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Principal Empirical Findings

Note

Money throughout refers to currency plus adjusted demand and time deposits of commercial banks held by the public.

Income throughout refers to net national product.

Nominal money or income is money or income in dollars or pounds at current prices.

Real income or output refers to net national product at constant prices.

Prices refer to the implicit price index obtained by dividing national product at current prices by national product at constant prices.

Basic data are geometric averages of annual data for cycle phases (expansions or contractions) that average 2.0 years in length for the United States and 2.8 years for the United Kingdom.

Rates of change for a phase are generally the slopes of straight lines fitted to the logarithms of three successive phase averages (the phase in question, the prior phase, and the following phase).

Demand for Money

1. In the century from the mid-1870s to the mid-1970s, the quantity of money rose in the United States from the equivalent of eleven weeks' income to nearly thirty weeks' income but fell in the United Kingdom from more than thirty weeks' income to twenty-five weeks' income (table 5.2).

2. These contrasting results were produced by

a) Increasing financial sophistication in the United States (particularly before World War I), reflected in a reduction in the fraction of money held as currency from 33 percent to 12 percent just before World War I and 11 percent in the mid-1920s (sec. 6.3).

b) Rising real per capita incomes in both the United States and the United Kingdom. The rise in income raised money holdings in the United

States, expressed in terms of weeks on income, lowered them in the United Kingdom (see point 4).

c) A more rapid rise in nominal yields on financial and physical assets in the United Kingdom than in the United States. United States yields were higher than United Kingdom yields at the outset of the century but lower at the end (table 5.3).

3. Our data support the theoretical expectation that changes in population and prices would affect nominal aggregate money holding but not real per capita money holdings (sec. 6.5).

4. Rising real per capita income had opposite effects on money holdings expressed in terms of weeks of income in the United States and the United Kingdom. With other variables constant, a 1 percent increase in real per capita income on the average increases real per capita money holdings by about 1.1 percent in the United States, by about 0.9 percent in the United Kingdom (sec. 6.7). Hence rising income raised money holdings expressed in terms of weeks of income in the United States (i.e., lowered monetary velocity) but lowered them in the United Kingdom (i.e., raised monetary velocity).

5. Aside from the difference in real income elasticity and change in financial sophistication, not only was the real quantity of money demanded affected by the same variables in the two countries during the century we study, but also those variables had the same quantitative effect (sec. 6.7). The chief other variables that operated throughout the period were (1) the differential between the interest return on financial assets and the interest return on money; (2) the yield on physical assets (sec. 6.6). In addition, two factors had significant effects for part of the period in both countries: (3) a delayed adjustment to wartime disturbances; (4) an upward shift in demand during the Great Depression and the Second World War, produced, we conjecture, by greatly increased uncertainty (sec. 6.4).

7. On the average a one percentage point (*not* 1 percent) change in the difference between the yield on financial assets and on money produces something more than a 9 percent (not percentage point) change in the opposite direction in the quantity of money. We measured the yield on financial assets by the short-term interest rate, which in various tests proved a better variable than an alternative long-term rate. Nothing was gained by adding a long-term rate as well. However, theoretical considerations suggest that the entire term structure of yields should be relevant. An experiment with United States data supports the theory but does not increase predictive accuracy of the resulting demand equation (sec. 6.9).

8. As a proxy for the nominal yield on physical assets we have used the rate of change of aggregate nominal income. Both theoretical considerations and empirical tests (sec. 6.6.3; sec. 10.3) support the validity of the

proxy as possibly the best available approximation to the average yield on a broad range of physical assets (including not only those for which there are corresponding market instruments such as shares of stock or deeds of possession, but also human capital). On the average, a one percentage point change in our proxy produces something more than a 0.4 percent change in the quantity of money demanded in the opposite direction (sec. 6.6.3).

9. The single equation we estimate for the two countries combined leaves a residual variation to be explained by omitted variables or statistical error of about 5 percent for the level of money demanded, about 1.5 percentage points for the rate of change of the quantity of money demanded. The residual variation is approximately the same for the United States and for the United Kingdom.

10. The simplest of quantity theories, which supposes that the ratio of nominal money to nominal income is a numerical constant aside from independent random errors in money and income, supplemented for the United States by an adjustment for increasing financial sophistication before World War I, turns out to be an impressive first approximation, which accounts for well over half the variation in money (if income is viewed as the independent variable) or in income (if money is viewed as the independent variable). Allowing for an income elasticity differing from unity, shift variables, and yields does improve the results. It cuts the error remaining after allowing for the simple quantity theory by nearly three-quarters for the level of money (which means, cuts the variance by less than half) but by only one-quarter for the rates of change of money (chap. 6, tables 6.6 and 6.14 and equations 26 and 27).

11. For both levels and rates of change, allowing for an income elasticity differing from unity and for the shifts accounts for the bulk of the reduction in the residual error. Allowing in addition for yields reduces the residual error for levels by about one-fifth, and that for rates of change only trivially (chap. 6, tables 6.6 and 6.14 and equations 26 and 27).

Common Financial System

12. The level of velocity in the United States parallels that in the United Kingdom for most of the century our data cover; and the rates of change are nearly identical in the two countries (sec. 7.2; chart 7.1; table 7.2).

13. The high correlation between the two countries of velocity and its rate of change reflects the determination of the demand for money in the two countries by the same variables (point 5 above) plus the similar movements in these common determinants. If the movements of the common determinants had been uncorrelated between the two countries,

the variance of the differences between the two countries would have been doubled for levels of velocity and more than quadrupled for rates of change of velocity (sec. 7.3; table 7.3).

14. The common movements of velocity reflect a unified financial system in which monetary variables such as prices, interest rates, nominal income, and stocks of money are constrained to keep largely in step except as changes in exchange rates alter the number of units of one country's currency equivalent to one unit of the other country's currency. However, physical magnitudes are not so constrained. The highest correlation for the two countries is for prices; the lowest, for real per capita income (table 7.2).

15. Influence ran both ways across the Atlantic, though there is some evidence that real effects were stronger from the United States to the United Kingdom and price effects from the United Kingdom to the United States. Changes in each country affected both nominal income and prices in the other country (sec. 7.4.2).

16. For nominal income before 1914, the influence of each country on the other was manifested entirely through its influence on the other country's quantity of money—the classical specie-flow process. After 1914, that remains true for the United States but not for the United Kingdom. United Kingdom nominal income, for a given quantity of money in the United Kingdom, was also affected by changes in United States money and velocity. We conjecture that the channel of influence was interest rates. The difference between the United States and the United Kingdom in channels of influence is something of a puzzle, only partly explained by the far greater role of the United States after 1914 than before (sec. 7.4.2).

17. For prices throughout the period, the influence of each country on the other operates not only through effects on the other country's quantity of money but also more directly. To isolate this effect after 1914 requires allowing explicitly for changes in exchange rates (sec. 7.4.2). This is an expression of the "law of one price."

18. Evidence on how well the "law of one price" holds is provided by estimates of the purchasing-power-parity exchange rate—the number of United States dollars that has the same purchasing power as one British pound. If the "law of one price" held perfectly, the purchasing-power-parity exchange rate would equal the market rate. Our year-by-year estimates fluctuate around the market rate, much more closely before the early 1930s (between plus and minus 10 percent of the market rate) than afterward (between 10 percent below the market rate and 60 percent above). Government intervention in the exchange market since the 1930s has been more potent in disunifying the markets than improvements in transportation and communication have been in unifying them (sec. 6.8).

Relation between Nominal Money and Nominal Income

19. The level of nominal income parallels with great fidelity the level of the nominal quantity of money, and the rate of change of nominal income parallels the rate of change of the nominal quantity of money. That is true for both the United States and the United Kingdom and for the whole of the century our data cover. The largest discrepancies occur during and just after World War II (secs. 5.2, 5.3; charts 5.2 and 5.4). This parallelism is a manifestation of the stable demand curve for money plus the excellence of the simple quantity theory approximation.

20. The fluctuations about the trend tend to be greater in amplitude for nominal income than for nominal money—in conformance with an implication of the theoretical analysis of chapter 2 (sec. 5.2; table 5.5).

21. Both nominal money and nominal income are more variable after 1914 than before, and that is equally true for output and prices for both countries—which we interpret as resulting from the effective end of the international gold standard (table 5.5).

22. We estimate that measurement error (standard error) in the level of nominal income is between 2.5 and 4.5 percent; in the rate of change of nominal income between 0.5 and 0.75 of one percentage point, about the same for the two countries. We have no comparable estimates for nominal money or its rate of change (sec. 8.1).

23. Estimates of the temporal reaction pattern of income to a sustained change in the rate of monetary growth, though not firmly determined statistically, are in general conformance with the pattern suggested by the theoretical analysis of chapter 2. Generally the pattern involves an initial overshoot of nominal income, produced by transient effects, then a highly damped cyclical return to an equilibrium trend (chart 8.1). The effects take a considerable time, measured in phases, not quarters.

24. Our data are consistent with the theoretical expectation that the cumulative effect of a 1 percentage point change in monetary growth will be a 1 percentage point change in the same direction in the rate of nominal income growth (table 8.6).

The Division of Nominal Income Change between Prices and Output

25. The fraction of nominal income change accounted for by price change and output change varied greatly over the period. In both countries, prices had roughly a horizontal trend before 1914 and a generally rising trend after 1914 (interrupted most drastically by the Great Depression). There is no corresponding difference in output, which had a generally rising trend, at roughly the same rate, throughout the century. As a result price change accounted for a decidedly larger share of nominal income change after than before 1914 (table 5.5).

26. The average rate of output rise was greater throughout in the United States (3.1 percent per year) than in the United Kingdom (1.7 percent per year). The rate of price rise was greater in the United Kingdom (2.3 percent per year for the century, 3.0 percent after 1914) than in the United States (1.8 percent per year for the century, 2.1 percent after 1914) (table 5.5; chap. 9).

27. Throughout the period, the level of the nominal quantity of money per unit of output parallels with great fidelity the level of prices, and the rate of change of the nominal quantity of money per unit of output parallels the rate of change of prices. That is true for both the United States and the United Kingdom and for the whole of the century our data cover. The largest discrepancies occur during and after World War II (chap. 5; charts 5.3, panel 3, and 5.6, panel 3). This parallelism reflects the parallelism of nominal money and nominal income (point 19 above) plus the greater influence of monetary change on prices than on output.

28. Estimates of the temporal reaction patterns of prices and output to a sustained change in the rate of monetary growth, though not well determined statistically, are in general conformance with the pattern suggested by the theoretical analysis of chapter 2: generally, an initial overshoot of prices followed by a cyclical reaction pattern, and a cyclical reaction pattern in output. The price pattern deserves some confidence, the output pattern very little (chap. 9; chart 9.5).

29. It takes a considerable time, measured in phases, not months or quarters, before a change in the rate of monetary growth is fully reflected in prices (point 23 above and secs. 9.3 and 9.6).

30. For United Kingdom peacetime years, there is little if any effect of monetary change on output. The rate of change of output seems to be a random series from phase to phase (though not pure white noise because there is some serial dependence). Its variability is of the same order of magnitude as would be produced by measurement error (chap. 9, tables 9.10, 9.13, 9.14). The results are consistent with a simple quantity theory that regards price change as determined primarily by monetary change and output by independent other factors. A sustained 1 percentage point change in the rate of monetary growth ultimately produces a change of 1 percentage point in the same direction in the rate of price change, but initially is absorbed partly by a change in velocity in the opposite direction.

31. For the United States, roughly the same conclusions hold for the pre–World War I and post–World War II periods with two minor differences: (1) there is evidence of at least a transitory influence of monetary factors on output change; (2) output is more variable than prices, whereas the reverse is true for the United Kingdom (tables 9.10, 9.13, 9.14). However, the dominant influence and ultimately the whole influence of monetary change is on prices rather than output and, as for the United Kingdom, a sustained change of 1 percentage point in the rate of

monetary growth ultimately produces a 1 percentage point change in the same direction in the rate of price change.

32. For peacetime years for the United Kingdom, and for the United States excluding the interwar period, price change between cycle phases tends to be inversely related to output change, rather than positively related, as seems true within cycles and as is implicit in analysis along Phillips curve lines. Put differently, the Phillips curve, at least for cycle phases, seems, if anything, positively, rather than negatively, sloped (tables 9.1, 9.12; secs. 9.2, 9.7).

33. The interwar period for the United States is idiosyncratic—though for that very reason both important and instructive. It is the only peacetime period for either country in which (*a*) monetary change has a major influence on output change in the same direction (table 9.1; secs. 9.5, 9.7); (*b*) price change and output change are positively correlated (table 9.1); (*c*) most of nominal income change is absorbed by output change (table 9.6); (*d*) a Phillips curve is clearly negatively sloped (table 9.13).

34. The idiosyncrasy of the interwar period appears to arise from the importance of major economic contractions during the period (three in twenty years: 1920–21, 1929–33, 1937–38) and to reflect features common to such major contractions. Traces of the same phenomena appear in the pre–World War I period at times of major contractions (sec. 9.2). We concluded in *A Monetary History* that there is a one-to-one connection between severe monetary contractions and severe economic contractions, and that connection seems to dominate the United States interwar period.

35. The rate of price change (i.e., inflation), given the rate of monetary change, depends systematically on the prior rate of inflation, not at all (except for the United States interwar period) on the ratio of output to capacity (sec. 9.7; table 9.13). We use the rate of prior inflation as a proxy for expectations of inflation.

Interest Rates

36. For the century our data cover taken as a whole, the nominal yield on short-term nominal assets averaged 4.2 percent for the United States, 3.5 percent for the United Kingdom. The corresponding averages for long-term assets were 4.8 percent for the United States, 4.2 percent for the United Kingdom, or a trifle higher than for short-term assets, reflecting the rather small price that borrowers had to pay on the average to get lenders to sacrifice liquidity (table 10.1).

37. The corresponding real yield on nominal assets, obtained by subtracting the rate of inflation from the nominal yield, averaged for short-term assets, 2.6 percent for the United States, 0.9 percent for the United Kingdom; for long-term assets, 3.3 percent for the United States, 1.7 percent for the United Kingdom (table 10.1).

38. On the average for the century as a whole, the yield on physical assets (as proxied by the rate of change of income) was between the short-term and long-term yields on nominal assets: nominal yields of 4.5 percent for the United States, 4.2 percent for the United Kingdom; real yields of 3.0 percent for the United States, 1.6 percent for the United Kingdom (table 10.1). Apparently, for the century as a whole, there was effective arbitrage between the yields on nominal and physical assets.

39. For both nominal and real yields, the United States yields are higher than those in the United Kingdom: by about 0.7 percentage points for nominal yields, by about twice as much for real yields. The smaller differential for nominal than for real yields reflects the higher average inflation in the United Kingdom (table 10.1).

40. For the period as a whole, short- and long-term rates on nominal assets are highly correlated (correlation coefficient about 0.9 or higher). In view of the high correlation, and the problem of identifying the holding period corresponding to long-term yields on nominal assets, our more detailed analysis of yields on nominal assets is restricted to short rates only (sec. 10.3). Neither the short- nor the long-term rate on nominal assets is highly correlated with the yield on physical assets (table 10.1).

41. The rough equality of yields on nominal and physical assets for the century as a whole does not hold for subperiods classified by the behavior of prices. The yield on physical assets tends to exceed the yield on nominal assets in periods of rising prices, to be less than the yield on nominal assets in periods of falling prices.

42. The data for all subperiods before World War II behave as if prices were expected to be stable and both inflation and deflation were unanticipated: nominal yields on nominal assets average much the same in periods of rising and falling prices; real yields on nominal assets are low in periods of rising prices and high in periods of falling prices. On the other hand, nominal yields on physical assets are high in periods of rising prices, low in periods of falling prices; real yields on physical assets are much the same in periods of falling and rising prices. These results for physical assets do not represent successful prediction of inflation. Rather, the receipts from the use of physical assets and the costs of operating them adjust more or less automatically to the contemporaneous rate of inflation or deflation, and hence produce the equivalent of automatic indexing in respect of their yields (table 10.3).

43. The failure of the nominal yield on nominal assets to adjust to inflation or deflation before World War II confirms the general conception that inflation benefits debtors and harms creditors, whereas deflation benefits creditors and harms debtors. However, the evidence does not confirm a related conception: that such transfers of wealth make deflation adverse to growth and inflation favorable to growth. The clearest comparison is between the period of falling prices before 1896 and of rising

prices from 1896 to World War I. For both the United States and the United Kingdom, output grew somewhat more rapidly in the earlier period of deflation than in the later period of inflation (sec. 10.4.2).

44. After World War II, the financial markets began to behave differently. Beginning in the 1960s, there is a gradual shift, in both the United States and the United Kingdom, from the prior pattern to one involving anticipation of inflation: interest rates start to parallel rates of inflation, so nominal returns on nominal assets become more variable, and real returns on nominal assets become less variable.

45. We estimate from the subperiod data for both countries that, on the average, asset holders preferred physical to nominal assets, being willing to accept a 1.25 percentage point lower yield on physical than on nominal assets (sec. 10.4.2).

46. The differential between United States and United Kingdom yields on nominal assets also varies considerably among subperiods. (*a*) It was highest before 1896, when the fear of inflation, despite the fact of deflation, kept United States rates high (they averaged 2.5 percentage points higher than United Kingdom rates). (*b*) The differential was about one percentage point lower from 1896 to 1914, when confidence in the stability of the currency kept United States rates low despite the fact of inflation. (*c*) It declined another percentage point (to about 0.5 percentage points) from the pre–World War I period to the interwar period as a result of a decline of about that magnitude in the excess of the yield on physical capital in the United States over the yield in the United Kingdom. (*d*) It fell another two percentage points (to -1.5 percentage points) from the interwar to the post–World War II period as a result of greater inflation in the United Kingdom than in the United States and an accompanying depreciation of the pound sterling (table 10.4; sec. 10.4.1).

47. Our results strongly support the doubts expressed by Frederick Macaulay more than forty years ago about the universality of the "Gibson paradox"—a positive correlation between interest rates and price *levels* (not rates of price change). Such a correlation does hold for the United States and the United Kingdom before World War I; it does not hold over periods witnessing a substantial shift in the price level; it holds in much-muted form between the wars; it is hardly evident at all for the period after World War II (chart 10.18; table 10.6; sec. 10.6).

48. The more restricted "Gibson phenomenon" (hardly a "paradox") can plausibly be explained along the lines suggested by Irving Fisher: a relation between interest rates and the anticipated rate of price change, where anticipations are formed by extrapolating a fairly long series of past price changes, plus allowance for such episodic phenomena as the free silver movement in the United States in the 1880s and the 1890s (sec. 10.7.1).

49. Our estimate of the period of price change entering into the formation of price anticipations is some six to nine years, distinctly shorter than the period estimated by Fisher and others (table 10.8; sec. 10.7.1).

50. Our data reject the Wicksell-Keynes explanation that the positive correlation between interest rates and the price level reflects fluctuations in the real yield on capital, transmitted to both prices and nominal interest rates through commercial banks, which delay the impact of changes in real yields on nominal rates by altering the quantity of money (sec. 10.7.2).

Long Swings

51. For the United States, the long swings in money, nominal income, and real income that remain after lengthening the period used to compute rates of change from three successive phases to nine phases are members of the same species as those studied by Kuznets, Burns, Abramovitz, and others. For the United Kingdom, it is dubious that there are any long swings in our series except those that reflect the smoothing of the two wars, plus possibly a post–World War II upsurge. This corresponds with the difficulty that investigators of long swings have had in demonstrating their existence in the United Kingdom (sec. 11.1; chart 11.1).

52. For the United States, the swings in money and nominal income are decidedly larger in amplitude than in real income. Yet the extensive literature on long swings hardly mentions money.

53. The evidence from our data suggests (*a*) that money has played a major role in the United States long swings identified in the long-swing literature; (*b*) that wars and major deep depressions have been the major source of wide variability in money, nominal income, prices, and real income. These findings suggest that the empirically observed swings reflect not a self-generating cyclical process but rather episodic phenomena smoothed both by the economic reaction to them and by the statistical treatment of the economic data. This episodic interpretation is consistent with the apparent absence of long swings in the United Kingdom, since the absence can be explained by the relative unimportance of deep depressions in the United Kingdom.