-powered money in wartime, which is doubtful in view of the almost universal government control over high-powered money and the varied (but easily identified) reasons for the particular amounts issued.

However major wartime inflations are interpreted, they are sufficiently unlike business cycles to warrant separate attention and so are mostly excluded from the tabulations here pertaining to cyclical fluctuations.

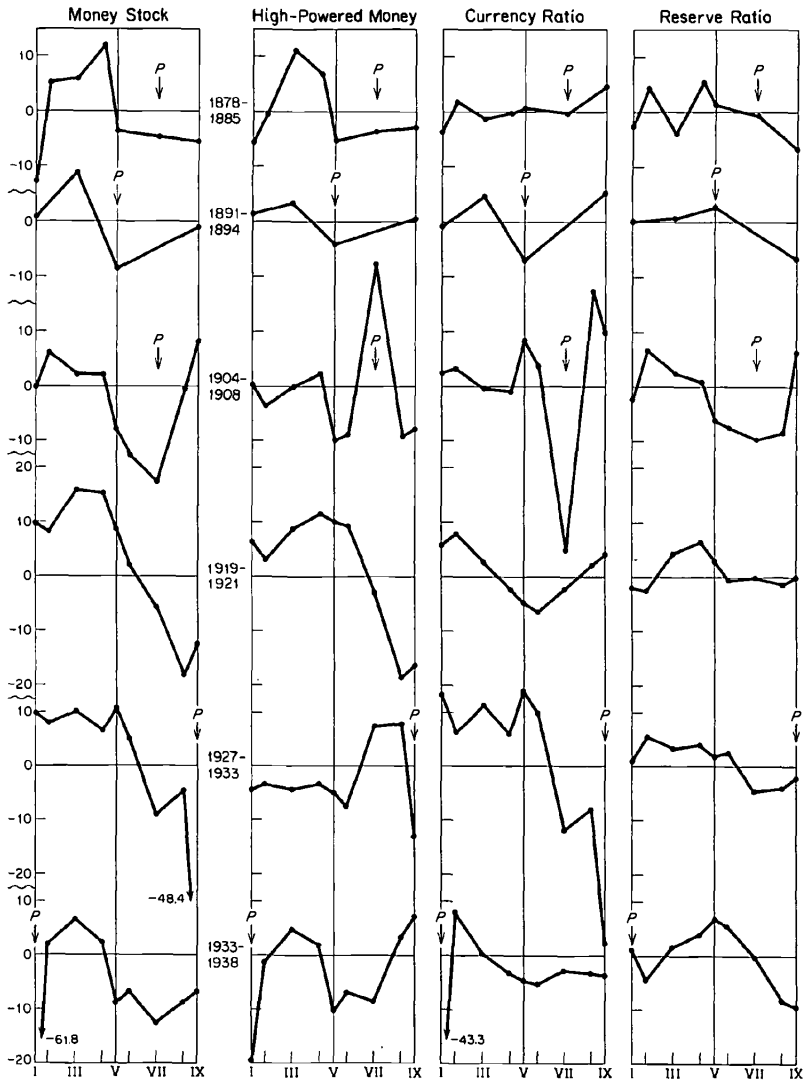
All severe contractions in U.S. business activity have been accompanied, during about the first half of their length, by an unusually sharp decline in the rate of change in the money stock; near its lowest point, the rate became negative, signifying an absolute decline in the stock. In mild business contractions the drop in the rate of change was not nearly so deep and seldom as prolonged. If we take the reference cycles containing the six largest business contractions as representing severe business declines, Table 1 shows that the matching specific-cycle contractions in the rate of change in the money stock were also the six largest. (That correspondence applied as well to the severe reference contraction of 1873–79, the amplitude of which was not included in Table 1, making seven since the Civil War.) The patterns of the six declines in monetary growth are shown in relation to reference cycles, along with the contributions of the three determinants, in Chart 23. The patterns are adjusted to have an average level of zero. The sign of changes in the currency and reserve ratios is reversed to show their contributions to the rate of monetary growth.

Most of the declines reached their lowest point in stage VII or VIII. The first two severe cycles appear to be exceptions, only because the annual data distort the true pattern. In 1878–85, the full force of the panic came mainly in fiscal 1884 with a sharp drop in the contribution

CHART 23

Reference Cycle Patterns of the Rate of Change in the Money Stock and the Contributions of the Three Determinants, Six Cycles with the Most Severe Business Contractions, 1878–1938

(per cent per year)



Source: Table F-2.

Note: *P* denotes stages in which panics occurred. Fiscal-year data from 1878 through stage IV of 1904–08 cycle; monthly data thereafter. Nine-stage patterns were computed throughout, except the 1878–85 contraction and 1891–94 expansion, for which there is one stage standing between the peak and trough; and the 1891–94 contraction, for which only the peak and terminal trough standings were computed.

(or rise in the level) of the currency ratio (see Chart 1). Stage VII of this cycle, however, is an average of 1884 and the preceding fiscal year, and so smoothes out the deep trough produced by the panic. In 1891–94, the annual data put the panic in stage V, though it actually occurred in May 1893, four months after the monthly reference peak in January. The annual data do not permit an independent computation of the mid-contraction stages. The 1927–33 severe cycle, therefore, is the only one with a trough in the money series at the end of the reference contraction; here the banking holiday reversed the incipient recovery in monetary growth from stage VII to VIII.

Most severe business contractions have involved financial panics, as evidenced either by banks' suspension of payments or by issue of Clearing House loan certificates in New York City. The panics represented a scramble for currency, in which the public and the banks attempted to increase the currency and reserve ratios and so contributed to declines in the rate of change in the money stock. In two severe business contractions without panics—1921 and 1937–38—the rate of change also declined, not because of liquidity crises, but mainly because of reduced contributions from high-powered money—and, in 1937–38 only, also because of a large increase in reserve requirements. In the pre-World War I cycles, gold flows often contributed to a fall in monetary growth in the early part of business contractions, as Chart 23 shows.

How can this association between monetary growth and the severity of business contractions be explained? The accompanying financial panics seem to be a link, because they were responsible for the large increases in the two ratios, frequently responsible for a sizable part of the decline in monetary growth. The only exceptions, as already noted, were 1921 and 1937–38. The 1929–33 contraction was not an exception, because the growing distress of banks in the three years preceding the 1933 holiday had the same effect of drastically increasing the demand for currency. It is tempting to explain the panics as resulting from the severity of the accompanying business contractions. Timing inconsistencies, however, plague this explanation. Some of the earlier panics came during the first part of the business contractions (1873, 1890, 1893, 1907) and before the contractions became deep enough to undermine the financial structure. A partial exception is the panic

of 1884, which occurred midway during the long contraction of 1882–85. (The two later panics of 1914 and 1933, of course, came at the end of business contractions.) It is extremely doubtful that severe contractions are, from the beginning, so special a breed that they can precipitate panics even before their full repercussions hit economic activity at large. Most panics appear to have reflected special circumstances, perhaps conditioned by declining business activity, but not dependent upon a severe contraction or low level of activity. One might still deny that deep depressions originate in money-stock changes by contending that they are initiated by panics, which also produce the ensuing decline in the money stock. This contention asks us to assign separate economic effects to a panic itself and to the resulting contraction in bank deposits, ignoring how closely connected they are.

Even if that could be done, the argument stumbles over severe business contractions in which no panics occurred or, if they did, occurred late but were not exceptions in terms of the behavior of the money stock. Two severe business contractions had no panic—1921 and 1937–38—and two had panics that came late—1882–85 and 1929–33. In all four the money stock declined, and in the last, before and during the panic. Exceptions on other grounds also occurred: the 1890 and 1914 panics accompanied mild business contractions and comparatively mild declines in the rate of change in the money stock, because both had mild repercussions on the banking system. To explain such inconsistencies, one might argue that a severe business contraction causes an increase in the reserve ratio because of a falling demand for loans (it is hard to conceive of other possibilities) and in this way reduces monetary growth; and that panics are epiphenomena with no important effects on either the money stock or business activity. That is an extreme position. It ignores all we know about how banking panics jolt the economy, especially when banks suspend payments. In addition, it conflicts with the evidence (see Chapter 5, section 4). Both the reserve and the currency ratios appear to respond mildly to declines in economic activity, no matter how deep, and sharply only to financial panics.[26] Although the currency ratio recovers quickly after panics, the reserve ratio has a delayed response and recovers slowly, so that their combined response covers an extended

[26] The reserve ratio also responds sharply, of course, to a large increase in reserve requirements.

period. Severe contractions are an important exception, therefore, to the above statement that fluctuations in business activity seem to produce the cycles in the money series. For severe contractions, this effect may explain the timing, but apparently a deep depression cannot account for the sharp decline in the rate of change in the money stock associated with it.

Since there have been so few cycles with severe contractions and banking panics for which there exists the documentation needed to draw inferences, the evidence is admittedly limited and any conclusion, necessarily tentative. Still, the evidence just reviewed makes no sense if monetary developments are assumed to have played a minor role. Without that assumption, each piece falls in place: panics made ordinary business contractions severe when they led to substantial decline in the rate of monetary growth, and not otherwise. Substantial decline in this rate, by itself with no panic, could and has produced severe business contractions. The variety of reasons for decline in monetary growth during severe depressions rules out any single cause and rules out, in particular, a sharp fall in business activity as the main reason for the associated decline in monetary growth. The evidence is therefore consistent with and, taken as a whole, impressively favors emphasis on the decline in the rate of monetary growth as the main reason some business contractions, regardless of what may have initiated them, became severe.

This proposition is hardly novel, though the supporting evidence is much stronger than is generally recognized. Yet, severe business contractions are often cited as a prime example of how unimportant monetary factors are. The period most often cited is the 1930's. Although it is widely conceded that the panic in 1933 made the business contraction worse, one event allegedly buries all monetary interpretations of that period and settles the issue—the several years' failure of monetary expansion to usher in full employment.

The failure does not, however, prove monetary effects to be unimportant. The events can be interpreted differently. A large part of the increases in the money stock after the spring of 1933 only restored what the preceding decline had destroyed. Those increases and the following ones were accompanied by the rise of prices and output from the depths of the depression. Indeed, the expansion of real income from 1933 to 1937 proceeded at a faster rate than that during

any other four-year period since 1869 and roughly matched in magnitude the rate of decline from 1929 to 1933. That employment did not absorb the intervening growth in the labor force for many years proves only that full recovery from a very low level takes time, not to mention the uncertainties of government policies and other developments disturbing to business confidence during the New Deal era. The contraction of 1937–38 also delayed the return to full employment. The failure of monetary expansion after 1933 to achieve full employment by 1937 has been likened to the futile gesture of pushing on a limp string; but the analogy should be changed to pushing on a taut coil spring, which compresses—but not indefinitely.

In any event, the efficacy of monetary expansion in that recovery, however assessed, does not bear upon the capability of monetary factors to *deepen* contractions.

ALTERATIONS IN MONETARY INSTITUTIONS AND PRACTICES: MILD CYCLES

Although the evidence points to a crucial role of the money stock in severe business contractions, it need not follow that its role in mild cycles is equally important. For one thing, mild business contractions have none of the features of a financial disturbance. Money markets do not thrash about in panic; interest rates ease as the decline in demand for loanable funds outweighs rising liquidity preference by lenders; and banks do not take strong steps to increase their reserve ratios. Under such conditions, nonmonetary factors appear relatively important, and we do not know to what extent they are set off or aggravated by declining growth in the money stock. Although the cyclical patterns of the money series and the three determinants cannot definitely indicate the cause-and-effect relations, we may examine their behavior from the point of view of summarizing the answers they suggest to this question.

To show the contributions of the three determinants to monetary growth in a way that relates their movements to fluctuations in economic activity, Chart 23 presents reference cycle patterns for cycles with severe business contractions, and Chart 24 presents the patterns for cycles with mild contractions. This second chart shows two later cycles not included in the cyclical analyses in preceding chapters. It will help in examining these patterns to keep in mind several points

noted earlier. (1) The patterns are adjusted to have an average level of zero. (2) The sign of changes in the currency and reserve ratios is reversed to show their contribution to the rate of change in the money stock. (3) These patterns are somewhat dissimilar from those for specific cycles, summarized in Chart 2, because matching stages of specific and reference cycle patterns, after the timing lead of the specific cycles is taken into account, have different time spans.[27] Specific cycle peaks often correspond in time to stage II or III of matching reference cycles, for example, and the two stages differ appreciably in the length of the periods encompassed. For this and the additional reason that rate-of-change series are highly volatile, these reference cycle patterns do not always exhibit the position of the peak and trough accurately. (Specific cycle turning points are given in Table 1.) Finally, Chart 24 reveals considerable diversity among cycles, which reflects in part the variable timing relation between the cyclical turning points in money and the corresponding reference turns. Consequently, the average patterns, presented at the bottom of the chart, have less amplitude than do most of the individual patterns, and fail to catch some of the typical movements. The averages are presented to indicate that the earlier and later subgroups are very similar for the money stock and the currency ratio, but not for high-powered money and the reserve ratio. For comparing the movements with business cycles, we should not rely exclusively on the average patterns.

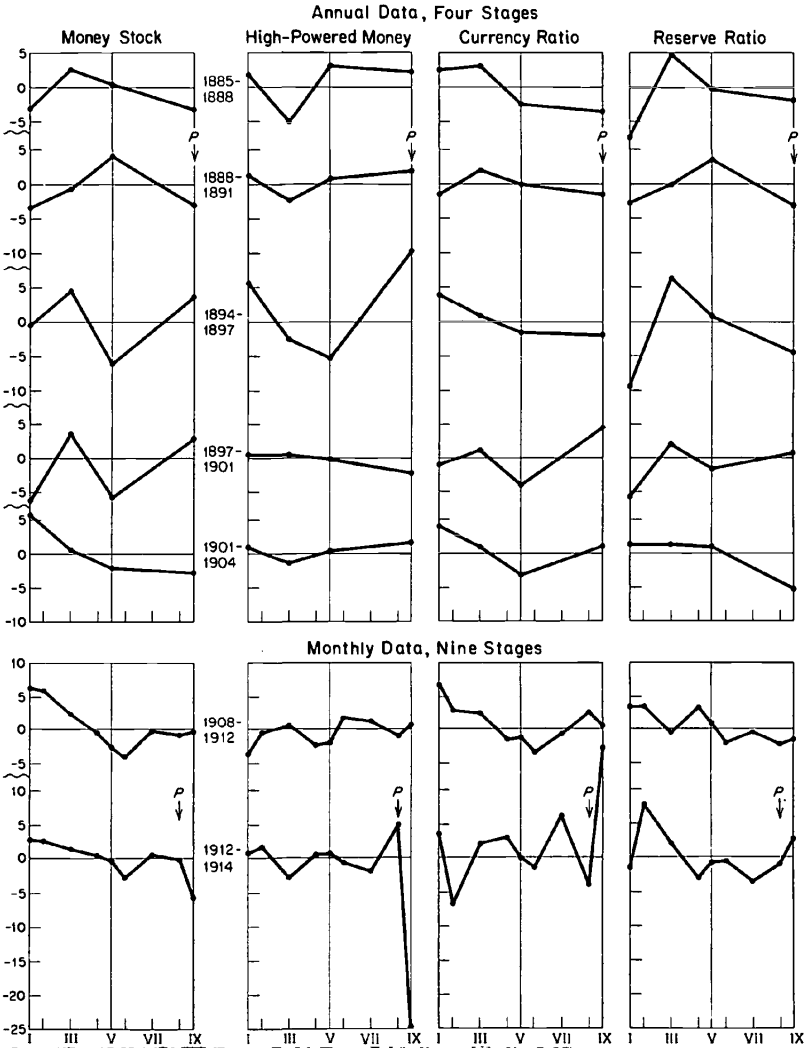
On a reference cycle basis, the rate of monetary growth has a peak in stages I to III. The only exception among these nonwar mild cycles is 1888–91, for which the annual data put the peak in stage V. Following the peak, the rate falls to a trough usually in stages V and VII. (In a few cycles the trough comes earlier or later.) The rise following the trough is often broken by a decline in the last stages of the reference contraction.

The individual patterns for the growth rate of high-powered money differ considerably. Before World War I, the patterns commonly show a trough in stage III or V and little accord with respect to the peak. In the later period, by contrast, they most typically rise to a peak in stage III. The growth rate then usually declines until stage

[27] Also, the underlying series differ slightly (see notes to Table F-1), but this difference should not matter much.

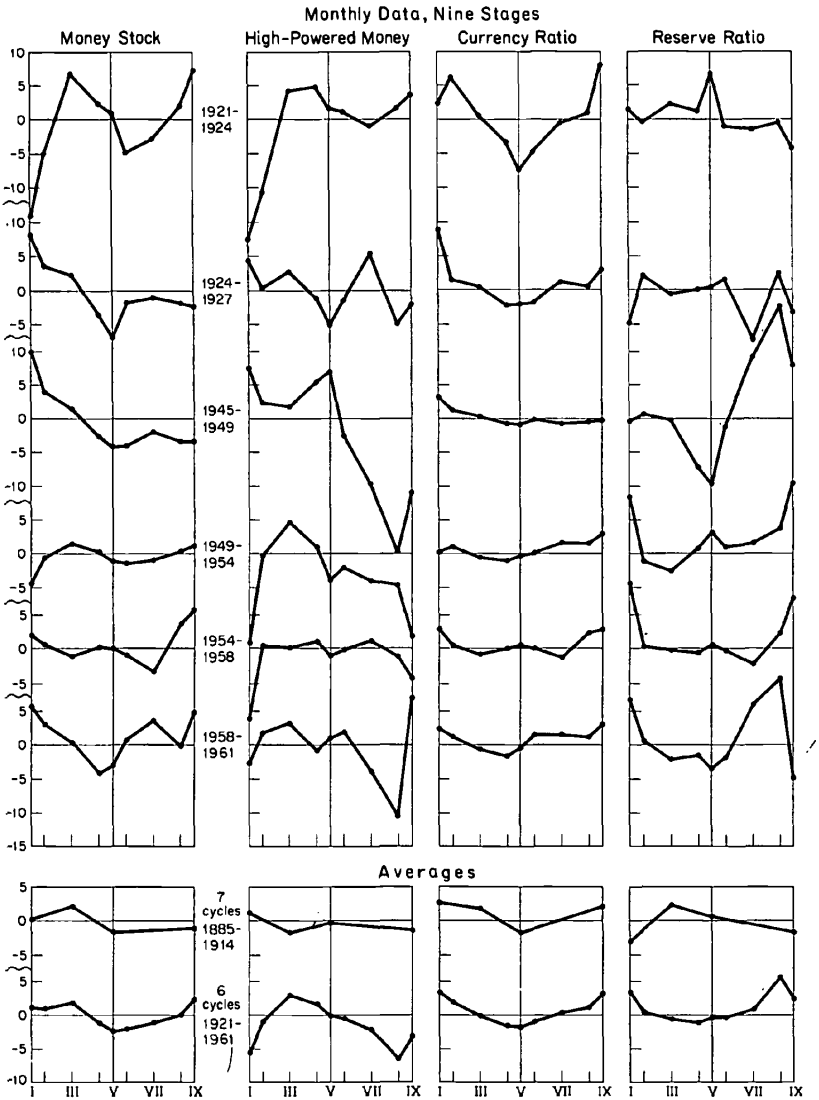
CHART 24

Reference Cycle Patterns of the Rate of Change in the Money Stock and the Contributions of the Three Determinants, Nonwar Cycles with Mild Business Contractions, 1885–1961 (per cent per year)



Note: *P* denotes stages in which panics occurred.

CHART 24 (*concluded*)



Source: Table F-2.

VII or VIII, though sometimes the decline is interrupted by a rise from stage IV or V to stage VI or VII.

The contribution of the currency ratio most often displays an inverted pattern with a trough near the reference peak. In terms of movements in the level of the ratio, this pattern reflects a diminishing rate of decline during the first part of reference cycles, in which the ratio levels off from stage IV to VII and then starts to fall again in the final stages. These movements in the level of the ratio approximate a sine curve with a trough at stage III and a peak at stage VII (see Chart 11).

The contribution of the reserve ratio has a markedly different pattern before and after World War I or even, perhaps, after the turn of the century. In the earlier period it usually rose until stage III and fell thereafter, which reflected, in terms of movements in the level of the ratio, a fall at a diminishing rate during reference expansions and a moderate rise during reference contractions. The contribution of the ratio after World War I, as shown by its average pattern at the bottom of Chart 24, is inverted, but this is mostly due to some large changes in reserve requirements, particularly in 1948–49, 1953–54, and (owing to a sharp rise in time deposits relative to demand deposits) in 1960–61. If we exclude these movements, the reserve ratio has no clearly defined cyclical pattern in the later period, which manifests a tendency, first noticeable around the turn of the century and continuing except during the 1930's, of banks to keep reserves fairly close to required amounts in all phases of the business cycle.

To describe the cyclical behavior of the money stock does not, of course, explain it. Chapters 3 to 5 analyze the evidence. It seems highly probable that cyclical fluctuations in business activity account for most of the cyclical variations in growth of the money stock, although many variations in particular years can be traced to special monetary developments largely unrelated to concurrent business conditions. The pattern of money-stock changes shown in Chart 24 can also be interpreted as supporting that explanation. The patterns may be viewed as having an inverted conformity to business cycles with approximately coincident or perhaps somewhat lagging turning points. That is, peaks in monetary growth correspond to reference troughs, and monetary troughs correspond to reference peaks. By this interpretation, business activity produces inverted cycles in monetary

growth and accounts for the correspondence of turning points. On the additional assumption that changes in monetary growth affect the economy after a fairly short lag, it may be concluded that they work to *dampen* fluctuations occurring for other reasons in business activity.

The length of the lag in monetary effects is, of course, crucial to this interpretation. If the lag is long—which is not implausible in view of the institutional arrangements by which changes in the money stock work into the economy—there may also be, in addition to the inverted relation, a positive relation (Table 1) between money and business activity, with a considerable time difference between turning points. By this second interpretation, the effect of business activity on money produces an inverted pattern and, at the same time, the effect of money on business produces a leading positive pattern.

While it is difficult to measure the relative importance of these two relations and to determine whether the second effect contributes significantly to the observed association, there is some evidence suggesting that it does. First, the timing relation between turning points in the money series and reference cycles seems to show less variability on a positive than on an inverted basis.[28] In line with the foregoing argument, this suggests that the effect of money on business activity is the more consistent relation. This finding alone is not conclusive, because of the practical difficulties of dating turning points in the rate of monetary growth, and because of the fundamental pitfalls in measuring a complicated relationship between two series solely by their turning points.

Another piece of evidence is the persistence of the association over time. No significant secular change in the relative timing or amplitude of cyclical movements in the money stock and business activity is evident for the period since the 1870's, notwithstanding the considerable variability in these measures from cycle to cycle and the changes in the relative contributions and patterns of the three determinants (Chapter 2). If the direction of influence ran from economic activity to the money stock but not the other way, the association between the two ought by all odds to bear evidence of the substantial

[28] This evidence is presented and discussed by Friedman and Schwartz in "Trends and Cycles in the Stock of Money in the United States, 1867–1960," a National Bureau study, in preparation, Chap. 5; a preliminary presentation appears in *Forty-Fourth Annual Report*, NBER, 1964, pp. 14–18.

changes in our monetary institutions over the past seventy-five years. These changes have involved all three determinants.

(1) High-powered money has been issued over the period under radically different institutional arrangements. A new source of issue—Federal Reserve Banks—has been introduced, which apparently increased the dependence of this determinant on movements in the two ratios. Restrictions on international trade here and abroad have interfered with the operation of the gold-flow mechanism. The Treasury, from time to time, has in other ways expanded or contracted the quantity of high-powered money outstanding.

(2) Legislation has substantially altered the banking structure. The Federal Reserve Act and the Federal Deposit Insurance Act have regulated banking operations, and many other federal and state laws have in various ways restricted the money market and all its related institutions. The latter developments have touched banking directly, and also indirectly, by reducing the risk of bank defaults and by shifting the comparative advantages of deposits and other financial assets. The conformity of the money stock to business cycles is often explained by the effect of market credit demands on the reserve ratio. Yet, though such demands presumably behave the same today as before 1914, the importance of this determinant has changed considerably. Except during panics, the reserve ratio has contributed much less to cycles in the rate of change in the money stock under the Federal Reserve than under the national banking system.

(3) The behavior of the currency ratio has undoubtedly been affected, though in a manner and degree hard to determine, by various developments in the economy at large. Financial assets have taken new forms, reordering the relative advantages of the different ways in which people hold wealth. The relative amounts of money balances held by various sectors of the economy have shifted with likely effects on the aggregate demand for currency. Changes in the manner and means of making payments have altered earlier practices in the relative use of currency and deposits.

These well-known developments might have been expected to produce changes also in the response of each determinant to external influences and hence to changes in the effect of fluctuations in general activity on the money stock. And, indeed, the cyclical patterns of the three determinants before World War I are different than after it

(according to the analysis, mostly the patterns of high-powered money, less so of the reserve ratio, and least of all of the currency ratio). Yet, we still observe no important change in the timing and amplitude of the money stock relative to business activity. One reason could be that the uniformity of this association over time reflects a different effect not appreciably touched by the institutional developments, the effect of changes in the money stock on business activity. Though undoubtedly altered to some degree by institutional developments, this effect has probably escaped their full force, remaining comparatively the same in form and magnitude. A reorganization of financial institutions is likely to affect the manner and means in which they supply their product and not so much the impact of changes in that supply on other sectors.

The behavior of the currency ratio is particularly relevant to this question. Its correspondence to cycles in the money series and business activity remained high over the entire period examined, and even in the cycles after 1914, when the offset produced by high-powered money appears to have increased in certain stages. If the contribution of the currency ratio was offset to a large degree, how could it continue to correspond to both the money stock and business activity? We should expect cycles in the money series to take on a different pattern and timing as a result of the offsets, and so no longer to correspond to cycles in the currency ratio, which conformed to fluctuations in business activity. One explanation of the dual correspondence is that business cycles were set in train by changes in the money stock and, in turn, produced corresponding movements in the currency ratio.

These are qualitative considerations; though relevant and suggestive so far as they go, their importance is hard to assess. We can not easily measure institutional developments or quantify the effects they might have had on the relation between money and economic activity. The evidence for the importance of monetary effects in severe cycles supports a presumption that similar effects operate during mild cycles in smaller absolute magnitude, regardless of what produces the changes in the money stock. The preceding evidence leaves open whether the magnitude of the effects in mild cycles is just as large or is smaller *relative* to the amplitude of the fluctuations in economic activity.

IMPLICATIONS OF MUTUAL DEPENDENCE

A mutual dependence between the money stock and economic activity, if it exists, has important implications for the self-generation of cycles. These implications can be explored by outlining the form of a self-generating, purely monetary business cycle suggested by the preceding analysis. The discussion will be partly hypothetical, because the preceding evidence does not firmly establish the relative importance of the two parts of the mutual dependence. The exploration may nevertheless shed light on an aspect of business fluctuations that has been largely neglected in much recent research on cycle models.

In very simple terms, the evidence examined suggests that economic activity has a lagged relation, in some undetermined form, to past rates of change in the money stock; and the past rates of change are related to economic activity, perhaps also with a lag, most likely short. An initial rise (or fall) in business activity induces a rise (fall) in the rate of change in the money stock which, after the lag period, produces a further rise (fall) in activity. For a while the mutual stimulation is reinforcing. A cyclical movement occurs because of limits to short-run expansions or contractions in the money stock, which produce turning points in its rate of change. Because of these limits, a rise (for example) in aggregate activity induces a rise in the rate of change in the money stock during the early stages of a cyclical expansion—but not indefinitely. Soon the monetary system begins to reach the end of its expansionary capabilities, and the rate of growth of the money stock slows down, even though aggregate activity continues to rise. After the lag period, the slowing down takes the steam out of the expansion in aggregate activity and eventually causes it to turn down. The sequence is similar for contractions and upturns.[29]

This model of a monetary cycle is similar to those of Hawtrey and of Mitchell[30] and many other writers. Aside from the findings presented here about the behavior and timing of turning points in the

[29] Appendix D presents a mathematical formulation of this model.

[30] See R. G. Hawtrey, "The Trade Cycle," *Readings in Business Cycle Theory*, Philadelphia, Blakiston, 1944, pp. 330–349; and Mitchell, *Business Cycles and Their Causes*, reprint, Part III of *Business Cycles*, University of California Press, 1950, especially pp. 47–52, 77–107, 137–139. For the same ideas presented in a different form, see J. R. Hicks, *A Contribution to the Theory of the Trade Cycle*, London, Oxford, 1950, Chap. XI. See also L. R. Ayres, *Turning Points in Business Cycles*, New York, 1939, pp. 144–146.

three determinants, theirs differ from the foregoing chiefly in relating activity to the level of the money stock rather than to its rate of change. If we inserted in the foregoing model "money stock" for "rate of change," the model would be identical with theirs, apart from certain details. The evidence suggests that this difference is important. If one looks at its level without adjustment for trend, the money stock seems to lag behind turns in aggregate activity, and the association between the two appears weak and irregular. With the rate of change in the money stock, however—or what is similar in practice though not in concept, deviations of the stock from its long-run trend[31]—the association appears fairly close. Hawtrey's and Mitchell's theories are not inconsistent with this form of the relation, but their emphasis on the level of the money stock led many to conclude erroneously that the association was not very close in any form.

The dimensions of the variables used in the model sketched here, whether appropriate or not, do not affect the analysis of the behavior of the three determinants. Their cyclical behavior was related to business cycles without deciding whether changes in the level or the rate of change in economic activity was more important. The choice of dimensions mainly affects the timing relation between the variables.

If one accepts the interpretation of the evidence presented here—or goes somewhat further than this evidence can justify—and designates the preceding monetary model of the cycle as a full explanation, the validity of many other models of the business cycle is not necessarily thereby denied, though the rationalizations for them would then be different in some respects. The reason is that such models can be more or less descriptively accurate even though incomplete. There is nothing in the preceding model that rules out, or even makes unlikely, cyclical relations between income, consumption, investment in plant and equipment or inventories, and other variables depicted in the well-known multiplier-accelerator model in all its versions. Indeed, the latter model seems quite consistent with the purely monetary model just described. One can make a long list of other relations that might hold for cyclical movements, whatever the initial source of instability. If the preceding monetary model is valid (in the sense of descriptive

[31] Clark Warburton uses this method. See his "The Misplaced Emphasis in Contemporary Business-Fluctuation Theory" in *Readings in Monetary Theory*, American Economic Association, 1951, especially pp. 296–300.

accuracy), these other models may or may not be valid; the case is in no way prejudiced. Nevertheless, given the validity of the monetary model, these other models must be incomplete—in the sense of omitting "important" elements of the cyclical process—as also the purely monetary model would be if any of the other models proved to be valid.

Business cycle research has found so many sources of instability in our economy that it would be rash indeed to suggest that money-stock changes are the main one. Aside from possible government stabilization, an industrial economy will undergo fluctuations stemming from the ubiquitous lags and rigidities, which prevent instantaneous adjustments to changes in demand. Lagged adjustments tend to be accentuated and prolonged by the interdependence of many economic variables, a process that the various "multipliers" and "accelerators" help to describe. Nevertheless, the evidence on deep depressions suggests that our largest disturbances are intensified by contractions in the money stock and otherwise would probably not have been nearly so severe. The ordinary garden variety of cyclical pest also seems to be nourished by changes in the money stock; whether and to what degree it is bred by these changes, however, cannot be clearly determined from the evidence presented here.