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CHAPTER VI

INTEREST RATES AND COMMODITY PRICES

THE statistical study of time series has presented few more puzzling problems to the economist than those concerned with the relations between interest rates and commodity prices. The apparently high correlation between the movements of bond yields and the movements of commodity prices has been accepted, not merely by the man on the street but also by many professional economists, as virtually conclusive evidence that interest rates and commodity prices must be causally related in some extremely direct if not extremely simple manner. But the prevalence of this conclusion has resulted more from the aggressive assurance of a few hierophants than from a careful examination and consideration by their disciples of either the data themselves or the treatment of the problem by the masters.

The complete assurance that a persistent similarity between the movements of bond yields and the movements of commodity prices is so well established as to call loudly for explanation is typically expressed by John Maynard Keynes in his *Treatise on Money*. Mr. Keynes, after drawing attention to "the extraordinarily close correlation over a period of more than a hundred years between the rate of interest, as measured by the yield of Consols, and the level of prices, as measured by the Wholesale Index-Number", goes on to add that this correlation "is one of the most completely established empirical facts within the whole field of quantitative economics" and concludes that "it is very unlikely indeed that it can be fortuitous, and it ought, therefore, to be susceptible of some explanation of a general character".[1]

[1] II, 198. The reader should be very careful that he does not give more weight than should be given to the expression "over a period of more than a hundred years" in the above quotation. A high correlation between two long extended series is an index of the closeness with which the two series can be expressed in terms of one another *by a particular mathematical equation*, usually a straight line with two defi-

As illustrations of how the relationship has been or can be demonstrated, Mr. Keynes presents first a table comparing 'adjusted' commodity prices with the yield of Consols by five-year periods from 1791 to 1919 and annually from 1920 to 1928.[2] The 'adjustments' consist in increasing by 10 per cent the commodity-price figures for 1791–99, 1820–54, 1875–84 and 1926–28, by increasing by 20 per cent the figures for 1885–1914, and *decreasing* by 20 per cent the figures for 1915–20. Mr. Keynes describes these 'adjustments' as "dampening down the more violent movements" of the price series.[3]

Leaving the 'adjustments' with the statement that, "whilst making matters clearer to the eye", they are "not, however, at all necessary to establish the correlation", Mr. Keynes proceeds to introduce some of the statistical work of W. H. Coates and E. G. Peake. Mr. Coates, comparing annual figures for the yield of Consols with annual figures for the *Statist* index of British commodity prices, had found[4] that "the Pearsonian coefficient of correlation" between the raw annual figures for the two series was, for the period 1825–1924, $+.893 \pm .014$ and, if the yields of Consols were lagged one year, $+.903 \pm .012$. Mr. Peake had found, for the years 1882–1913, high coefficients of correlation between the *Statist* price index number and the yields of London and Northwestern Railway Debenture Stock ($r = +.880$ without lagging and $+.888$ when the yield was lagged one year). He had also found lower but still relatively high coefficients between the commodity price series and short term money rates during the same period. Without lagging, the comparison with the average annual rate on 'floating money' gave $r = +0.801$ and the comparison with the discount rate on three months' bank bills gave $r = +0.724$. In each instance, lagging decreased the coefficients.[5]

In his popular summary of the movements of commodity prices and

(Footnote [1] concluded)
nite constants. Now such a high correlation gives no proof that the series can be as adequately expressed in terms of one another in their successive parts *by the same equation*—which the expression "over a period of more than a hundred years" might lead the careless reader unconsciously to assume.

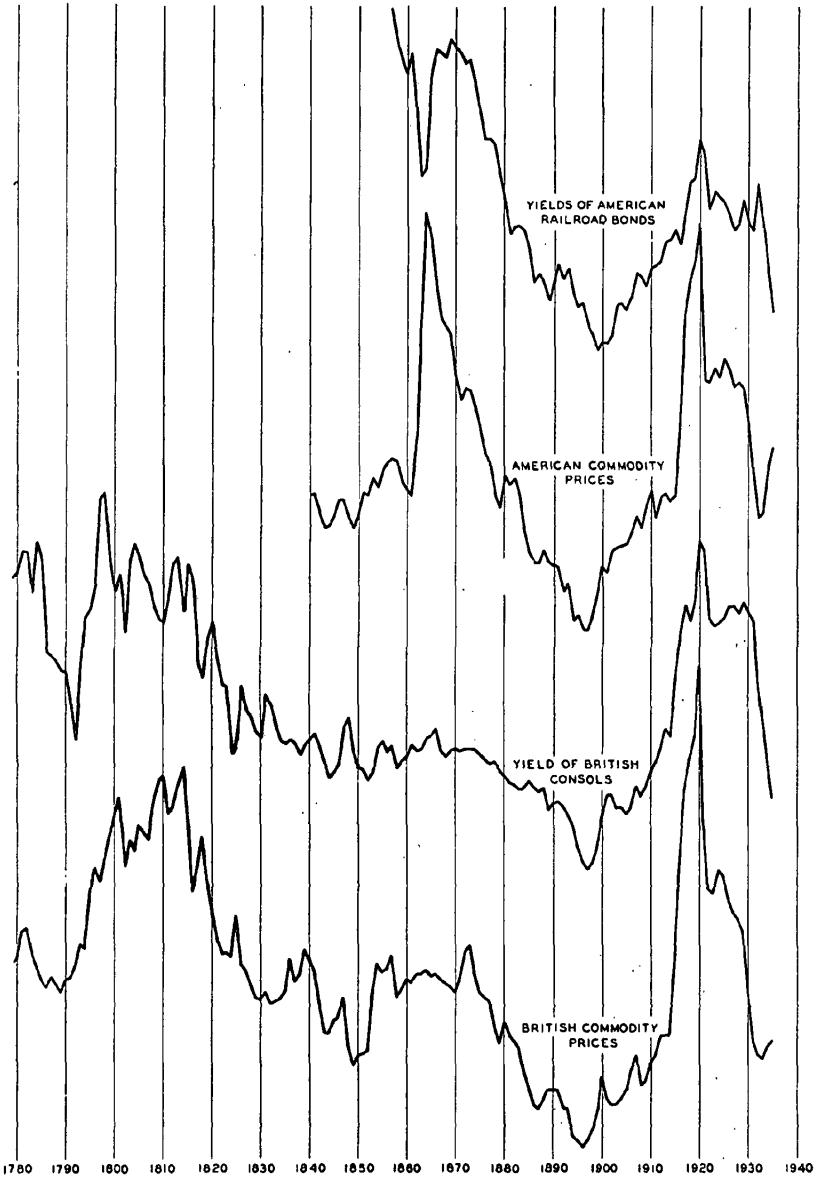
[2] *Ibid.*, p. 199.

[3] *Ibid.*, p. 200. Considerable insight into the nature of these 'adjustments' may be obtained by examining Chart 16 on which are presented annual data for (unadjusted) British commodity prices and the yields of Consols.

[4] See Colwyn Report on National Debt and Taxation, Appendix XI, p. 101.

[5] J. M. Keynes, *Treatise on Money*, II, 202.

CHART 16-BOND YIELDS AND COMMODITY PRICES
(LOGARITHMIC SCALES).



the yields of British Consols, Mr. Keynes writes:[6] "The broad character of the statistics since 1820 can be summarized as follows. Prices and Interest fell together from 1820 to 1850, rose together from 1851 to 1856, fell together in 1857–58, rose together from 1858 to 1864, fell together from 1866 to 1869, fell together from 1873 to 1896, rose together from 1896 to 1900, fell together from 1901 to 1903, rose together from 1905 to 1907, fell together in 1907–08, rose together from 1908 to 1914 and 1914 to 1920, and fell together from 1920 to 1923. And over and above these general trends, a number of the minor oscillations of the two are in the same direction."[7]

[6] *Ibid.*, p. 201.

[7] *Ibid.*, p. 201.

The numbers of years in "these general trends" (in which the years 1865, 1870, 1871, 1872 and 1904 do not appear) are 31, 6, 2, 7, 4, 24, 5, 3, 3, 2, (7, 7), 4.

The 31-year period from 1820 to 1850 shows a very considerable dissimilarity in the 'minor oscillations' of the two series. But the trend of each series is undoubtedly downward throughout the period (see Chart 16). And the declines from the earliest to the latest year are almost identical. Prices (on the Sauerbeck-Statist index used by Mr. Keynes) were 31 per cent and the yield of Consols 30 per cent lower in 1850 than in 1820. The 31-year period is the period covered by the first of the "general trends".

But, in the 25-year period from the price minimum year 1849 to the price maximum year 1873 the two series show no such similarity of long term trend. The Sauerbeck-Statist index for 1873 is 148 per cent of the 1849 figure, but the average yield of Consols was, in 1873, the same as in 1849. It is true that the yield of the high-yield year 1866 was 13 per cent higher than that of the low-yield year 1852; but 1852 is three years *later* than the price-minimum year 1849, and 1866 seven years *earlier* than the price-maximum year 1873. Mr. Keynes does not present the 25-year period 1849–73 as the period of one of the "general trends". He breaks it up into no less than four 'general-trend' periods—1851–56, 1857–58, 1858–64, and 1866–69. The analysis stops with 1869. No reference is made to the period 1870–73, in which the commodity price index rose more than 15½ per cent while the yield of Consols hardly even fluttered—Sauerbeck's index for these four years being 96, 100, 109, 111; and the annual average prices of Consols 92.44, 92.71, 92.46 and 92.61.

Mr. Keynes' action in not breaking up the 1873–96 period seems wise. There are no appreciable bond yield movements corresponding to the two minor upswings of annual commodity prices during the period. On the other hand, the trend of each series was undoubtedly downward throughout the period, though the commodity price decline was much more rapid in the earlier years than it was in the later and the bond yield decline much more rapid in the later years. The convex and concave appearance of the two trends may be seen in Chart 16.

Mr. Keynes next states that the two series "rose together from 1896 to 1900" and "fell together from 1901 to 1903". The first of these statements may be passed over without comment, but the second calls for some hesitation. It is true that, from 1901 to 1903, with the data Mr. Keynes was using (Sauerbeck's index number of

Before coming to any decision as to the conclusiveness of Mr. Keynes' various arguments, the reader should, of course, examine the data.[8] That's always a good thing to do! And it is especially desirable in the present instance. Many readers are inclined to investigate for themselves the statistical adequacy of a mere verbal summary. But few have the hardihood to face boldly that mystic clincher of argument, a high coefficient of correlation. And the advocates of the various theories concerning the relations between commodity prices and interest rates have no compunction about how they use that terrifying blunderbuss.

Professor Irving Fisher has for many years been intensely interested in demonstrating the existence and investigating the economic significance of a time relation between the movements of interest rates and the movements of commodity prices. He believes, as firmly as does Mr. Keynes, that the statistical history of the two series demonstrates an interrelation that "ought to be susceptible of some explanation of a general character". Over and over again he has marshaled the

(Footnote [7] concluded)
commodity prices and A. H. Gibson's figures for the yield of Consols), prices fell from 70 to 69 and yields from 2.917 per cent to 2.825 per cent. The yields for 1901 and 1903 are, of course, based on the prices of the new stock that the British Government had, in 1888, offered the holders of the old 3 per cent Consols. But the Government announced *in 1888* that the new stock would carry 3 per cent interest until April 5, 1889; 2¾ per cent interest thereafter until April 5, 1903; and 2½ per cent interest thereafter until April 5, 1923, after which date the Government could redeem it at par. Now the 'yields' that Mr. Gibson assigned to this stock are not calculated on the basis of these conditions. They are calculated on the assumption that the current rate would be paid in perpetuity. For example, the 1901 yield is obtained from the 1901 average price by assuming that 2¾ per cent of par would be paid in perpetuity (the terms of the bond to the contrary notwithstanding). The 1903 assumption seems to be that the total payment of that year (2 9/16 per cent of par, or one-quarter at 2¾ and three-quarters at 2½) would be the amount paid per annum in perpetuity. The average *price* of the bond was 94¼ in 1901 and 90¾ in 1903. The correctly calculated yield was *higher* and not lower in 1903 than it was in 1901. We have, in Chart 16, presented the Gibson yields. They are the yields that are used by Keynes and Fisher. But they are not correct for the period 1888 to 1903 (compare Chart 16 with Chart 19 which shows *prices* of both series).

For the whole period 1896 to 1923 the reader may check up and weigh Mr. Keynes' analysis by consulting not only Chart 16 but also Chart 19 (*price* data for the two series).

Mr. Keynes does not present any "general trends" for the period after 1923 though his table (*Treatise on Money*, p. 199) gives prices and yields annually through 1928.

[8] See Charts 16 and 19.

evidences that high and low interest rates tend to accompany high and low commodity prices. "These high correlations do not necessarily mean that the interest rate will always be high when prices are high and low when prices are low, but the tendency toward this is definitely established." [9] And again, ". . . over long periods of time high or low interest rates follow high or low prices by about one year." [10]

But Professor Fisher is not satisfied that the truly significant relation is between high and low prices and high and low rates. He finds a high correlation between *levels* difficult to explain. His theoretical analysis had suggested that interest rates (in terms of money) *ought* to be high while prices are *rising* and low while prices are *falling*. He therefore asked himself whether the interest rate figures, which seem directly dependent on price *levels*, cannot be presented at least as adequately in terms of price *changes*.

In *The Rate of Interest* (1907) he had offered evidence that short term interest rates tend to be higher during periods of rising commodity prices than during periods of falling commodity prices, and to be functionally related to the *rate* of rise or fall. At the end of a rather long statistical section, he writes: "We therefore conclude with great confidence that, 'other things being equal', *the rate of interest is relatively high when prices are rising and relatively low when prices are falling.*" [11] The tables upon which this conclusion is based contain comparisons of 'bank' and 'market' short term interest rates in various financial centers with the annual percentage rise or fall of commodity prices during periods of rise and fall.

There is a statistical peculiarity of these early tables that does not appear in the revised form in which they are presented in Professor Fisher's later book, *The Theory of Interest* (1930). In the earlier book, periods described as periods of rising (or falling) prices include the final, *but not the initial*, years of rise (or fall).[12] But, even in the

[9] *Theory of Interest*, p. 431.

[10] *Ibid.*, p. 430.

[11] *The Rate of Interest*, p. 277.

[12] For example, if annual average prices ran 100, 104, 108, 104, 100, 104, 108, 104 *ad infinitum*, each period of 'rising' prices would be assumed to consist of two years with respective prices of 104 and 108; and each period of 'falling' prices would be assumed to consist of two years with prices of 104 and 100. The average price would, therefore, during years of 'rising' prices, be 106; and, during years of 'falling' prices, 102. Such treatment of the data is, of course, to be peculiarly deprecated

later book, we find evidences of the difficulty of deciding objectively how the 'periods' should be selected. For example, in the table [13] that compares London open market rates [14] with 'annual rates of change in the price level', the first four periods are given as 1825–34, 1834–39, 1839–52 and 1852–57. An examination of the lowest line of (our) Chart 16 would suggest not 1834 but 1832 as the bottom year of the decline in prices (the independent variable) from 1825; and 1849, rather than 1852, as the bottom year of the decline from 1839.[15] But, if we make the seemingly unimportant substitutions of 1832 for 1834 and 1849 for 1852, we seriously affect the apparent significance of the entire table. The correlation between the interest rates (for each period) and the rates of change in the price level (for the corresponding periods) falls from the low figure +0.33 to the insignificant figure +0.23.[16] And, if New York rates and American prices be used instead of London rates and English prices, the results are even more meaningless.[17]

By 1930, Professor Fisher himself was no longer enthusiastic about the tables comparing 'bank' and 'market' rates with average annual percentage movements of commodity prices. In the earlier book these

(Footnote [12] concluded)

when the objective is to demonstrate that high interest rates accompany not high but rising commodity prices. If rates were a constant multiple of prices, they would, with such treatment, appear to be higher during periods of rising prices than during periods of falling prices—as would the prices themselves.

[13] Table VII, p. 527, *The Theory of Interest.*

[14] The averages of the Bank of England rates of discount contained in this table need correction for the periods 1852–57 and 1858–64. They are averages of the annual rates given in the table on p. 520 of *The Theory of Interest.* The rates of that table reproduce, with a few corrections, a portion of the table that appeared on pp. 418–20 of *The Rate of Interest.* But some serious errors are uncorrected. The annual averages of the Bank rates for 1853, 1854, and 1855 remain 2.7, 2.1 and 2.9 instead of the correct figures, 3.7, 5.1 and 4.9. The corresponding figure for 1859 remains 3.7 instead of 2.7. A correction of these errors would somewhat improve Professor Fisher's case. But the open market rates, which we discuss in the text, present his case more strongly than even the corrected Bank rates.

[15] For the years 1831-35, the price index Professor Fisher prints and uses runs 92, 89, 91, 90, 92; for the years 1848–53, it runs 78, 74, 77, 75, 78, 95.

[16] The correlation for the period from 1858 to 1927 is only +0.19.

[17] Professor Fisher's table of New York rates and changes in American prices (Table VIII, p. 527, *The Theory of Interest*) must not be used. The calculations, and even the algebraic signs of that table, are inaccurate. For example, the period 1860–65, during which prices *rose* from 100 to 232 (on the price index used by Professor Fisher), or at the rate of 18.3 per cent per annum, is described as a period during which prices were *falling* at the rate of 14.3 per cent per annum, etc.

tables constitute the backbone of a chapter. In the later book, they are tucked away among the appendices. Indeed, in the *text* of the later book, the theory that the *levels* of rates are simply and directly related to price *changes* is completely abandoned. On page 417 of *The Theory of Interest,* we read, "A very brief examination of the charts below indicates that there is little or no *apparent* relationship between *price changes* and interest rates in any of the periods studied in either country [Great Britain and the United States] except for 1898–1924 in Great Britain" (Professor Fisher's italics). On page 418, we read, "These results suggest that no direct and consistent connection of real significance exists between P' and i." [18] And, on page 427, "The studies of both the long term and short term movements of prices and interest rates give very similar results. In both studies the r's are insignificant when P' and i are correlated directly, either with or without lagging. . . ." [19]

But Professor Fisher is not disturbed by this fact now that he believes that he has discovered that rates are really related to price *changes* rather than to price *levels*—though not in any such simple manner as he once assumed and now rejects. That the coefficients of correlation between rates and price changes are small, he now feels is of no great consequence. "The small numerical value of r suggests that the relation can be revealed only faintly by P' and i directly. But a little consideration suggests that the influence of P' on i may be *as-*

[18] By P' Professor Fisher refers to *rate of change* in commodity price level and by i to interest rate (whether bond yield or short term rate). For a fuller discussion of the meaning of these terms see Appendix B.

[19] The student of Professor Fisher's *The Theory of Interest* should consider very thoughtfully the significance of comparing P' with a lagged i. For example, if he wishes to understand just how, in a particular instance, varying the lag can affect the coefficient of correlation as it does, he will examine with great care the particular pair of series that are being correlated. He will study with great technical interest such data as those presented in the chart opposite p. 426 of *The Theory of Interest,* in order to discover how a coefficient of correlation between quarterly averages of short term interest rates and quarterly changes in commodity price levels can be —0.63 without lag, —0.16 when rates are lagged two years, +0.17 when rates are lagged four years, and reach a maximum (though it be no greater than +0.35) when the rates are lagged six years—in other words when the quarterly changes in commodity prices are correlated with quarterly short term interest rates *six years ahead.* (See chart number 50, p. 426, *The Theory of Interest.*)

And he might wonder how many more maximum and minimum values for r could be obtained if the lags were extended, a year at a time, until quarterly changes in commodity prices were being compared with quarterly short term interest rates a century later.

sumed to be distributed in time—as, in fact, must evidently be true of any influence. This hypothesis proved quite fruitful in my studies several years ago, in the course of which the theory of *distributed influence* or, if we wish to avoid the implication of cause and effect, of *distributed lag* was developed in considerable detail." [20]

The function that Professor Fisher uses to represent 'the aggregate influence' of past price changes on present interest rates, he terms $\overline{P'}$. "Arithmetically, $\overline{P'}$ is merely a certain weighted [arithmetic] average of sundry successive P''s." [21] The weights are the natural numbers beginning with unity.[22] The most recent P' has the heaviest weight. For example, if $\overline{P'}$ be a weighted arithmetic average of eight successive P''s, the weight assigned to the earliest P' will be unity, that assigned to the next P' will be two, and that of the most recent P' will be eight.

The coefficients that Professor Fisher obtained by correlating bond yields and short term interest rates with $\overline{P'}$, are, in almost every instance, higher than those he obtained by correlating them with P', *but lower than those obtained by correlating them with* P. In other words, rates and yields were usually more highly correlated with 'the weighted average of sundry successive' price changes than they were with the individual price changes; *but not so highly correlated as they were with the raw prices.* Before offering any suggestion as to the significance of this fact, it is desirable to present some of Professor Fisher's statistical results.

He applied the distributed lag ($\overline{P'}$) procedure to annual commodity price and bond yield figures for three periods [23] in Great Britain, (1820–64, 1865–97 and 1898–1924); and to one period in the United States, (1900–27). For the period 1820–64 in Great Britain, operations with the 'distributed lag' give a maximum coefficient of +0.46,[note 24] and direct correlation of the raw data a maximum coefficient of +0.57.[note 25] For the period 1865–97, the 'distributed lag'

[20] *The Theory of Interest,* p. 419. Professor Fisher's italics.

[21] *Ibid.,* p. 419. See also note 18, this chapter.

[22] *Ibid.,* p. 421, lines 3–6 incl.

[23] Breaking the data up into 'periods' results, of course, in the mathematical equations or 'laws' relating the two variables to one another being (except by accident) different for each period.

[24] Read from Chart 46, p. 421, *The Theory of Interest.*

[25] Read from Chart 53, p. 430, *ibid.*

gives a maximum of +0.80,[note 26] and the raw data +0.91.[note 27] Only for the period 1898–1924, does the distributed lag procedure give a higher coefficient (+0.98 [note 28]) than the raw data (+0.93 [note 29]).

For the period 1900–27 in the United States, the distributed lag gives a maximum coefficient of +0.857,[note 30] while the corresponding figure from the raw data is +0.92.[note 31]

After discussing British and American correlations between $\overline{P'}$ and bond yields, Professor Fisher has a few words to say about the use of the $\overline{P'}$ procedure with American commodity prices and *short term* interest rates. He writes: "A study of short term commercial paper rates in relation to short term price movements corroborates the evidence obtained from correlating long term interest rates and price changes. The New York interest rates on short term commercial paper have been correlated with changes in the quarterly wholesale price indexes computed from monthly indexes of the United States Bureau of Labor Statistics for the periods 1890–1914 and 1915–1927." [32]

For the period 1890–1914, he obtained from these quarterly data a maximum coefficient between P' and i of +0.37,[note 33] by lagging i four years. But, using $\overline{P'}$ in the form of an arithmetic average of thirty 'successive P''s' (extending, therefore, over a period of seven and one-half years), he obtained a coefficient of +0.41.[note 34] For the period 1915–27, he obtained a coefficient of +0.35,[note 35] between P' and the quarterly short term rates of *six* years later.[36] But, by using $\overline{P'}$

(Footnote [25] concluded)

Professor Fisher comments wistfully on the low figures for 1820–64. He writes: 'The British figures for 1820–64 give the lowest of any included in this study. These low figures are possibly due in part to the less accurate price indexes in those early years'. *Ibid,* p. 423.

[26] Read from Chart 46, p. 421, *ibid.*

[27] Read from Chart 53, p. 430, *ibid.*

[28] *Ibid.*, p. 423, line 23.

[29] Read from Chart 53, p. 430, *ibid.*

[30] *Ibid.*, p. 423, line 26.

[31] Read from Chart 53, p. 430, *ibid.*

[32] *Ibid.*, p. 425.

[33] Read from Chart 50, p. 426, *ibid.*

[34] Read from Chart 51, p. 427, *ibid.*

[35] Read from Chart 50, p. 426, *ibid.*

[36] The text does not state what years each series covers; whether thirteen years in each instance, that is, for example, 1909–21 for prices and 1915–27 for rates; or a mere seven years, that is 1915–21 for prices and 1921–27 for rates.

In the $\overline{P'}$ comparison of annual American prices with annual American bond yields

in the form of an arithmetic average of *120* 'successive P''s' [37] (extending therefore over a period of thirty years) [38], he obtained a coefficient of +0.738.[note 39]

This is an appreciable degree of correlation. But the correlation between the *raw quarterly prices* (P) and the *raw quarterly rates* for the same period (1915–27)[40] is, without lagging, +0.709. And, if the rates be lagged one quarter, +0.829. If the rates be lagged two quarters, r = +0.891.[note 41]

(Footnote [36] concluded)
for the period 1900–27, both types of comparison seem to have been made. See the notations in the body of Chart 47, p. 422, *The Theory of Interest.*

[37] Compare first paragraph of note 36.

[38] The coefficient of correlation is a measure of the degree of accuracy with which the relation between the two variables may be represented by a particular mathematical equation. There is always the chance that, when a period of time is broken up into pieces and correlation applied to the variables during each piece, the mathematical equations representing this relationship will differ greatly from piece to piece. The burden of proving that these differences are reasonable or at least not absurd is on the investigator who proposes the breaking up.

Now, if we interpret Professor Fisher's mathematical treatment of the problem described in the text as he asks us to interpret it, we find ourselves faced by an absurdity. The function $\overline{P'}$ is interpreted by Professor Fisher as 'a weighted average of sundry successive P''s'. And, because the weights assigned to the successive P''s run 1, 2, 3, ... n, the variations in the influence of any particular price change (i.e., a particular P') upon successive interest rates run n, ... 3, 2, 1. Or, in the words of Professor Fisher, ". . . . the form of variation of the weights is exactly—but in reverse order—the form in which the distributed influence of P' tapers off during successive periods of time" (*The Theory of Interest,* p. 420). But, while the correlation coefficient for the 1890–1914 period is obtained by assuming that the quarterly interest rates of that period are related in a linear manner to a $\overline{P'}$ that contains 30 successive P''s, the coefficient for the 1915–27 period is based on the assumption that the rates are a linear function of a $\overline{P'}$ that contains *120* successive P''s. This amounts to asking us to believe, for example, that the influence on interest rates of the change in price level that occurred during the last quarter of the year 1897 faded out completely by the second quarter of the year 1905 and remained zero until the first quarter of the year 1915 when it reappeared and did not disappear again until the year 1927.

If this absurdity be removed by using the same 'distributed lags' for both periods, the coefficients are greatly reduced. The numbers 30 and 120 (or at least some figure greater than 90) are an essential feature of Professor Fisher's argument. For example, if 30 be used for both periods, the 1915–27 coefficient is reduced from 0.738 to 0.52. If 40 be used, the coefficients are 0.60 and 0.34 instead of 0.738 and 0.41. If 50 be used, they are 0.63 and 0.11. (See *The Theory of Interest,* Chart on p. 427.)

[39] *Ibid.,* p. 427, lines 4–7 incl.

[40] For these data see *The Theory of Interest,* Appendix Tables XIV and XV, pp. 532 and 533.

[41] *The Theory of Interest,* p. 431, lines 1–4.

As a statistical explanation of why the coefficients obtained by correlating the raw data [42] for selected periods sometimes run so high, the 'distributed-lag' theory seems very weak. In all but two of the comparisons made by Professor Fisher, the application of the theory lowers the coefficient.[43]

And, even if it usually *raised* the coefficient, that fact would not necessarily prove that rate *levels* were helpfully interpretable in terms of past price *changes*. For only technically is $\overline{P'}$ a measure of price *change*. As the number of P''s included in $\overline{P'}$ is increased, the configuration of $\overline{P'}$ (with such data as commodity price index numbers) usually approximates more and more closely the configuration of P, the original data.[44] The reason for this condition is that, if the month-to-month (or year-to-year) fluctuations of the data are not too violent (and they seldom are with commodity price index numbers), $\overline{P'}$ tends to approximate a constant multiple of the deviation of the logarithm of the present price from an arithmetic average of the logarithms of a specified number of past prices. In other words, if for the original data we substitute their logarithms, $\overline{P'}$ (as calculated from the original data) tends to approximate a constant multiple of the deviations of these (logarithmic) data from an uncentered moving average. The *levels* of $\overline{P'}$ are, of course, affected by changes in this moving average, but, if the average covers a sufficiently long period of time, the *configuration* or 'shape' of the $\overline{P'}$ curve will tend to approximate that of the log P curve, and therefore, unless the fluctuations of P are very large, the configuration of the P curve also. It is questionable, therefore, whether, even if the use of $\overline{P'}$ raised the coefficients, we would be warranted in assuming that it did so because $\overline{P'}$ was a 'weighted average of sundry successive P''s' rather than because it was a deviation of log P from a moving base.

[42] Prices and short term rates or prices and bond yields.

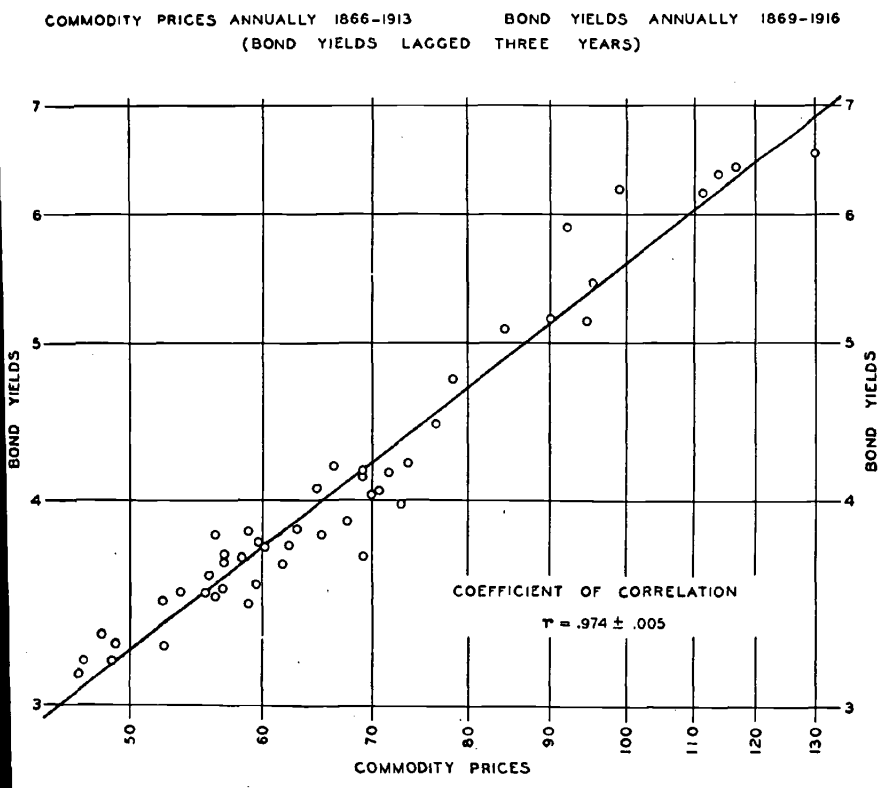
[43] One of these two comparisons supplies the only coefficient of correlation mentioned in the summary section 'Relations of Prices and Interest Interpreted' (*The Theory of Interest,* p. 438). Professor Fisher there writes: 'The rate of interest correlates very markedly with $\overline{P'}$, representing the *distributed* effect of lag. For recent years in Great Britain [1898–1924], the close relationship is indicated by $r = +0.98$ when i is lagged and the effects of P' are distributed over 28 years.'

[44] See Chart 48, p. 424, *The Theory of Interest.* Compare also the $\overline{P'}$ and P lines of Chart 49, opposite p. 426, *ibid.*

However, as the use of $\overline{P'}$ instead of P does not tend to raise the coefficients, the suspicion naturally arises that the coefficients obtained from using $\overline{P'}$ are as high as they are because of the degree of similarity of configuration of $\overline{P'}$ and P; and not as high as when P is used

CHART 17

AMERICAN RAILROAD BOND YIELDS AND COMMODITY PRICES



because the base from which P (in the form of log P) is measured (the uncentered moving average) is not as good a base (distorting to some extent the P configuration) as the simple horizontal straight line base that correlation itself introduces.[45]

But these criticisms must not blind us to the fact that casual inspection strongly suggests that there is a problem. Over long periods of

[45] See Appendix B.

time the two series seem to go up and down together. High correlations between them have been obtained and others are easy to obtain.[46] But just what and how much do these correlations mean? We must not forget that a high coefficient of correlation between two time series should never be accepted as more than merely suggestive of even probable statistical functionality, let alone causal relationship, until the mathematical origins of the high correlation have been carefully investigated.

Does the high correlation exist with respect to both long and short term movements, to both trends and deviations from trends? If it exist for long term movements, are there many such movements or is the high correlation primarily a result of one or two great movements of the data? If it exist for short term movements, how consistent is the statistical relation? Does it hold only for 'hand-picked' periods or does it hold pronouncedly throughout the range of the data, as a whole and by pieces? If it holds by pieces, does it do so without necessitating radical changes in the mathematical equation or 'law' assumed to relate the one variable to the other? Does anything that is known about the series beyond the range of accurate numerical data make it extremely probable if not almost certain that the long term or even the short term movements are *not* highly correlated or are differently related to one another in such outside ranges?

It is apparent from Chart 16 that the long term movements of the data, for either England or the United States, are very few, and that, because of the relative insignificance of the minor movements, these long term movements control the coefficients of correlation. But, for England, it is a rough and violent control. Both series were very high in the early years of the nineteenth century, declined irregularly into the late nineties of that century, advanced to great heights in 1920 and declined irregularly thereafter. But the irregularities are so great as to require explanation. The 1798 peak in the yield of Consols occurred sixteen years before the 1814 peak in commodity prices. There is no movement of Consols that can be related to the almost

[46] For example, by using only a little statistical ingenuity in the choice of functions and lags (and chicane in the choice of period), we obtained for forty-eight years of American bond yields and American commodity prices a coefficient of $+0.974 \pm 0.005$. The period covered is the whole period from the close of the American Civil War to the entry of the United States into the World War; 1866–1913 for the commodity prices and 1869–1916 for the bond yields (the bond yields are lagged three years). Both series are used in the form of logarithms. See Chart 17.

major reversal of trend in commodity prices from 1849 to 1873. And, though yields eventually completed their 1921 and 1922 fall in the thirties of the present century, they drifted slowly upward for ten years (1922–31) while commodity prices were declining; only renewing their collapse when commodity prices were ready to steady and begin a slow advance (see Chart 19). Ten years *late* on the decline instead of sixteen years *early* as in the early years of the preceding century.

Superficially considered, the American picture may seem less erratic than the British. Bond yields and commodity prices each show a huge trough beginning shortly after the close of the Civil War and ending in 1920. But, even in this period, the lags are very irregular. The early peak in bond yields came five years after the peak in commodity prices, and the beginning of the *rapid* decline was nine years later for yields than it was for prices. By the time the bottom of the trough was reached, in the nineties, the lag was less than three years; when the peak of 1920 was reached the lag had vanished.

Outside the range of the great trough, it is more difficult to show that American rates and prices were high and low or moved up and down together. Is the great fall in yields from 1857 to 1863 and 1864 to be tied up with the minor drop in commodity prices from 1857 to 1861?[47] Before coming to any such conclusion, it would be well to remember that bond yields began their Civil War collapse only after the gigantic *rise* of commodity prices had begun. There is every reason for believing that this great fall in yields can be more properly considered as economically associated with the tremendous synchronous *rise* in prices than with the negligible preceding decline. Similarly, the gigantic snapback of yields after 1864 can be more satisfactorily tied up with the synchronous collapse of prices than with the earlier rise.

Neither American series shows any appreciable trend from 1922 to 1929. But the violent *rise* in yields from the summer of 1931 to the summer of 1932 occurred in the midst of a continuous and rapid *decline* in commodity prices that lasted from the autumn of 1929 to the spring of 1933; and the great *rise* in commodity prices that began in the spring of 1933 was accompanied by a continuous and violent

[47] Though 1857 was a peak year for bond yields, the *trend* had been downward since the early forties. The increase in the 'spread' between prices and yields during the twenty years from 1840 to 1860 is therefore tremendous.

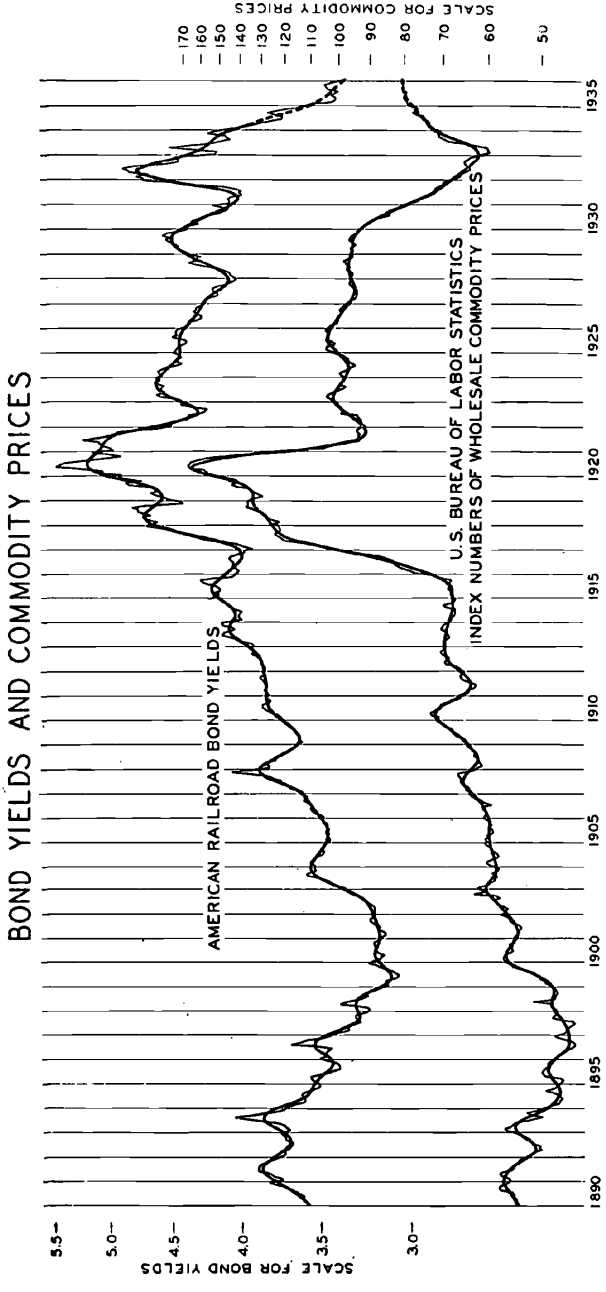


CHART 18
BOND YIELDS AND COMMODITY PRICES
AMERICAN RAILROAD BOND YIELDS
U.S. BUREAU OF LABOR STATISTICS
INDEX NUMBERS OF WHOLESALE COMMODITY PRICES
SCALE FOR BOND YIELDS
5.5
5.0
4.5
4.0
3.5
3.0
SCALE FOR COMMODITY PRICES
170
160
150
140
130
120
110
100
90
80
70
60
50
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935

collapse of bond yields. These movements are well illustrated by Chart 18 on which monthly data are shown.

And even if the statistical relationship between the two series were much closer and more regular than it is, what then? Ten years before he wrote his *Treatise on Money*, Mr. Keynes, in his *Treatise on Probability*,[48] explained and emphasized the importance of distinguishing between description and induction, correlation and causation. His remarks are so neatly worded that we cannot resist quoting from them.

"The Theory of Statistics, as it is now understood, can be divided into two parts which are for many purposes better kept distinct. The first function of the theory is purely *descriptive*. It devises numerical and diagrammatic methods by which certain salient characteristics of large groups of phenomena can be briefly described; and it provides formulae by the aid of which we can measure or summarise the variations in some particular character which we have observed over a long series of events or instances. The second function of the theory is *inductive*. It seeks to extend its description of certain characteristics of observed events to the corresponding characteristics of other events which have not been observed. . . .

"The union of these two distinct theories in a single science is natural. . . . But this union is also the occasion of a great deal of confusion. The statistician, who is mainly interested in the technical methods of his science, is less concerned to discover the precise conditions in which a description can be legitimately extended by induction. He slips somewhat easily from one to the other, and having found a complete and satisfactory mode of description he may take less pains over the transitional argument, which is to permit him to use this description for the purposes of generalization. . . .

" . . . By the method of correlation tables and correlation coefficients the descriptive statistician is able to effect this object [the determination of the degree of correspondence between the two variables within the field of observation], and to present the inductive scientist with a highly significant part of his data in a compact and instructive form. But the statistician has not, in calculating these coefficients of observed correlation, covered the whole ground of which the inductive scientist must take cognizance. . . .

"The truth of this is obvious; yet, not unnaturally, the more com-

[48] See the chapter on *The Nature of Statistical Inference*.

plicated and technical the preliminary statistical investigations become, the more prone inquirers are to mistake the statistical description for an inductive generalization. This tendency . . . has been further encouraged by the terminology in ordinary use. For several statistical coefficients are given the same name when they are used for purely descriptive purposes, as when corresponding coefficients are used to measure the force or the precision of an induction. The term 'probable error', for example, is used *both* for the purpose of supplementing and improving a statistical description, *and* for the purpose of indicating the precision of some generalization. The term 'correlation' itself is used *both* to describe an observed characteristic of particular phenomena *and* in the enunciation of an inductive law which relates to phenomena [of the same type] in general [both within and without the range of the observations]." [49]

To treat a calculating machine as an instrument for the automatic attainment of theoretically useful economic generalizations is almost as unwarranted a procedure as was that of the Lagadan professor with his "project for improving speculative knowledge, by practical and mechanical operations," by which "the most ignorant person . . . may write . . . philosophy, poetry, politics, laws, mathematics, and theology, without the least assistance from genius or study".[50] To hold any naive faith in the ultimate efficacy of throwing numbers into a mathematical hopper may easily become as definite an obstacle in the path of inquiry as was the assumption by the mediaeval schoolmen that it was possible to obtain a comprehension of the world outside themselves by the critical study of words and their meaning completely divorced from the study of those things for which the words stood. And the dangers that inhere in any such naive faith are, as the quotation from Mr. Keynes has just suggested, extremely insidious dangers.

That no palpably absurd conclusion should ever be drawn from the occurrence of even the highest coefficients of correlation is so well recognized as to be assumed to merit no comment. No one suggests that, because the graduated seasonal curve of temperature in New York City shows (with a definite lag) a virtually perfect *negative* correlation with the varying seasonal distances of the earth from the sun, those variations in distance are the cause of summer and winter in this city—*great* distance causing the *heat* of summer and *lesser*

[49] John Maynard Keynes, *A Treatise on Probability*, pp. 327–29.

[50] Gulliver, Part III, Ch. V.

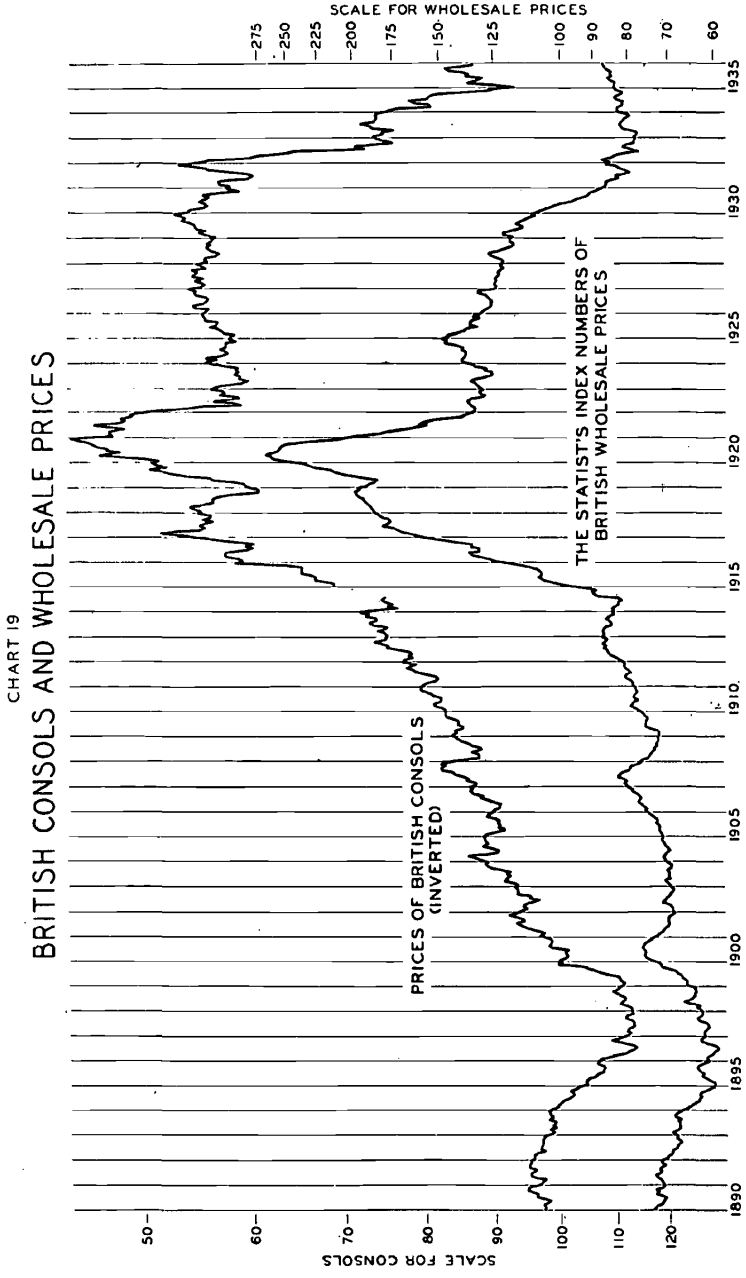


CHART 19
BRITISH CONSOLS AND WHOLESALE PRICES
SCALE FOR WHOLESALE PRICES
275
250
225
200
175
150
125
100
90
80
70
60
1935
1930
1925
1920
1915
1910
1905
1900
1895
1890
THE STATIST'S INDEX NUMBERS OF BRITISH WHOLESALE PRICES
PRICES OF BRITISH CONSOLS (INVERTED)
SCALE FOR CONSOLS
50
60
70
80
90
100
110
120

distance the *cold* of winter. Indeed, no coefficient of correlation is ever thought of as offering even evidence, let alone proof, of causal relationship if its origin can easily be explained without any such assumption and if any causal conclusions would conflict radically with the facts as determined from evidence whose significance and interpretation is open to no such possibility of questioning.

But all too often when little or nothing is known concerning the possibility of causal relationship between the two variables, the absence of visible danger signals is unconsciously interpreted as proof of the absence of danger, and a high coefficient of correlation is seized upon with avidity as strong if not conclusive evidence of a direct and simple causal connection.

At best (when the correlation is virtually perfect) this type of reasoning is often almost indistinguishable from 'induction by simple enumeration', so contemptuously commented on by John Stuart Mill. "It consists in ascribing the character of general truths to all propositions which are true in every instance that we happen to know of. . . . Whether the instances are few or many, conclusive or inconclusive, does not much affect the matter . . . provided no other experience of a conflicting character comes unsought." [51] "The name of Empirical Laws," writes Mill in a later chapter,[52] has been given "to those uniformities which observation or experiment has shown to exist but on which one hesitates to rely in cases varying much from those which have been actually observed, for want of seeing *why* such a law should exist. . . . If true at all, its truth is capable of being, and requires to be accounted for."

Of course any *extremely* great regularity of either coexistence or sequence, or statistically, any extremely high and persistent "correlation" between two or more variables (without radical changes in the functional relation) should suggest strongly that the nature of the relation and the possibility that it might be more than merely "empirical" should be carefully considered. Hypotheses to explain the regularity should be constructed and tested not merely for statistical adequacy but also for logical consistency and plausibility; and for the accordance or non-accordance with fact of the implications that they will necessarily involve. And, even if no hypothesis can be formulated that stands up

[51] *Logic*, Book III, Ch. III.
[52] *Logic*, Book III, Ch. XVI.

under investigation and analysis, the assumption should not too easily and cavalierly be made that the search for such an hypothesis should definitely be abandoned.

Writers on scientific method, and even scientific investigators, have sometimes too hurriedly assumed that unexplained apparent relationships were non-existent, accidental, or at best mere empirical curiosities. Bode's Law, according to which the relative distances of the various planets from the sun were expressed by an extremely simple formula, began as an arithmetic curiosity but became accepted as demanding explanation when, upon the discovery of Uranus, the distance of that planet from the sun was found to follow the 'law'. But, when Neptune was discovered and its distance from the sun was found to be quite different from that required by the formula, Bode's 'Law' became accepted, not as demanding explanation, but as the perfect example of accidental and unmeaning empiricism.

However, in recent years, astronomers have begun to suggest that Bode's Law fails to cover the cases of Neptune and Pluto, not because the relative distance of the planets from the sun should not be expected to follow any 'law' but because of the inadequacy of the particular 'law' Bode proposed. The suspicion is becoming general that Bode's Law is empirical primarily in the technical sense in which so many engineering formulas are empirical rather than in the more fundamental sense in which any explanation of summer and winter in terms of the varying distance of the earth from the sun would be empirical; that it is empirical not because the relation it attempts to describe is non-existent, or scientifically irrelevant, accidental and without fundamental significance, but because the mathematical formulation of the law is of such a nature that, even if it covered all the facts with which it is directly concerned, it not only could not be used to unearth new facts and discover new relations by mere mathematical analysis, but its implications would conflict with the body of more rigidly established astronomical fact.

Merz could think of no more damning indictment of Mendeléef's periodic classification of the chemical elements than to suggest that it might be as purely empirical as "the once well-known but now [1896] forgotten law of Bode".[53] But Mendeléef's classification is no longer a mere curiosity. The recognition of its fundamental signifi-

[53] *History of European Thought in the Nineteenth Century*, I, 422 and 423.

cance has grown steadily since Merz wrote. It is almost as easy to make the mistake of assuming that a rational law is merely empirical as it is to make the mistake of assuming that a mere empirical curiosity is rational.

An empirical law or unexplained generalization that presents, in a not palpably absurd form, an astonishingly adequate descriptive summary of observed facts usually merits careful consideration, but the consideration it merits varies with the adequacy of the descriptive summary. The summary is, at best, only an hypothesis. And, to the extent that it is full of holes and exceptions, it loses its right to demand consideration, let alone explanation. In this respect an empirical law differs from a well established and seemingly rational generalization that has been fitted into its proper place among allied scientific generalizations, that helps to explain them and that is explained by them. The unexplained perturbations in the orbit of the planet Uranus led Adams and Leverrier to suspect the existence of some other as yet undiscovered planet rather than to doubt the Newtonian formulation of the law of gravitation. The calculations of Leverrier concerning the size and position of the new planet were almost instantly verified by Dr. Galle's discovery of the planet Neptune.[54]

The 'explanation' that lifts a generalization out of the empirical and into the rational need not be of a directly causal type. Two variables, such as the diameter and circumference of a circle, may be *functionally* related without the suggestion of a causal nexus. A statistical 'law' relating the height and weight of men does not necessarily suggest that variations in either variable are *caused* by variations in the other. Similar illustrations may be taken from the field of economics. The high correlation between the prices of substitutes or partial substitutes, such as scrap and pig iron, is evidence of a functional but not of a one-way causal relation. Different effects of the same cause yield examples in which the variables themselves are not causally related to one another. For instance, the effects of year to year variations in rain-

[54] Of course, an exception that needs an *ad hoc* hypothesis to explain it always casts some degree of doubt on the original generalization until the *ad hoc* hypothesis is verified. We must not forget that Leverrier's later suggestion that the unexplained perturbations of the planet Mercury pointed to the existence of an undiscovered planet (Vulcan) between Mercury and the Sun was never verified, and that the perturbations of Mercury were explained only when Einstein's hypothesis had amended that of Newton.

fall on the year to year variations in the yield per acre of different crops in the same area. The seasons carry a succession of agricultural phenomena that may be described as functionally but not as causally related to one another. The peak in strawberry production precedes the peak in apple production, though the two production series are not causally related.

But the fact that the 'explanation' that lifts the empirical into the rational need not be of a directly causal type does not warrant throwing entirely aside the concept of causation. Though an almost impregnable metaphysical case can be made for the contention that the most desirable objective of science, and indeed the only one that it can possibly attain, is to *describe* phenomena completely and in the simplest possible manner, the unthinking acceptance of this doctrine may easily lead to meaningless and useless empiricism. It is all too easy to forget the tremendous significance that must be attached to the words 'completely and in the simplest possible manner'.

The casting out of the metaphysical devil of causation all too easily leads to his return with seven other devils. The economist must beware that the statistician, while seeming merely to describe mathematically certain characteristics of the data, does not insidiously suggest a causal relation, though the evidence be evidence only of the probability—or possibility—of a functional one. He must not allow himself to be befogged by professional patter about a 'multiplicity of causes' if there is a definite possibility that the variables that are being statistically compared are not themselves causally related. In such cases, he would usually be well advised to forget that science is merely description and to think in terms of a less refined but simpler metaphysics of *verae causae*.

Now it is true that, in various countries and often for long periods of time, the movements of interest rates (or rather bond yields) and commodity prices have been such as to suggest that they might be rationally related to one another in some direct and simple manner. But, over the whole range of available data, the exceptions to this appearance of relationship are so numerous and so glaring that they cannot be overlooked. And the *distribution* of the exceptions is such as to awaken the liveliest suspicion that any theory which proposes an explanation of the apparent agreements should also explain the unmistakable exceptions. The exceptions are not scattered over the range

of the data in a haphazard manner; they occur in 'bunches'. And, the timing of these 'bunches' or *periods* of exception is such as not only to suggest why the exceptions occur but also to throw considerable light on the assumed functionality let alone causality of the periods of agreement.[55]

Of course, if any formula that was not palpably artificial and *ad hoc* described at all adequately the entire range of the data, it could not reasonably be thrust aside without the most careful study of why it did so. But so far no one of the numerous attempts that have been made to develop even a good descriptive summary of the supposedly close relation has led to any such accurate and reliable account of all that has actually occurred as to call insistently for explanation. And, even if such a good descriptive summary existed, we should still be faced with the important question, what, if any, are the causal elements in the statistical relation.

The common assumption that, between the bond yield and commodity price series, such causal elements exist and are important has resulted not merely from the aggressiveness with which readers of economic literature have been assured that statistics support the contention that a functional relation exists; but also from the apparent simplicity of explaining why it *should* exist. But the 'explanations' are numerous and some of the more popular ones are mutually contradictory. Any explanation seems good enough. Indeed, all too often the elucidations sound suspiciously like what the Freudian psychologists term 'rationalizations'. And this is but what might be expected. If a formula be empirical in the fundamental sense that it is unrelated or only distantly related to the true causes of the phenomena it attempts to describe, it naturally tends to be difficult to explain. To ask why seasonal variations in the temperature of New York City are caused by variations in the distance of the earth from the sun or why the strawberry crop gives rise to an apple crop three months later is to

[55] In the statistical comparison of time series, mere absence of the highest degree of correlation, if the absence results from a moderate degree of irregularity in the relation *over the whole period,* may often reasonably be assumed to result from the disturbing effects of other causal factors. But, when the hypothetical relation sometimes disappears completely for years or even decades at a time, the investigator should seriously consider the possibility that causal relationship either does not exist or is of a more complicated and totally different kind from the simple and direct relation suggested by the correlation during the periods in which it is high.

propound questions worthy of a lawyer cross-examining an expert witness.

And, as we have already seen, of the mathematical relations that are presented by the various writers on interest rates and commodity prices, those giving the highest coefficients of correlation are often those that seem most suspiciously empirical and difficult to explain. For example, if the data be assumed to support the contention that the *levels* of interest rates or bond yields depend upon the *levels* of commodity prices, they indeed seem to prove too much. Professor Fisher has himself remarked that " . . . it seems impossible to interpret it [the association of high and low rates with high and low price levels] as representing an independent relationship with any rational theoretical basis. It certainly stands to reason that *in the long run* a high level of prices due to previous monetary and credit inflation ought not to be associated with any higher rate of interest than the low level before the inflation took place. It is inconceivable that, for instance, the rate of interest in France and Italy should tend to be permanently higher because of the depreciation of the franc and the lira, or that a billionfold inflation as in Germany or Russia would, after stabilization, permanently elevate interest accordingly. This would be as absurd as it would be to suppose that the rate of interest in the United States would be put on a higher level if we were to call a cent a dollar and thereby raise the price level a hundredfold. The price level as such can evidently have no permanent influence on the rate of interest except as a matter of transition from one level or plateau to another." [56]

But the apparently high correlation between the levels of commodity prices and the levels of bond yields is explained with great confidence by the average businessman. It would seem permissible to lighten the present discussion by digressing for a moment to notice some of the explanations he offers. The commonest one is that interest rates and bond yields are naturally and logically higher in periods of high commodity prices than they are in periods of low commodity prices because in periods of high commodity prices "a dollar is worth less and hence lenders will insist on borrowers paying more dollars for a loan just as they pay more dollars per bushel for potatoes". The argument is that interest is a price—the price paid for a loan. For it to be high when prices in general are high is therefore quite as natural as for

[56] *The Theory of Interest,* pp. 440, 441.

the price of pig iron or the price of potatoes to be high when prices in general are high. Incomes must be adjusted to the level of commodity prices. Lenders, therefore, will naturally insist on higher interest rates when prices are high than when they are low.

Persons who are satisfied with the above explanation never bother to ask themselves why *borrowers,* in a period of high commodity prices, should not insist that *lenders,* in return for the promise of a specified future money income, pay the *borrowers* more (present) dollars, because, in such a period, *those* dollars are worth less. But this idea has actually been used to develop the conclusion that high commodity prices, instead of being naturally accompanied by *high* interest rates, should naturally be accompanied by low rates. Of course, as interest rates and commodity prices show more of a tendency to be high and low together than *vice versa,* the theory, as an explanation of the actual facts, is worse than useless. But the reasoning, as such, is slightly more plausible than that presented in the preceding paragraph. As the Red Queen might have remarked, "I've heard nonsense, compared with which this would be as sensible as a dictionary." The argument has been definitely formulated as follows: "Money is valuable only as it commands commodities or services and therefore the price of money, which is interest, should vary inversely with the price of commodities." [57]

The origin of the strange fallacies of confusion illustrated in the two preceding paragraphs is, of course, easily traceable to a muddle-headed use of the word *price.* The rate of interest may, for some purposes, be considered a *price*—but a different kind of price from the

[57] O. K. Burrell, *The Behavior of Bond Prices in Major Business Cycles* (University of Oregon Studies in Business No. 13), p. 62.

In this instance, the author's apparent assumption that the theory was useful to explain the facts as they are seems to have been made in a moment of inadvertence. Not only the statement on p. 6 where he writes, "Bond *prices* normally vary inversely with commodity prices . . .", but also the context on p. 62 seems inconsistent with the idea that he really thought that the rate of interest even tended to "vary *inversely* with the price of commodities". The context on p. 62 runs as follows: "This long range rise in bonds and decline in commodities may be explained on two bases. In the first place, there is probably a causal relationship between the level of commodity prices and the level of bond prices. Money is valuable only as it commands commodities or services and therefore the price of money, which is interest, should vary inversely with the price of commodities. Probably a more fundamental explanation of the long term relationship between commodity prices and bond prices is that the same influences that operate to force commodity prices downward cause bond prices to move upward, and *vice versa.*"

price of commodities. The *price* of a commodity at a specified date refers to an exchange relation between a specified quantity of money at the specified date and a specified quantity of the commodity at the same date. Potatoes are fifty cents a bushel when fifty cents of present money will exchange for one bushel of present potatoes. The relation is an exchange relation between different things at the same date.[58] Now a rate of interest refers to a quite different kind of exchange relation. It is an exchange relation between the same thing at different dates instead of an exchange relation between different things at the same date. The relation is not between present money and present something else but between present money and future money. Money is on both sides of the equation.

And this brings up another phase of the absurdity inherent in the 'price' arguments—also unsuspected by their naive proponents. A price is a ratio. A rise in the potato price of cotton *is* a fall in the cotton price of potatoes. A high rate of interest indicates a high price for present money in terms of future money. But a high price for present money in terms of future money *is* a low price for future money in terms of present money. If either of these ratios is to be considered as the same kind of a price as the price of a commodity, it surely should be the price of future money in terms of present money and not *vice versa.* Present money can be used to buy future money or present commodities.[59]

The recognition that the exchange relation to which a rate of interest attaches is an exchange relation between present money and future

[58] Even so-called 'future' contracts do not constitute real exceptions to this definition. Though a typical 'future' contract, such as a contract to buy and sell wheat or cotton on a specified future date or within specified future dates may be entered into at the present time and, though the exchange to which it refers may not actually occur until some time in the future, that exchange, when it does occur, will be of different things at the same date.

The case in which money is paid in the present in exchange for an agreement to deliver a commodity in the future is, of course, a hybrid. The price paid in the present is the price that, at present, seems a proper future price under a 'future' contract such as that just described, less a deduction determined by interest rate considerations. It contains two elements, a (future) price element and an interest rate element. Similarly with the purchase of a durable good such as a house. Whether the house is to be lived in by the owner or to be rented, the future returns are 'discounted'.

[59] It is this consideration that led us to suggest that the analogical reasoning back of the second of the two theories we have been examining is, in some respects, slightly more logical or at least more verbally plausible than that back of the first and commoner theory.

money, between the same thing at different dates, and not an exchange relation between different things at the same date has led to an extremely simple but also extremely naive explanation of why rates and prices have moved as they have. Because the explanation exhibits some real comprehension of the fundamental nature of interest rates, it offers, from a purely formal standpoint, a much more logical explanation than either of the two preceding ones. But it not only shows a deplorably inadequate acquaintance with the historical facts to be explained but also assumes on the part of borrowers and lenders a capacity to forecast the future that is positively fantastic. It explains why almost all men are either inordinately rich or excessively clever by drawing attention to the effectiveness of the almost universal desire to be one or the other—if not both.

When a lender gives up present money in exchange for a promise to pay future money, he relinquishes, so runs the theory, a possibility of present spending in return for a possibility of future spending. And, if the purchasing power or spending potentialities of a present dollar are greater than the spending potentialities of a future dollar, because commodity prices are at present lower than they will be when the future payments are to be made, the lender will insist upon and the borrower will acquiesce in a higher rate of interest than would be agreed upon by both if future commodity prices were to be lower than or even the same as present prices. The theory asserts that the buyer of a bond, for example, is not buying a series of future money payments but a series of future commodities and services (which the future money payments will be used to obtain). If the money prices of commodities and services are to be relatively high in the future, the future money income will necessarily buy but little. The present money price of the bond will therefore be relatively low, and the 'yield' or 'rate of interest' correspondingly high.

Of course, no one proposing this explanation of why rates and prices have moved as they have would think of even suggesting that borrowers and lenders, who are responsible for the movements of interest rates and bond yields, are capable of forecasting with complete and mathematical accuracy the future of commodity prices. They would no more think of making such a suggestion than they would think of suggesting that buyers and sellers of high-grade long-term bonds are capable of forecasting accurately the future of short-term interest

rates. However, an enlightening first approach to the problems presented by any theory that interest rates and bond yields are completely determined, or even usually greatly affected, by forecasts of future commodity prices may be made by beginning with just such absolute assumptions. What would be the movements of short and long term interest rates if borrowers and lenders, valuing future funds only because they could be used in the future to purchase commodities, were able accurately to forecast future commodity prices; and, because of their forecasts, so operated in the money and investment markets that both short and long term rates were always logically adjusted to the future movements of commodity prices—the short term directly, and the long term indirectly (in accordance with the principle of 'investment indifference'[60])?

Under these hypothetical conditions the *levels* of short-term interest rates would vary with the *rates of change* of commodity prices. If prices were *advancing* rapidly short-term rates would be *high* and, *vice versa,* if prices were *declining* rapidly short-term rates would be *low.* For example, if short-term rates could be assumed to remain constant at, say, four per cent per annum when the level of commodity prices was not changing; then, during a period in which prices were rising at the rate of 6 per cent per annum, rates would remain constant at a little less than ten and a quarter (10.24) per cent per annum.[61]

If future commodity prices were to trace out a sine curve on a logarithmic scale, short-term interest rates (plus unity) would trace out a curve resembling the commodity price curve, but the maximum interest rates would occur when the *slope* of the logarithmic price curve was at a maximum, and the minimum rates when the *slope* of the price curve was at a minimum. The maxima and minima of the short-term interest rate curve would *precede* the maxima and minima of the commodity price curve by a quarter cycle.

[60] See Ch. II.

[61] In addition to the usual absurdities brought to light by a discussion of the implications of any such contrary-to-fact assumptions as those we are making, a peculiar and specific unreality is here suggested. If commodity prices were *declining* at the rate of six per cent per annum, short-term rates should stand at approximately *minus* two and a quarter (2.24) per cent per annum. But, as money is physically not a perishable commodity, *bona fide* negative rates, that is negative rates that are not measures of the value placed on some privilege or right unconnected with the receipt of interest, are even theoretically quite impossible beyond the extremely low percentage necessary to cover safe-deposit or other custodial charges.

Furthermore (under the doctrine of 'investment indifference'), during a period in which commodity prices were rising at a constant rate, and in which short-term interest rates therefore remained constant, the return that could be obtained by buying (without commission) a bond of hypothetically absolute security and later selling it (also without commission) would be a constant rate per annum—the same rate as the short-term rate. If the 'current' yield of the bond, as the brokers term it, in other words the yield on the arbitrary assumption that the bond is a perpetuity, were less than the constant short-term paper rate, the *price* of the bond would *advance* (and the 'current' yield *decline*) continually throughout the period; if the 'current' yield were greater than the constant short-term paper rate, the *price* of the bond would *decline* (and the 'current' yield *advance*) throughout the period.[62] Furthermore, if, at the beginning of any six months' period, the bond's *yield to maturity* were *less* than the short-term rate for the next six months, the yield to maturity would have to decline still further during that six months. *But the bond would not necessarily advance in price.*[63] And *vice versa.*

If the movement of interest rates were completely determined by a knowledge of the future movements of commodity prices and if it were known that commodity prices were, in the future, to move up and down in a sinusoidal manner, short term rates would, as we have seen, move in a similar manner but reach maxima and minima a quarter cycle early. However, as bond yields (to maturity) would be declining whenever short term interest rates were above the yield of the bonds and advancing whenever the short term rates were below the yield of the bonds, the bond yields would tend to reach maxima and minima

[62] In each case, the assumption must be made that, because of complete knowledge of the future of commodity prices and short-term interest rates, the price of the bond at the time of purchase would be such as to permit these price movements to occur in such a manner as to end (at 'maturity') with the face of the bond plus the last coupon.

[63] If a 6 per cent bond having 2 years to run sells for 103.81, its yield to maturity is 4 per cent per annum. If at the end of six months (1½ years to run) it sells for $103.62, its yield is then 3½ per cent per annum. The realized return over the six months to a purchaser who bought at $103.81 immediately after one coupon payment and sold at $103.62 immediately after the next would be $2.81 ($3.00 coupon minus 19 cents depreciation in price) on an investment of $103.81 or more than 2.7 per cent *per half year.* Assuming this to have been the semi-annual return on short-term money, we see the bond yielding at both dates less than the short-term rate and the yield falling between the dates *but the price also falling.* See Ch. II.

at approximately (*very* shortly after) the dates on which commodity prices reached *minima and maxima.* But the proponents of the theory do not offer it as an explanation of why bond yields should be low when commodity prices are *high* and *high* when commodity prices are *low,* but as an explanation of why yields and prices are so often high and low together.[64]

Of course, if only the *near* future of commodity prices (and hence of short term interest rates) were foreseen, there would be no reason

[64] Compare J. M. Keynes, *A Treatise on Money,* II, pp. 202 and 203.

"Nor can we regard the facts as an example of Professor Irving Fisher's well-known theorem as to the relation between the rate of interest and the appreciation (or depreciation) in the value of money. Indeed quite the contrary. For the compensatory movements which Professor Fisher postulates relate to the sum of money repayable a year hence against cash loaned today which will cover interest *plus* (or *minus*) an allowance for the change in the value of money during the year. Thus, if real interest is 5 per cent per annum and the value of money is falling 2 per cent per annum, the lender requires the repayment of 107 in terms of money a year hence in return for 100 loaned today. But the movements to which Mr. Gibson calls attention, so far from being compensatory, are aggravating in their effect on the relation between lender and borrower. For he shows us that, if prices are rising *(e.g.)* 2 per cent per annum, this will usually be associated with a tendency for the capital value of long-dated securities to be *falling* 2 per annum; so that the purchaser of long-dated securities will possess a year later a sum which is worth 2 per cent less in terms of money which is itself 2 per cent less valuable, so that he is 4 per cent worse off, the two factors of change not balancing, but aggravating, one another—whilst the variations in the rate of interest earned during the year in question are too small to make much difference."

The theory here attacked by Mr. Keynes is presented most openly in Professor Fisher's earlier book, *The Rate of Interest.* Mr. Keynes' criticism is useful because suggestive. But the reader should notice that he takes no cognizance of either the relation of 'investment indifference' which, theoretically, should exist between bond yields and (known) future short term interest rates or the distinction between 'promised' and 'realized' yields. Professor Fisher's contention was that, if 'real' (or 'commodity') interest for the next year was to be 5 per cent per annum and it was known that commodity prices were, during that time, to rise 2 per cent, a lender would insist that, if he were to lend his money for that year, 7+ per cent per annum must be 'promised' him. What effect his insistence should theoretically have on the yields of outstanding long term bonds Professor Fisher does not say. It is, however, at least imaginable that, if borrowers and lenders thought in terms of 'commodity' rather than 'money' rates and if they could see into the future of commodity prices for one year but not for more than one year, 'promised' yields on one-year loans could follow Professor Fisher's scheme; though, in the absence of knowledge of future short term rates beyond one year, bond prices and yields would not move in such a manner as to create a condition of 'investment indifference' and hence the return 'realized' by buying a bond and selling it one year later would not necessarily correspond to the 7+ per cent yield 'promised' in the one-year note.

for a relation of 'investment indifference' to arise between long term bonds and short term notes. As a period of rising commodity prices approached and began to be foreseen, both short and long term rates would rise; the short term rates as soon as commodity prices actually began to rise and the long term rates almost immediately, because the foreseeing of the future high short term rates (which would come with the rising commodity prices) would produce an upward adjustment in the community's estimate of that peculiar 'average' of expected short term rates that would constitute a bond 'yield'. Such a condition could, of course, help to explain why 'investment indifference' is not a reality of the market place, why bond yields are always being 'adjusted' to short term interest rates but only to short term rates that are unmistakably imminent or have already materialized.[65]

There is still another type of forecasting theory. It is that the movements of interest rates depend on forecasts of future commodity prices but that the forecasts are not necessarily good or even conscious forecasts. They are mere unreasoning carry-overs from the past, from what has been occurring. This type of theory contends that the longer a commodity price movement lasts the more do borrowers and lenders consciously or unconsciously adjust their dealings with one another to the assumption that the movement will continue, and interest rates therefore continue to rise (or fall) as long as commodity prices continue to rise (or fall). This contention does not involve the proven absurdity of assuming good forecasting to be habitual or even usual, but the theory fails as a general explanation of the facts, though the consideration it stresses may often be a minor and sometimes, under peculiarly exceptional circumstances, a major factor in the determination of rates.[66]

Forecasts that prevailing price movements will continue tend to be better than would be those based on the mere flips of a coin, only because commodity price movements so often gather very considerable

[65] Of course, even the *near* future of short term rates is, as we have shown in Chapter II, seldom foreseen with much accuracy. The 'adjustment' of bond yields to short term rates is usually an adjustment to present or past rates. As an adjustment to future rates, it is almost invariably overdone—as though the forecast were that a present high level of short term rates was an important indication that those rates would permanently or at least for a long time be much higher than had been expected before they rose.

[66] For example, in a period of pronounced and increasing currency inflation.

momentum. They never last forever but they often last a considerable time. Innumerable minor fluctuations may be superposed on major swings but the picture is usually like stormy waves on the open sea or rolling hills and surface irregularities in a mountainous country rather than like ripples on the flat surface of a small pond or ups and downs in a ploughed field. As the crest or trough of a great wave is reached, in other words when the future is no longer to be as the past has been, the forecasting is almost always exceedingly bad; that it is usually a mere straight-line projection of *past* price movements soon becomes all too evident. In the absence of startling occurrences whose economic significance seems fairly plain (such as war or a runaway currency inflation), rational as opposed to such mere projective forecasting is rare.[67]

At this stage of the discussion it is desirable to introduce and examine an assumption that is implicit in most of the theories that stress the importance of conscious or unconscious commodity price forecasting. That assumption is that the only, or at least the overwhelmingly important, reason why anyone should value a promise to pay money in the future is that future money can be used, in the future, to buy commodities. Indeed, the suggestion has often been made that 'money' interest was a mere artificiality and 'commodity' interest the only 'real' interest.[68]

[67] Professor Fisher, though he continues to strike the conscious-forecasting note, tends to press down more and more resolutely on the soft pedal. And that seems wise. The third sentence of Ch. XIV of *The Rate of Interest* (1907) states: "The object will be to ascertain the extent to which, in the actual world, the appreciation or depreciation of the monetary standard is foreseen by borrowers and lenders, and provided for in the rates of interest upon which they agree." The corresponding sentence of the corresponding chapter (XIX) of *The Theory of Interest* (1930) runs: "The main object of this chapter is to ascertain to what extent, if at all, a change in the general price level actually affects the market rates of interest." In many parts of the chapter of the later book, the language of forecasting persists but it often seems to be a mere hang-over from the earlier book. The theory of the "distributed lag" (presented in the later book) explains the movements of interest rates exclusively in terms of *past* commodity price movements.

[68] Compare Irving Fisher, *The Theory of Interest*, p. 42.

"Is there, then, no absolute standard of value in terms of which real interest should be expressed? Real income, a composite of consumption goods and services, in other words, a cost of living index in accordance with the principles set forth in Chapter I, affords a practical objective standard. By means of such an index number we may translate the nominal, or money rate of interest, into a goods rate or real rate of interest, just as we translate money wages into real wages."

In recent years, this idea has gained considerable currency. Indeed, many buyers of bonds rather sententiously assert that, before investing, they attempt to forecast the cost of living. They insist upon the importance of future 'corned beef and cabbage' as opposed to future money. However, even the briefest interrogation will quickly disclose the fact that in almost every instance they are not talking about their own corned beef and cabbage but some one else's corned beef and cabbage. They personally are concerned only with future *money*. They want *money* interest and if possible a *money* profit on the purchase price of the bond. Even those investors [69] for whom the importance of future money might seem to be fairly measurable by the future commodities and services that it could buy, almost always think and act in terms of money rather than in terms of its future purchasing power. With exceptions so rare as to be negligible, the only reason why bond buyers or sellers talk about commodity prices is that they believe commodity price movements are highly correlated with bond price movements. Why this is so they do not know. Introspection leads them nowhere. They themselves do not think in terms of commodities.[70] All the 'corned beef and cabbage' talk is purely impersonal. It circulates like gossip without serious scrutiny or even clear formulation.

Corned beef and cabbage theories grossly underestimate the importance of money as *undifferentiated* purchasing power. Unless a potential lender of money who intends to use the resulting income for the purchase of consumers' commodities knows that he will, in the future, want only commodities that, because they do not deteriorate with time, can be bought in the present, and, unless he also knows exactly what commodities he will then want, he cannot forestall his future needs by present purchasing.[71] To the extent that his future

[69] Such as retired business and professional men who are free from debt and are living on the returns from their investments.

[70] This is, of course, not true when, as in the midst of an uncontrolled paper money inflation accompanied by rapidly increasing distrust in the currency as such, the probability of an *extremely violent* price movement seems great.

[71] And he cannot *advantageously* forestall his future needs for even commodities that will not appreciably deteriorate, unless the market price of such commodities is to advance more rapidly than would money accumulate if placed in a superlatively secure investment maturing at the time he will wish to use the commodities. For instance, if the 'lender' discussed by Mr. Keynes (see note 64) were unwilling to accept 5 per cent money interest for a year because commodity prices were to rise 2 per cent during the year, he could not better himself by buying commodities and selling them at the end of the year with a profit of 2 per cent.

wants will be for perishable goods, he will want future purchasing power; and, to the extent that he does not now know what those wants will be, he will want not a ticket good merely for particular commodities but *undifferentiated* future purchasing power. He may, of course, obtain this undifferentiated purchasing power by speculating in commodities that he does not want to use or by engaging in a business that would be advantageously affected by a rise in the general price level. But the fact remains that what he wants and should want is undifferentiated future purchasing power—in other words, money not commodities.

And, for every dollar lent by such an individual who thinks in terms of future purchasing power (even if undifferentiated), there are many many dollars lent by institutions whose managers do not and should not so think. The corned beef and cabbage theory forgets that future money can be used to discharge future money obligations as well as to buy future commodities. The largest buyers of bonds are the banks and insurance companies. To liquidate their future money obligations, they clearly will need future dollars and not future commodities. If the managers of such institutions are interested in what happens to the market value of their bond portfolios, and if they believe that the movements of commodity prices affect the movements of bond yields, they will, of course, be interested in the future of commodity prices; just as they will be interested in the future of business activity. But their direct concern is with dollars and not with corned beef and cabbage. The same is true of borrowers. Though, like lenders, they may be affected indirectly by their intelligent or unintelligent pondering over the possible influence that future commodity price movements may have on future interest rates, they certainly do not, in their own business calculations, usually measure or even think of future interest payments in terms of relinquished future purchasing power. Unless they expect a *gigantic* rise or a *gigantic* fall in commodity prices, both borrowers and lenders tend to think in terms of money rather than in terms of commodities.

And thinking in terms of gold rather than paper is only partially an exception to this rule. Though, when such thinking occurs, the relatively stable purchasing power of gold may be stressed, the gold is not thought of as a commodity that, because of its physical characteristics, is desirable for its own sake; but as another and better money. It is

not wanted because it can be used to manufacture jewelry or tone photographs, but because of its undifferentiated purchasing power. It has been, and to a considerable extent still is, 'the money of the international republic'. It can be used as such or (at least till recently) converted into a larger or smaller number of paper dollars. But, whether to be converted or to remain unconverted, it is thought of as the supreme type of undifferentiated purchasing power.

If serious doubt arises as to the monetary soundness of the home currency, a foreign money, especially if it be gold, may be thought of as a more 'real' money. But, in the absence of any such doubt, the purchase of a bond payable in the foreign money will tend to be thought of by all, except those to whom for one reason or another the foreign currency is really 'money', as a speculation rather than an investment. During the long period in which the commodity purchasing power of silver was more stable than that of gold, there was no visible tendency for the inhabitants of countries on a gold basis to think of bonds payable in silver as more conservative and less speculative 'investments' than those payable in gold.

Of course if, in a particular market, there exist a general forecast that the price of a foreign money in terms of the home money is to rise or fall, and if there be in that market two bonds similar in all respects save that the one bond is payable in the money of the market and the other bond in the foreign money, then the *relation* between the promised yields of the two bonds (calculated for each bond in terms of the money in which its promises are made) will tend to be affected by this forecast.[72] The anticipated change in the price of the one money in terms of the other money may, of course, be expressed in terms of anticipated changes in the general purchasing powers of the two moneys. But the introduction of these new (and presumably unknown) variables is quite unnecessary. In determining the *relation* between the two yields, borrowers and lenders are concerned with the present and future prices of a unit of the one money in terms of a

[72] Compare Professor Fisher's table giving, annually for the period 1865–1906 inclusive, the gold yield of British India bonds payable in gold and the silver yield of British India bonds payable in silver, both yields being calculated from prices in the London market. *The Rate of Interest,* pp. 266–68 and *The Theory of Interest,* p. 404.

The relations between the yields of the table are far different from what they would have been had they been controlled by good price forecasting.

unit of the other money, entirely divorced from anticipated changes in the general purchasing power of a unit of either money. It is not necessary for them to forecast whether general purchasing power will be increasing for one money and decreasing for the other or increasing or decreasing for both.

Because of the desire for future 'money' there will, in any market, tend to be a factor favoring bonds payable in the money of that market. But this factor is of a monetary rather than a commodity nature. It exists whether the money of the market be appreciating or depreciating in terms of commodities or of another money. Only if the purchasing power of the market money declines so rapidly and far as to affect radically the essential monetary characteristics of the market money will the influence of this factor disappear or become reversed. In the past, its importance seems usually to have been definitely on the wane when the inhabitants of a country in the throes of a currency inflation have begun to stop ascribing their troubles to a rise in the currency price of gold and to talk about a fall in the gold price of the currency. By the time that most important contracts are being made in terms of gold or some foreign currency, the influence of this 'home market' factor has become reversed. The 'flight' from the old money is then nearly complete. No longer is it *the* money of the country. 'At long last' has come recognition that the trouble is with the paper and not with the gold. " 'It is not I who am ailing', said the wizard; 'but there is one here very sick'."

But, in the absence of radical inflation and assuming, as we have been doing, that the monetary obligations of the buyers and sellers are predominantly in terms of the money of the market in which the bonds are being bought and sold, it would seem that the importance of the factor favoring bonds promising payment in that money would not usually be appreciably affected by a change in the forecast of the future price relations between it and some other money. The factor exists not because of the nature of such forecasts but because of their uncertainty. Its influence is usually therefore to a high degree independent of the influence of those forecasts.

If, in the seventies or eighties of the last century, a retired London banker, who neither had nor expected to have monetary obligations payable in rupees, had been weighing the relative investment attractiveness of the gold and silver bonds of British India, he would not

have bought a rupee bond if he expected rupees (in terms of pounds sterling) to depreciate over the life of the bond, unless the sterling price of the bond when converted into rupees was such as to give a higher rupee yield than the gold yield of an otherwise identical British India bond payable in gold. But, in addition to the extra silver yield he would have demanded because of his expectation of a fall in the gold price of rupees, he would have insisted upon a further premium for the *uncertainty* of the (future) value of his (future) rupee payments in terms of (future) pounds sterling—or (future) English 'money'. If, on the other hand, he had been a retired Calcutta banker having and expecting to have only rupee obligations, he would have been willing to accept a *smaller* silver yield than his forecast of a depreciation of rupees in terms of sterling would warrant. Because, in actual fact, the primary market for the sterling bonds was England and that for the rupee bonds was India and because of the peculiar monetary and trade relations between England and India, it is very hard to estimate how much or how little the 'spread' between the two yields was increased or decreased by the combined operation of the two factors, one favoring bonds payable in silver and the other favoring bonds payable in gold.

But although the case for believing in the importance of the money-of-the-market factor be extremely strong, we do not always find unequivocal statistical assurance of even its algebraic sign. It is therefore only natural that statistical evidence of the influence of the often almost supposititious forecasting factor (whether of the price of gold, of commodities in general or of a foreign money) should seldom be clear cut and unmistakable. To assume, tempting as in any particular instance it may be to do so, that the influence of price forecasting can be discovered from past rates and succeeding prices (as they actually materialized) may be quite unwarranted. To reason that, because the rates and the succeeding prices do not seem incompatible with an assumption of good forecasting, the forecasting *was* good and the rates *were* so determined may be to introduce merely a grossly *ad hoc* fictional 'as if'. But to argue that, when rates (in the light of succeeding prices) give no suggestion of *good* forecasting, they must neecessarily have been determined by *bad* forecasting may well amount to the crassest of circular reasoning.

And, if to discover (except in periods of pronounced currency in-

flation) unequivocal statistical evidence of the mere existence of this elusive factor is often difficult, to *measure* its influence (even in such periods of pronounced inflation) is commonly found to be virtually impossible. How large or small an influence forecasting of the (paper) prices of gold and commodities (together with an almost certainly varying degree of preference for bonds payable in paper) may have had, for example, upon the (paper) prices and yields of American railroad bonds during the Civil War years of the 1862–79 inflation is certainly a 'puzzling question' even if not 'beyond all conjecture'.

Only a pale and flickering light is thrown on this question by the relative prices of gold and paper bonds. Even if we completely ignore differences in coupon rates and are extremely liberal as to differences in time to maturity, we still find it virtually impossible to discover pairs of important bonds identical or nearly identical in all respects save their media of payment. They fail to fulfill one or both of the two fundamental requirements of direct statistical comparison, identity of markets and equality of confidence in future payments.

Almost no instances occur of pairs of otherwise similar gold and paper bonds that were traded in exclusively or even nearly so on one and the same monetary market and that market alone; not merely were they bought and sold on two or more monetarily different markets but the relative importance of the various markets was usually not even approximately the same for the two bonds. Indeed, in many instances, it seems that neither bond was traded in to more than a negligible extent on the primary market of the other bond; the primary market for the paper bond being Boston or New York and the primary market for the gold bond London. The differences in assurance that the promised future payments would be met as promised seem to have been great though almost certainly unmeasurable. Contemporary newspaper and magazine articles suggest strongly that both domestic and foreign confidence that the promised gold payments of almost any specific American gold bond would be met (in gold) fell appreciably short of the confidence that promised paper payments of paper bonds of the same obligor would be met (in paper). This was unmistakably true not only of Federal bonds but also, though to a less extent, of the best New England municipal bonds.

The relative yields of such gold and paper bonds as were otherwise at all comparable seem seldom to have been grossly incompatible with

such market opinion as pictured by the financial commentators. But there were so many unmeasured if not unmeasurable factors that it is usually difficult to draw any very definite conclusions from the quoted prices. In March 1864, the Federal Government issued the '5 per cent Ten-Forties'. These bonds were payable at the pleasure of the Government after any period not less than ten years and not more than forty years from date. Both principal and interest were, by the Loan Act of 1864, payable unequivocally in gold. But, though the bonds were offered to the public at par (100) in *paper,* on the first day of offering (March 26, 1864) only $875,000 was subscribed, the second day $130,000 and the third day $430,000.[73] On March 26, 1864, the price of greenbacks in gold ranged from 58.91 to 59.00 per 100. The gold yield of these bonds was therefore, even if they were to remain outstanding for the entire forty years, more than 8½ per cent per annum; if paid in gold at the end of ten years, the gold yield would be over 12 per cent per annum. Later, in the summer of 1864, the *paper* price of the Ten-Forties was only 109 at a time when the paper price of gold was 250. The gold price was, therefore, at that time less than 44 and the gold yield, even to the forty year maturity, more than 11½ per cent per annum.[74] The paper yields of Federal paper bonds were running high but at no such levels as these. Under the circumstances, it is difficult to say what part of the spread between the gold and paper yields was caused by distrust of the gold promises and what part (if any) was caused by the market's forecasting a rise in the gold price of paper. We must not forget that, even as late as 1869, there was no great assurance that even the 5 per cent Ten-Forties would have their *principal* paid in gold.[75] The yields of gold and paper municipal and railroad bonds present similar difficulties.

During such a disturbed period as the year 1865, for example, fluctuations in the paper price of gold, because they affected confidence in the gold promises of the government, did not affect the paper prices of Federal gold bonds in the manner in which they might theoretically be expected to do. If the yield in gold of a gold perpetuity were to

[73] *Hunt's Merchants' Magazine,* April 1864, p. 303.

[74] The complete lack, at this time, of British confidence that the American Government gold bonds would actually be paid in gold is seen in the fact that, in July 1864, the *gold* 6 per cent Five-Twenties of 1882 were *offered* in London at 49 gold while 50 gold was being *bid* for New York Central 6 per cent *paper* bonds of 1883.

[75] See *Commercial and Financial Chronicle,* March 20, 1869, p. 257, column 2.

remain constant, its price in gold would remain constant and therefore its price in paper would be a constant multiple of the paper price of gold. But if, whenever the paper price of gold declined, confidence that the bond would remain on a gold basis increased, the paper price of the bond would not decline as much as the paper price of gold; indeed, if the increase in confidence were sufficiently great, the paper price of the bond might even advance. Now the year 1865 was a year of rapidly declining paper prices of paper bonds and rapidly, though less uniformly, declining paper prices of gold. But from December 31, 1864 to March 1, 1865 the paper price of the Ten-Forties rose from 101¾ to 102¾ while the greenback price of gold was declining from 226 to 200. And, though the price of the bonds declined from 102¾ on March 1, 1865 to 91½ on March 22 while the greenback price of gold was declining from 200 to 157, it advanced to 95 on May 17 though the greenback price of gold had in the meantime declined further to 130. By November 25, the paper price of the bond had declined to 91 though the paper price of gold had advanced to 147. But, even after this decline, it was, relatively to the paper price of gold, much higher than it had been at the beginning of the year. The paper yields of American railroad bonds were during the year 1868 only a shade lower than the peak yields of 1865, but confidence that the Ten-Forties would be paid and paid in gold had increased so much (it would seem) that during that year they sold as high as 109⅛ (paper) and never below 100 (paper) even though the greenback price of paper went down as low as 132⅛.[76]

[76] The movements of the prices of many Federal bonds suggest that confidence that promised payments of principal in gold would actually be kept tended to increase as maturity approached and no adverse governmental action occurred. On January 26, 1866, the Federal gold 6's of 1847 (due in 1867) sold at 123¼ in paper with gold at 139¾, but thirteen months later (February 27, 1867), with gold at the same price, the paper price of the bonds had risen to 135.

It is, of course, in a case like this, extremely difficult if not quite impossible to estimate at all accurately the separate effects of increasing confidence in the gold promise, possible (bad) forecasting of the price of gold, preference and possibly changing preference for bonds payable in the money of the market, varying relative influence of the New York and London markets, etc.

We must remember that an American who wished paper rather than its gold equivalent but who bought the bonds because he expected the paper price of gold to advance or at least not decline appreciably would have faced a very serious paper loss if the premium on gold had virtually disappeared before the maturity of the bond; though an English purchaser would have been completely unperturbed by such an eventuality.

The great fall in the (paper) yields of American railroad paper bonds during 1862 and the abnormally low levels of those yields during 1863 and 1864 might easily suggest that the railroad bond market was at that time forecasting an imminent and prolonged fall in the paper price of gold, or commodities, or both gold and commodities. But one of the difficulties of this assumption is that, during the period in which the paper price of gold (and of commodities) was rising most rapidly and a forecasting of an imminent decline would therefore seem psychologically most improbable (paper) yields were falling—reaching their lows in July 1864, the peak month for the paper price of gold (six months before the peak month for commodity prices). Of course, it is barely possible that, unwarranted as it may seem to have been, the financial community was, during this period of rapid depreciation of the currency, actually expecting a speedy fall in the paper price of gold (and commodities) and operating on that expectation.[77]

But, if this were true, why did (paper) yields begin to rise sharply as soon as the peak in the paper price of gold was passed and the expectation of a fall in its price became really warranted? It would, of course, be quite understandable that they should have risen if the impending fall in the prices of gold and commodities had all along been fairly accurately foreseen. And, in the sense that the price future proved not inconsistent with a probably unwarranted but possibly existent general expectation, they may have been 'foreseen'. But even this seems rather hard to believe—much like being asked to take seriously the prophecies of Nostradamus.[78]

[77] See Wesley C. Mitchell, *A History of the Greenbacks,* pp. 369 and 370.

"Nor . . . is it surprising that business men failed to see what was coming; for the course of prices depended chiefly upon the valuation set upon the greenbacks, and this valuation in turn depended chiefly upon the state of the finances and the fortunes of war—matters that no one could foresee with certainty. Indeed, there was much of the time a very general disposition to take an unwarrantedly optimistic view of the military situation and the chances of an early peace. Many members of the business community seem to have felt that the premium on gold was artificial and must soon drop, that prices were inflated and must collapse."

[78] The yields of some of the bonds in our list would seem to suggest that there possibly was a real forecast of an even more rapid return of paper to a par with gold than actually occurred. For example, the Pennsylvania Railroad *Second* Mortgage 6's *due in 1875* (Bond Number 9) sold at lower yields than the *First* Mortgage 6's of the same road *due in 1880* (Bond Number 10) every month from March 1864 to August 1864 inclusive. Though, of course, all that this fact could logically be

Before leaving these puzzling Civil War years, it is desirable to remind the reader that, even if it could be known that the movements of American railroad bond yields during the years 1862–65 inclusive were as they were largely because of conscious gold or commodity price forecasting (which, whether accidental or not, would have been *good* forecasting); that fact would not help us to explain why, as for example during the period 1916–21 for commodity prices and 1917–22 for railroad bond yields (see Chart 18), bond yields and commodity prices should ever be *positively and not negatively* correlated—unless we are willing to introduce the *deus ex machina* of *bad* forecasting.

But 'much study is a weariness of the flesh. Let us hear the conclusion of the whole matter'. In the first place, the absence of a really persistent and uniform statistical relation between the series suggests strongly that, even if the one series be to a greater or less extent dependent on the other, the very nature of that dependence may vary. For example, forecasting may be a negligible or an important factor and, if important, may be good or bad. Thus, it is at least possible that railroad bond yields were low during the high gold and commodity prices of the Civil War because a great fall in prices was, whether warranted or not, being commonly expected; and high during the high commodity price period centering round 1920 because of conditions caused by the rise of prices but quite unrelated to (bad) forecasting.

Of course, even in a period of uncontrollable inflation, high rates and yields may be only partly the result of a sheer 'corned beef and cabbage' complex. We must remember, for example, that during the panic of such a period, with the increasing rapidity of circulation, commodity prices rise faster than the volume of the circulation and an intense money shortage therefore occurs. But, even with such refinements, it is not very difficult to understand why rates and yields should be high in such a period. If forecasting be assumed to occur,

(Footnote [78] concluded)

made to signify, if (in spite of the results of our examination of the relative yields of serial bonds in the present century) we assumed that the relation between the yields of the two bonds was methodically considered, is that buyers and sellers felt that the paper yield of the bond with the shorter maturity should, for the period terminating March 31, 1875, be lower than the paper yield of the bond with the longer maturity for the period March 31, 1875 to December 31, 1880. But, in view of the bond with the longer maturity being a *First* mortgage bond and the bond with the shorter maturity only a *Second* mortgage bond, even this is curious enough.

both its direct and its indirect influences can be relatively easily analyzed.

But it is much more difficult to see why and how rates or yields should be affected by price levels or price changes during periods in which forecasting would seem to be a quite unimportant factor. The suggestion that, though there be periods in which conscious forecasting is negligible, there are no periods in which unconscious forecasting is unimportant, that when prices are rising the common though unconscious forecast is that they will continue to rise, is not as helpful as one might expect it to be. At best it offers an explanation of a usually non-existent condition. To the extent that the problem suggested by the statistics may be a real problem at all, it is why, in spite of numerous and glaring exceptions, rates to some extent and yields to a much greater extent are so often high when prices are high and low when prices are low or rise and fall with prices, not why they are high when prices are rising and low when prices are falling. And no question-begging description of rates or yields as 'viscid' or 'sticky' is more enlightening than the old explanation that a body was hot because it contained much phlogiston. Even if such a physical analogy as the concept of 'stickiness' were thoroughly warranted, the question would still remain, *why* are rates and yields sticky?

If the movements of commodity prices ever affect the movements of interest rates and bond yields *directly,* in other words if the two series are ever, in the absence of conscious forecasting, more closely related to each other than as two aspects of some more fundamental condition, I suspect that the mere *existence* of long term debts (such as are represented by bonds), with rigid future interest obligations, is an extremely important factor in bringing about this result.

During a pronounced rise in commodity prices, though it may lead to an increased logarithmic 'scatter' among the prices, there is a pronounced tendency for the prices of nearly all things to rise. Though wages lag, even they eventually rise. *But (aside from the resumption of payments on debts in default) interest payments on unmatured debts do not rise.* Now this condition may possibly have an extremely important influence on rates and yields. After a rapid commodity price rise of one hundred per cent, the prices of the products of industry (except of those industries in which selling prices are determined by law) will, in general and as an average, have

doubled, *but the burden of debt will remain virtually unchanged.* Relatively to prices that burden will, therefore, have been halved. The market value of all plants (that do not have the prices of their products determined by law or custom) will, therefore, in general (ignoring depreciation and obsolescence) have at least doubled and that of going businesses more than doubled. *The ability of business to borrow will be greatly increased—much more than doubled.* And the urge to borrow will also be greatly increased; not merely because the volume of new loans necessary to continue the business at its old pace will have risen with the price level but also because the price rise will probably be associated with a rise in the prospects for profits and hence few businesses will be satisfied to continue operating at the old pace.

But there will be no corresponding increase in the ability and willingness to lend. Not merely will the bond income of existing bond holders remain unchanged but the prices of those things for which they used to spend that part of their income which they did not invest will have doubled. This great source of demand for new bonds will therefore, instead of increasing, actually decrease. Similarly with the (of course less important) demand for bonds from wage and salaried persons. Their incomes will not have kept pace with prices. There remains the great class of stockholders and business entrepreneurs. But the business entrepreneur will, during such a period, be expanding his business. And his silent partner, the stockholder, will tend indirectly to do likewise. An even larger percentage of his income than usual will go back into 'the market'. *Either directly or indirectly, both the active and the silent partners will be increasing their borrowing more than their lending.*

Moreover, as commodity prices rise and the burdensomeness of corporation debt declines, second and third grade bonds become first grade. *The volume of bonds of the highest grade therefore increases even more rapidly than the increase that results merely from new issues.* And it is the possible relation between commodity prices and the yields of these highest grade bonds that the hypothesis would attempt to explain.

But 'intriguing' as this all sounds, the hypothesis is almost as difficult to reconcile with parts of the record of actual rates and prices as are some of the theories upon which we have so adversely commented. If the long time major movements of prices and rates are ever causally

related, the 'mere existence of long term debts' may, as I am inclined to suspect, be an extremely important factor—without being the only factor needed for a complete solution of the problem of why and how they are related. *Entia non sunt multiplicanda praeter necessitam* rules only that causes are not to be multiplied *beyond what is necessary*.