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The Demand for Currency Relative to Total Money Supply

PHILLIP CAGAN

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(Resolution adopted October 25, 1926
and revised February 6, 1933 and February 24, 1941)

THE DEMAND FOR CURRENCY RELATIVE TO THE TOTAL MONEY SUPPLY[1]

PHILLIP CAGAN
University of Chicago

THE public's demand for currency as a fraction of the total money supply has long interested economists s well as bankers. Under fractional-eserve banking, a withdrawal of deposs in (non-bank) currency reduces bank eserves and, unless reserves were preiously in excess of the desired level or re otherwise replenished, forces a mulple contraction of earning assets and eposits. A deposit of currency augments ank reserves and allows a multiple exansion of earning assets and deposits. 'hus the public's conversion of its cash alances from one form to the other, if ot offset by other factors, alters the agregate amount of the money supply as ell as its composition. This effect on the ıoney supply, unlike changes in bank reserve ratios or issues of Treasury and Federal Reserve money, is not subject to direct control by the monetary authorities. However, it can be offset by appropriate open market operations of the central bank and so is an important consideration in planning monetary measures.

There has been a good deal of speculation about the factors that underlie the demand for currency, but empirical inquiry has been limited chiefly to seasonal variations in demand because adequate data covering a long period were not available. New estimates of the United States money supply since 1875 remedy this deficiency.[2] Figure 1 shows the ratio of currency to the total money supply[3] annually from 1875 to 1955. This article deals with the behavior and determinants of this ratio, mainly in the long run. A separate study of its short-run cyclical movements is in preparation.

The currency ratio has varied considerably. It was above 30 per cent just after the resumption of gold payments in 1879 and gradually declined to just over 7 per cent by 1930. Subsequently it rose to 20 per cent during World War II and

[1] This study is part of a project of the National ıreau of Economic Research under the over-all rection of Milton Friedman. His suggestions guid- the work in its initial stages and helped greatly improve the final product. Generous help was also ceived from Anna J. Schwartz, whose extensive ıowledge of this material made her comments espeılly useful. Solomon Fabricant, Edward J. Kilberg, orris Mendelson, and George J. Stigler also made eful comments. Not all these people entirely reed with the interpretation of some of the findgs, and it should not be assumed that they accept e conclusions without reservations.

The paper has been approved for publication as report of the National Bureau of Economic Reırch by the Director of Research and the Board Directors of the National Bureau, in accordance th the resolution of the board governing National ıreau reports (see the *Annual Report of the Naıal Bureau of Economic Research*). It is reinted, with the addition of an appendix on data d sources, as No. 62 in the National Bureau's series Occasional Papers.

[2] These estimates were developed by Milton Friedman and Anna J. Schwartz. See *The Supply of Money in the United States*, a forthcoming publication of the National Bureau of Economic Research.

[3] Currency is defined as the hand-to-hand notes and coin issues outside banks of the United States Treasury, Federal Reserve banks, and (until 1935) national banks. The total money supply is currency *plus* the demand and time deposits of all commercial banks held by the non-banking public.

then fell to 15 per cent in 1955. The largest short-run increases came during World Wars I and II and in the early 1930's.

These movements cannot in the main be explained by any simple correspondence with the trends of one or two economic factors, and in this respect the currency ratio differs notably from most other monetary variables. A favorite explanation of the early decline in the ratio is that an increasing proportion of the people's awareness of them. This ma have contributed to the early decline the ratio. But the decline continued lo after there could have been many peop still left who failed to adopt the bankin habit simply because they were ignora of its advantages. The number of ban increased faster in the West than in th East, probably because the West wa sparsely settled and many small ban could serve the growing but scattere population better than a few large bank

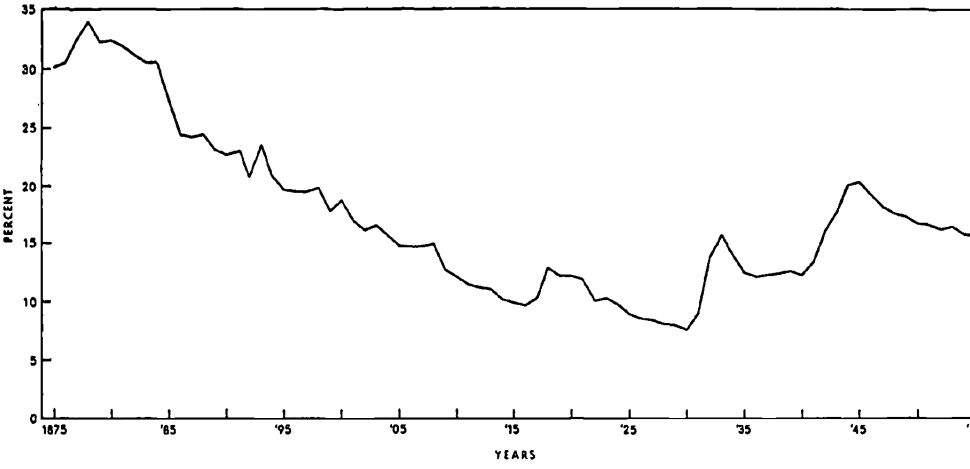

FIG. 1.—Ratio of currency to the money supply annually, 1875–1955

population gradually became familiar with banking.[4] Banking spread rapidly through the West in the half-century preceding World War I,[5] increasing the availability of checking accounts and

[4] See, for example, Irving Fisher, "Will the Upward Trend of Prices Continue?" *American Economic Review*, II (September, 1912), 547–49; and A. C. Pigou, *Essays in Applied Economics* (London: P. S. King, 1924), pp. 184–85.

[5] In 1880 the states west of the Mississippi (including all of Louisiana and Minnesota) had 26 per cent of the country's commercial banks and 22 per cent of the population; in 1914, these states had 50 per cent of the commercial banks and only 30 per cent of the population (see *Annual Report of the Comptroller of the Currency* [1880], pp. lxxxvi–ix; and Board of Governors of the Federal Reserve System, *Banking and Monetary Statistics*, Table 8).

In any event, the later increases in th ratio point to the influence of facto unrelated in any simple way to trends i the growth of the banking habit, an these same factors may account for substantial part of the early decline i the ratio. Indeed, the number of facto deserving consideration is, by norma standards of empirical analysis, distres ingly large, and the evidence sugges that no one of them has predominate throughout the period since 1875.

The following sections assess the im portance of the various factors that coul have produced substantial variations i the currency ratio. The first section di

usses all the variables that seem likley
o affect appreciably the public's desire
o hold part of its total money balances
n the form of currency. This discussion
ncludes some preliminary comment on
ne measurement of these variables and,
here possible, on their importance. Sub-
equent sections analyze their effects on
he currency ratio.

I. VARIABLES AFFECTING THE CURRENCY RATIO

The desired level of the currency ratio
epends on individuals' preferences for
urrency or deposits in the light of the
osts and advantages of holding these or
ther assets. An individual can easily and
uickly make the actual ratio of his cur-
ency to total money balances equal to
he desired ratio by exchanging his de-
osits for currency or vice versa. This
ssumes that there are no restrictions on
his exchange from the supply side, and
ormally this is so. However, during cer-
ain financial crises—1857, 1873, 1893,
907, and 1933—banks suspended con-
ertibility. At these times individuals
ould not exchange deposits for currency,
nd the desired currency ratio undoubt-
dly exceeded the actual ratio (produc-
ng, as a consequence, a premium on cur-
ency). At all other times the presump-
on that the actual and the desired ratios
re equal seems valid.

The economic theory of demand sug-
ests that the expected cost of holding
urrency in lieu of deposits is likely to be
ne of the major determinants of the de-
red ratio. Given the cost of holding cur-
ency, the desired ratio will then reflect
he comparative advantages of holding
urrency and deposits. These advan-
ages might depend on such variables as
xpected real income per capita, the vol-
me of retail trade, the volume of travel
er capita, the degree of urbanization,
and the rate of tax on transactions.[6] There are numerous other possible long-run influences on the currency ratio, and some will be considered briefly later. Most of these neither help to explain the long-run decline in the ratio nor seem relevant to its short-run movements, and therefore they will not receive much attention.

1. THE COST OF HOLDING CURRENCY

A rise in the cost of holding currency leads people to substitute deposits for currency, and conversely. The foregone cost of holding currency is measured by the current rate of return on deposits, since currency typically yields no nominal return. While all deposits once paid interest, the average return on demand deposits has been negative since 1934 because service charges have exceeded interest payments. Time deposits, on the other hand, have always paid interest, although the Federal Deposit Insurance Corporation and the Board of Governors of the Federal Reserve System jointly set maximum rates for insured banks.

Interest paid less service charges on deposits, however, is not the appropriate measure of the cost of holding currency; we should use the *expected net* rate of return. Before the introduction of deposit insurance in the 1930's, deposits were not as safe as currency against losses resulting from changes in economic conditions. The payment of a deposit might be delayed or defaulted if a bank became insolvent. Such losses reduce the net return to deposits. Individuals' expectations of losses should be deducted from the average rate of interest paid, to find the expected net return. Subjective expecta-

[6] The possible effects of most of these variables on the currency ratio have been recognized before (see, e.g., Irving Fisher, *The Purchasing Power of Money* [New York: Macmillan Co., 1926], pp. 51–52 and 165; and Pigou, *op. cit.*).

tions cannot be measured directly, but it is a plausible hypothesis that expectations of the future rate of loss on deposits are based on past experience and so depend largely on some average of past rates of loss. Such a measure of expected loss has been used in the statistical analysis reported below.

2. EXPECTED REAL INCOME PER CAPITA

Checking deposits offer a convenient method of exchanging money without risk of loss in transit; they also provide a permanent receipt for debts paid. In addition, holding balances in reputable banks avoids the hazards of keeping currency on hand. These advantages may well mean that the services of a dollar of deposits are preferred to those of a dollar of currency. If so, the currency ratio would tend to decline as real income per capita rose, other things, such as the comparative rates of return on the two kinds of assets, remaining constant. That is, both deposits and currency are considered superior to other assets as a form of holding wealth, but not equally so, deposits being superior to currency.[7] This does not mean that, for a given level of income, deposits are preferred to currency, no matter how large a fraction of money balances is already held as deposits; if this were so, no currency would be held at all, since some deposits pay interest and currency pays none. For a given size of the total balance, a sufficiently small fraction held as currency makes a extra dollar of currency preferable t an extra dollar of deposits. Nevertheles it may still be true that, beyond th point in the size of the balance and in th corresponding level of income, the in come elasticity of deposits is greater tha that of currency. A rise in real incom would then lead to a decline in the cu rency ratio. As we shall see, the highe income elasticity of deposits appears t explain most of the long-run decline i the ratio.

Since real income proves to be an im portant determinant of the currenc ratio, shifts in the distribution of incom may also affect the ratio and might do s even if the ratio of total money balance to money income for each income grou were unchanged. The share of total in come received by the lower-incom groups has increased over time, whic may have worked to increase the cu rency ratio. The effects of such shifts ar difficult to distinguish from those of th gradual rise in real income, however, be cause our information on them is limite to a few points in time. I have not a tempted to analyze them, and the ob served effect of changes in real incom probably incorporates any effect pro duced by long-run changes in the di tribution of income.

3. THE VOLUME OF RETAIL TRADE

One advantage of currency over de posits is wide acceptability. Check signed by a person unknown to th drawee can prove to be worthless and s are customarily not honored until the clear the drawer's bank. Because of th time usually required for clearings, th use of checks is limited to transactions i which delayed payment creates no di ficulties. Where wide acceptability is im portant, as in cash-and-carry transa

[7] For evidence on the historical superiority of money over other assets see Richard Selden, "A Study of Monetary Velocity in the United States," in Milton Friedman (ed.), *Studies in the Quantity Theory of Money* (Chicago: University of Chicago Press, 1956), Part V.

For some purposes it may be preferable to define the superiority of assets in terms of changes in total wealth rather than of changes in income, as is done in the text. The empirical difficulties of measuring total wealth, however, largely rule out the former approach.

ions between strangers, the use of currency predominates. If we suppose that a constant fraction of retail transactions involves the use of currency and that this fraction is substantially higher than for other types of transactions, then the currency ratio would vary directly with long-run movements in the fraction of total transactions made through retail stores. Such a relation is the main explanation of seasonal variations in the currency ratio: the ratio typically reaches its high point for the year during the Christmas spurt in retail trade. Can this relation explain long-run movements in the currency ratio?

There are no figures on the fraction of total transactions made through retail stores. Statistics on money flows, which help to fill this deficiency, cover only the very recent period. It is still possible to judge roughly the long-run behavior of this fraction by looking at the product of two of its components: (*a*) the value of goods sold through retail stores as a fraction of the value of total commodity output and (*b*) the value of total commodity output as a fraction of total transactions.[8]

Estimates of the first component are shown in Table 1 by decades from 1879 to 1949. The fraction of total output funneled through retail trade, as measured by these figures, has changed little. Over the entire period the estimated fraction is within 5 percentage points of 70 per cent. These figures even overstate the variability in the importance of retail outlets. There is a slight upward bias in the trend of the percentage arising from the unavoidable inclusion in the denominator of a declining quantity of goods exchanged through barter; for our purposes the denominator should measure only goods sold in exchange for money.

The second component—the value of total commodity output as a fraction of total transactions—could change radically over time only if the volume of wholesale and financial transactions or consumer services (discussed in n. 8) changed substantially relative to total commodity output. A relative rise in wholesale and financial transactions, which are conducted mostly with checks, would decrease the currency ratio. We do not know whether such a rise has occurred, but, even if it has, its effect on the currency ratio has probably been slight because a fairly large part of total money holdings is held by individuals. If the importance of wholesale and financial transactions has been growing, presumably the proportion of total cash balances held by businesses, which make most of these transactions, has also. The money holdings of all businesses, including non-bank financial intermediaries, has been only about 30 per cent of the total in recent

TABLE 1*

GOODS SOLD THROUGH RETAIL STORES AS FRACTION OF TOTAL COMMODITY OUTPUT, 1879–1949

Years	Per Cent
1879	70
1889	67
1899	68
1909	69
1919	66
1929	72
1939	75
1949	73

* Source: Harold Barger, *Distribution's Place in the American Economy since 1869* (National Bureau of Economic Research, 1955), Table 10, line 6 *times* line 8.

[8] These two fractions take no account of purchases of consumer services, which presumably are paid for with currency to roughly the same extent as other retail transactions. The growth of consumer services has outstripped that of commodities and probably also that of total transactions and has produced a rise over time in the proportionate use of currency. It does not, therefore, account for the long-run decline in the currency ratio.

decades,[9] however, and this includes the holdings of the large number of businesses engaged in retail trade, which are not reported separately.

It seems likely that a decline in the fraction of all transactions made through firms that sell directly to the public has not been an important factor producing the long-run decline in the currency ratio.[10]

4. THE VOLUME OF TRAVEL PER CAPITA

The amount of currency used to transact a given volume of retail trade may nonetheless vary substantially. Since payments by check require that parties to a transaction be known to each other, currency is likely to supplant checks when a person buys where he is not known or when he does not have the opportunity to establish a line of credit. These difficulties bother travelers in all transactions, and we might expect a direct relation between the currency ratio and an index of travel.[11]

An index of miles traveled per capita, which is the best measure we can get, is far from perfect for present purposes. The increasing speed of transportation allows a person to travel the same distance in less time and therefore perhaps with less need for currency. The need f currency probably rises more with tl duration of the trip than with the nur ber of miles covered. Nevertheless, tl number of miles of intercity travel p capita by passengers on all forms transportation (cars, buses, trains, ai planes, and boats) should reflect maj changes in the demand for currency ari ing from the inconveniences of paying b check when away from home. Such a index of travel was constructed for tl period 1921–51. It has a strong upwa trend and little year-to-year fluctuatio owing to the persistent growth in aut mobile travel, which makes up most the total except during the early 1920' The volume of travel thus seems unab to explain the major fluctuations in tl currency ratio since World War I, an because the long-run trend of travel ha almost surely been upward, it cannot e plain the long-run decline in the rat before World War I.

The possibility that travel accoun for part of the wartime increase in tl use of currency will be considered late otherwise we may disregard this facto

5. THE DEGREE OF URBANIZATION

There are two possible effects of u banization on the currency ratio tha work in opposite directions. First, urba ization, like travel, causes people t

[9] This percentage covers currency and commercial bank deposits only (see reports on liquid-asset holdings in *Federal Reserve Bulletin* and Solomon Shapiro, "The Distribution of Deposits and Currency in the United States, 1929–39," *Journal of the American Statistical Association*, XXXVIII [December, 1943], 438–44). Savings and loan associations are included with financial intermediaries in this percentage, although they are not so treated in the first source cited.

[10] Changes in the form of retail transactions may also have affected the currency ratio. Thus, for example, the growth in sales of consumer durables, which involve a lump-sum payment unless bought on the instalment plan and are conveniently purchased by check, has undoubtedly stimulated the use of checks. I have not analyzed this factor, because it seems less important for the period preceding 1900, when the decline in the currency ratio was greatest, but such effects of the form of retail transactions on the currency ratio deserve further study.

[11] Travel may cause increases in the use of tra eler's checks, which are best classified as a form currency, but such increases would reduce, rath than raise, the currency ratio as computed for Fig. That ratio includes banks' traveler's checks in tl denominator with deposits because of the impos bility of segregating them in the basic data. Trave er's checks have formed a very small fraction of tl total money supply, however, and could not possib be important for explaining the variations in tl currency ratio.

The outstanding traveler's checks of the Amer can Express Company, which can be estimated a nually from its balance sheet, have not been include in the money figures. This company is said to issu about half of the total traveler's checks outstandin It is the only non-bank issuer.

ade where they are not known, which uld reduce the use of checks. Historical ccounts suggest that it was once much ıore common for laborers to buy on redit between pay periods, at least in nall communities, and to pay their acımulated debts on payday. Payment of etail purchases in this way would derease the use of currency relative to deosits. The growth of cities may have reuced this practice and so have increased ıe use of currency. To be sure, charge ccounts are still widely used even in ırge cities, but their over-all importance ıay have decreased. Certainly the imersonal nature of urban trade itself disburages the use of checks and credit, alıough we do not know how seriously. Ve should consider the possibility that ıis effect has been important.

A second, quite different, effect of uranization on the currency ratio is somemes deduced from various facts sugesting that larger bank deposits are held y individuals in cities than in the coun-y. The implication drawn is that urban fe provides familiarity with the advanıges of checking accounts and encourges the banking habit. For example, the ayment of wages by check is more comıon in urban than in rural employments. 'he inconveniences of banking by mail nd the possible inefficiencies of small anks may also have limited the spread f banking in rural communities, though nly the most sparsely settled areas ould seem to be unable to support one ank, or at least a branch of a nearby ank. Branch banking is illegal in many tates, but it is questionable whether this rohibition would have endured if rural ommunities had demanded banking faılities that could be supplied economially only by branch banks.

While the use of bank deposits relative) income is possibly lower in rural areas ıan in cities, the same can be said of currency. All the preceding argument says is that rural areas have less demand for all kinds of money than cities do, or at least that they probably did until quite recently because barter was prevalent in frontier areas and because wages were paid partly in kind. This implies nothing about the proportionate demand for currency and deposits. The question is whether migrants from rural areas to cities become familiar with banking practices and expand their use of checking facilities at the expense of currency. Without evidence, there is little basis on which to judge.

Combining the second effect of urbanization with the first throws the over-all effect of this variable into doubt. These two supposed effects of urbanization on the currency ratio work in opposite directions, and there is no a priori basis for expecting their net effect to work one way or the other.[12]

The nature of the data largely rules out a resolution of this problem by time-series analysis. Urbanization has proceeded very steadily,[13] affording little

[12] There are other possible indirect effects of urbanization. Here is one: A change in the average pay period over time could produce a change in the currency ratio. For example, longer periods between income receipts would require larger money balances and would lead to the deposit of a larger fraction of such balances in banks by households in order to avoid holding too large an amount in currency. What evidence there is suggests that the pay period has declined through the years as part of the urbanization process, because of the tendency of urban factories to adopt shorter pay periods than have been common in rural employments. Changes in the pay period, therefore, cannot explain the long-run decline in the currency ratio.

[13] Bureau of the Census figures on the percentage of the United States population in urban centers (2,500 population and over) by decades are as follows:

1870.....	26	1920.....	51
1880.....	28	1930.....	56
1890.....	35	1940.....	56
1900.....	40	1950.....	59
1910.....	46		

It seems unlikely that the pattern of these figures depends much on the exact definition of urban centers used.

chance to disentangle its effects statistically from those of real income, which has also grown fairly steadily.

It is nonetheless clear that urbanization, whatever the direction in which it operates, has not played a dominant role in determining the currency ratio. If urbanization increased the use of currency, it could not account for the steady decline in the ratio. If urbanization on balance reduces the use of currency, its largest conceivable effect accounts for only two-fifths of the decline in the ratio. To see this, let us make the extreme assumption that urban residents use no currency whatsoever. Then the amount of urbanization that occurred from 1880 to 1910, when the effect of this variable on the currency ratio seems to have been the greatest, would have produced but 42 per cent of the observed decline in the ratio.[14] With a more realistic assumption about the use of currency by urban residents, much less of the actual declin could be attributed to urbanization.

Cross-sectional analysis can cast fur ther light on the effect of urbanizatio on the currency ratio. Two types of suc analyses could be useful. One could com pare over time different regions of th United States that had substantially dif ferent rates of urbanization. The othe could make an international comparison The first is presently ruled out by th absence of data on currency holdings b regions, without which any direct esti mate of regional currency ratios is impos sible. Barred from the first type of analy sis, I shall use the second. However, th lack of good monetary and populatio statistics for most countries limits com parison to one foreign country—Grea Britain. Britain nevertheless provides revealing comparison with the Unite States, because its rate of urbanizatio declined sharply after 1900, while th American rate remained high. Further more, it seems unlikely that any othe factors had strong differential effects o the currency ratios of the two countries

The data underlying an estimate of th currency ratio for Great Britain are sub ject to considerable error, especially fo the years before 1921, and the results o this comparison, presented in Table 2 must be taken with extreme caution. Th table lists as fully as the data allow th periods of steady decline in the Unite States ratio, thereby excluding Worl Wars I and II and the 1930's. The long run movement of the British ratio is simi lar to that of the American ratio with fe exceptions. The former rose slightly du ing the period 1895–1903, though thi rise could well reflect an error in the fig ures. The American ratio reached it minimum in 1930, but the decline in th British ratio continued until 1936. (Dat for 1921–36 are included in Table 2 fo

[14] Let c_u stand for the average currency ratio per person in urban centers, and m_u for the average size of total cash balances held by each person in urban centers as a proportion of the average size throughout the United States. The subscript r will denote rural areas, and U and R will denote population in urban and rural areas, respectively. Then the aggregate currency ratio, c_a, can be represented by

$$c_a = c_u m_u \left(\frac{U}{U+R}\right) + c_r m_r \left(\frac{R}{U+R}\right).$$

In 1880 c_a was 0.31, and the proportion of the population in rural areas was 0.72. Setting c_u equal to zero gives the maximum decline in c_a from urbanization, because any rise in the first term of the identity offsets the decline in the second term. Assuming that c_u equals zero, then, and substituting the foregoing values into the identity, we have

$$0.31 = 0 + c_r m_r (0.72), \text{ or } 0.43 = c_r m_r.$$

For 1910, assuming no change in regional ratios except for the proportion of the population in rural areas, which fell to 0.54, we have

$$0.23 = 0 + 0.43 (0.54).$$

This gives a maximum decline in c_a of (0.31 − 0.23), or 0.08, which is 42 per cent of the observed decline of (0.31 − 0.12), or 0.19.

omparison.) Both ratios rose during Vorld Wars I and II and declined after- vard. However, the British ratio started o rise again after 1950.

For the period before World War II, he British currency ratio declined, on he average, about half as fast after 1900 is in the preceding two decades, and this lower pace corresponds with a sharp lrop in the rate of urbanization. In the Jnited States, which had about as much urbanization after 1900 as before, there was also a reduction in the annual rate of decline of the currency ratio, though it was somewhat smaller than in Great Britain. The decline after 1895 in the United States was less than half as fast as the decline from 1883 to 1888 but was more than half as fast as the decline from 1888 to 1895. On the whole, there is only a small difference between the behavior of the ratios for these two countries, even

TABLE 2*

COMPARISON OF CURRENCY RATIO WITH URBANIZATION: GREAT BRITAIN AND THE UNITED STATES

A. RURAL TO URBAN POPULATION MOVEMENT† (PER CENT PER DECADE)

Period	Great Britain	United States
880–90.....	7.4‡	8.7
890–1900.....	5.3	5.5
900–10.....	1.3	7.2
910–20.....	1.3	6.4
920–30.....	1.0	5.7
930–50.....	0.5	1.7

B. NUMERICAL CHANGE IN CURRENCY RATIO§ (PERCENTAGE POINTS)

	Great Britain		United States	
Period	Total	Per Year	Total	Per Year
1883–88...	−2.9	−0.6	−6.1	−1.2
1888–95...	−4.1	− .6	−4.7	−0.7
1895–1903.	+1.1	+ .1	−3.3	−0.4
1903–14...	−3.5	− .3	−6.3	−0.6
1921–30...	−2.5	− .3	−4.3	−0.5
1921–36...	−3.9	− .3	.....	.....
1945–50...	−3.7	− .7	−3.7	−0.7
1950–55...	+3.6‖	+0.7‖	−1.6	−0.3

* Sources: For Great Britain, *Census 1951 England and Wales General Tables* (London: H.M. Stationery Office, 1956), p. 3; and *Census 1951 Scotland*, III (Edinburgh: H.M. Stationery Office, 1954), xxvii. For the United States, *Statistical Abstract* (1957), p. 20.

The figures for Great Britain are for the second year of each decade; those for the United States are for the first year of each decade. The definitions of rural and urban areas for England and Wales, Scotland, and the United States all differ. However, the figures give a fair approximation of rural-urban movement over time for a wide range of applicable definitions.

† The increase in urban population in excess of the increase that would have occurred if the ratio of urban to rural population at the beginning of the period had remained constant, namely,

$$(U_t - U_{t-1}) - \left(\frac{U_{t-1}}{U_{t-1}+R_{t-1}}\right) \times (U_t + R_t - U_{t-1} - R_{t-1}),$$

where U is number of persons living in urban places and R is number of all others. The subscript t refers to the end of the period and $t-1$ to the beginning of the period.

If we express this number as a percentage of total population at the beginning of the period and rearrange terms, we get

$$100\,\frac{U_t - U_{t-1}[(U_t+R_t)/(U_{t-1}+R_{t-1})]}{U_{t-1}+R_{t-1}}.$$

This formula was used to compute Part A of the table.

‡ 1861–91 at a decennial rate.

§ *Great Britain:* For 1914 and earlier years, currency includes estimates of total gold coin and bank notes issued (including bank holdings) for Great Britain and Ireland (estimates of silver coins were included for the period 1883–88 only) (see *Statistics for Great Britain, Germany, and France, 1867–1909* [Sen. Doc. 578 (61st Cong., 2d sess.)] [National Monetary Commission, 1910]) and E. Victor Morgan, *Studies in British Financial Policy, 1914–25* [London: Macmillan, 1952], p. 217). The years shown are the only ones for which these estimates are available. Deposits are estimates of total deposits with all banks in Great Britain and Ireland (see René P. Higonnet, "Bank Deposits in the United Kingdom, 1870–1914," *Quarterly Journal of Economics*, LXXI [August, 1957], 330, Table I, col. 1). These figures for currency and deposits are rough estimates subject to considerable error. Moreover, they include bank-vault cash, interbank deposits, and Treasury cash holdings. They are thus in error insofar as the ratio of currency to deposits held by banks and the Treasury differs from that of money held by the public. Only part of this error is avoided by ignoring the level of the currency ratio and looking at its change over time. Some rough estimates made to exclude bank holdings suggest that the error from including them is not so large as to destroy the usefulness of these figures for present purposes. However, the deposit figures are reportedly too low prior to 1890 because of incomplete coverage, so that the currency ratio is too high on that account prior to 1890; thus its measured decline from 1888 to 1895 is probably too large.

For 1921 and later years, currency includes mid-year amounts of notes and coins outside banks estimated by the research office of the Bank of England (see Bank of England, *Statistical Summary*, various monthly numbers beginning with May, 1932; revised figures for 1921–24 are given in Morgan, *op. cit.*, Table 29, p. 224). This series was adjusted to exclude the note issues of Irish banks in excess of their vault cash. Deposits refer to the middle of the year. They are the sum of (*a*) public deposits at the Bank of England; (*b*) deposits *less* float of the London clearing banks (see Central Statistical Office, *Annual Statistical Abstract*); (*c*) an interpolation of total deposits at a date near the end of the year with Scottish joint-stock banks (see *The Banker's Almanac and Yearbook*, section on "General Information"); and (*d*) estimates of total deposits with private banks in Great Britain and Ireland through 1937, after which they were negligible (see Sir Walter T. Layton and Geoffrey Crowther, *An Introduction to the Study of Prices* [London: Macmillan & Co., Ltd., 1938], appendix Table IV, p. 254). "Other accounts" at the Bank of England, which are not shown separately from interbank deposits before 1924, were excluded throughout; they are relatively small, and their exclusion does not appear to be a source of great error.

While all interbank deposits and float items have not been eliminated, the figures have fairly complete coverage and, in the main, appear to be reasonably accurate.

United States: Same as for Fig. 1.

‖ Excluding Scottish banks, reports for which were unavailable for the latest years. They represent a small part of the total, and their exclusion cannot affect the figures much.

though their urbanization rates contrast sharply.

By this evidence, urbanization works to reduce the currency ratio slightly. Had the United States been fully urbanized by 1875, therefore, its ratio would probably have declined a little more slowly than it did but certainly would have declined nonetheless. Apparently the two main effects of urbanization previously discussed largely cancel out, so that the net effect is fairly small. The unreliability of the early data for Great Britain, however, makes this conclusion tentative and makes further study of a wide range of countries desirable.

6. RATE OF TAX ON TRANSACTIONS

The last variable to be considered is the rate of tax on transactions. Some people evade taxes by making as many transactions as possible with currency and not reporting them to the tax collector. In the absence of independent evidence on transactions, such as canceled bank checks, tax evasion is difficult to detect. Obviously, evasion will occur on a large scale only if the tax rate is high enough to create sufficient incentive. The most extensive tax on transactions with a high rate is the income tax, and even here the rates have become exceptionally high only since the late 1930's. The nature of many income payments makes their transaction with currency highly impractical, so that the possibility of evasion by use of currency is effectively limited to the income of unincorporated businesses and independent professional practice. As for other taxes, most sales and excise taxes have fairly low rates and are difficult to evade. The tax variable will be discussed further in connection with wartime increases in the currency ratio.

This completes the list of variables that were examined for their contribution to long-run movements in the cu
rency ratio. The foregoing discussio
gave reasons for neglecting the effects
two—the volume of retail trade and
travel—and for attaching only minor im
portance to a third—urbanization. Tha
leaves three variables—interest on d
posits, real income, and the tax on tran
actions—whose relative importance r
mains to be assessed. One way of doin
this is by a correlation of time-serie
data, which is reported later. Anothe
way, taken up in the next section, is by
detailed examination of the exceptiona
movements in the currency ratio durin
World Wars I and II. The wartime de
mand for currency may have been a
fected by special factors not present a
other times, which need to be considere
in addition to the factors already dis
cussed.

II. WARTIME INCREASES IN THE DEMAND FOR CURRENCY

If we take the 1940 level of the cu
rency ratio as roughly "normal," cu
rency in circulation in 1945 was 8.1 pe
cent above normal, which implies tha
there was $10.1 billion "excess" currenc
in that year. This excess cannot be at
tributed to changes in either interes
payments or real income; such change
were not pronounced during this perio
(see Fig. 2), and their effects tended t
offset each other. During World War
the increase in the ratio was less pro
nounced. If the 1914–17 level of the rati
is considered normal, currency in circula
tion was 3 per cent above normal in 191
(The subsequent analysis largely ignore
the World War I period because neces
sary data on other factors are not avai
able.)

The excess wartime demand for cu
rency has attracted a great deal of atter
tion and is generally attributed to one

ive factors. Conceivably, all five could ıave contributed about equally to it. Yet, as will be shown, all but one of them ;an actually account for only a minor 'raction of the total increase, and that)ne—income tax evasion—could account 'or nearly all of it. This variable, there-'ore, will be singled out as the probable nain cause and will be discussed first. The other proposed explanations, dis-:ussed afterward, are black markets, travel, the size of the armed forces, and change of residence.[15]

1. EVASION OF TAXES

The use of currency to conceal taxable transactions was probably higher during and after the war, primarily because income tax rates were raised substantially early in World War II and have not been appreciably reduced since. Income received, held, and spent without prior deposit in a bank usually defies detection.[16] A tax on income thus leads some people to receive income and make expenditures as far as possible without the use of checks. To be sure, incorporated businesses and most wage and salary earners have little or no such reason for preferring payments in currency. The former undergo public audits, and most of the latter have their income tax withheld, a device that frustrates whatever temptations to defraud the government high tax rates may arouse. Even before withholding was introduced early in the war, most individuals who wished to be paid in currency could not hope to change the pay practices of their employers but had to seek out currency-paying employments. It is doubtful whether, at the low income tax rates prevailing before the war, many companies paid workers in currency solely to attract would-be tax evaders and thus to be able to pay lower wages. We may expect that, if evasion of income taxes through the use of currency were widespread, it would occur primarily among small unincorporated businesses, including independent professional practice.

How large, then, could the demand for currency be from unincorporated businesses and professional practice alone? One easy and revealing way of judging the size of this demand is to compare an estimate of unreported income based on the quantity of excess currency circulating in 1945 with an independent estimate of unreported business and wage income.

The currency ratio, excluding money balances of incorporated businesses, was 15.5 per cent[17] in June, 1940, which can be taken as roughly normal because income tax rates were then relatively low. (Because data on unincorporated businesses separately are unreliable, such businesses are included with all individuals.) This ratio implies normal currency holdings in June, 1945, of $12.4 billion for individuals and unincorporated busi-

[15] A sixth explanation—foreign demand for United States currency to hoard—has been unofficially estimated by the Federal Reserve Division of Research to account at most for about one-tenth of the 1940–45 increase in currency. This estimate suggests that foreign demand had a relatively small effect on the currency ratio and, for present purposes, can be ignored.

[16] But not always, as the following incident dramatically proves:

"Tax investigators recently closed in on a Dallas area dentist who stashed $20,000 of unreported income in a coffee can. He arrived home one day to discover his wife had thrown the can into the trash. After finding that neighborhood trash already had been collected, he hired a bulldozer for $5,000 [*sic*] and carefully sifted the city dump. By the time the frantic dentist finally located the coffee can, the whole town—as well as interested Government agents—knew about its contents" (*Wall Street Journal*, April 11, 1957).

[17] Based on figures for ownership of liquid assets (*Federal Reserve Bulletin*, June, 1948, p. 658, and July, 1954, p. 710). These figures exclude mail float from checking accounts, and this was added back according to the proportionate holdings for each group of demand deposits excluding the float.

nesses. In that month this group actually held $23.2 billion, an excess of $10.8 billion.[18] If it is assumed that all, or almost all, unreported income is transacted with currency, it follows that $12.8 billion was the amount of money held against unreported income.[19] What level of such income does this figure imply? As a rough approximation, we can multiply this estimate by the ratio of annual personal disposable income to total personal money balances, excluding incorporated businesses. This ratio shows the quantity of annual personal expenditures and savings normally handled by a dollar of money. In 1945 this ratio was 1.66, which would put unreported income at $12.8 billion *times* 1.66, or $21 billion. However, the real value of money balances was unusually large in that year; apparently many people had accumulated money savings with the intention of purchasing postwar consumer goods not then available. Such savings should perhaps be excluded from these calculations. We may do so by using the ratio of personal disposable income to personal balances in a normal year. In 1940 it was 1.84, and in 1950, 1.96. These ratios estimate unreported income in 1945 at $24 and $25 billion, respectively. Thus the estimate of excess currency in circulation in 1945 implies that from $21 to $25 billion of income was unreported.[20]

A comparison of this range with a comparable, independent estimate of unreported income will give one indication of the wartime increase in currency that resulted from tax evasion. While such an estimate can be made only indirectly and is obviously subject to considerable error, a very rough figure is available. It puts unreported income for 1945 at about $15 billion.[21] Compared with the preceding figures, this suggests that high in-

[18] Total holdings for all groups were $25.3 billion, as estimated in Friedman and Schwartz, *op. cit.*, from which holdings of corporations were deducted (*Federal Reserve Bulletin, loc. cit.*).

[19] This takes account of the currency that would ordinarily be used. Suppose that cash balances held against unreported income are M, all of which is currency. Thus M equals the $10.8 billion excess currency *plus* the currency that would normally be held against this income. One way to estimate the latter is to estimate the "normal" currency ratio. For 1945 we may take this to be 15.5 per cent, the figure for all groups in 1940 except corporate business, which is probably an overstatement for unincorporated businesses alone and so is biased unfavorably for the hypothesis being tested. Then, $0.155M$ is the normal amount of currency held, and M is found as follows:

$$10.8 + 0.155M = M \text{ and}$$

$$M = 12.8 .$$

[20] This range is equivalent to from 50 to 60 per cent of total non-corporate business income, in which most non-reporting presumably occurs. (The denominator of these percentages is the sum of the following items as estimated by the Department of Commerce: income of unincorporated enterprises, farms, and professional practice; rental income of persons; and income, including wages and salaries, from personal services and from services to private households. Except for the last item, these figures exclude all wages and salaries. For some excluded wages and salaries income taxes are not withheld at the source, and the figures thus exclude some income which may not be reported. In this respect these percentages are somewhat too high.)

[21] I am indebted to C. Harry Kahn for this estimate and the following description of its derivation: The estimate was obtained by adjusting the Commerce Department's personal income estimates to comparability with the income concept used on tax returns; namely, adjusted gross income (AGI). The following items were subtracted from total AGI to obtain an estimate of unreported income: (1) AGI reported on taxable and non-taxable returns as tabulated in *Statistics of Income for 1945* and (2) an estimate of the amount of AGI not reported because it was below the $500 filing requirement for that year. The resulting estimate of unreported AGI is $17,537 million, which includes dividends and interest. To eliminate the latter, Selma Goldsmith's estimate of $2,612 million for unreported dividends and interest (see *Studies in Income and Wealth* [National Bureau of Economic Research], XIII, 302) was subtracted from $17,537 million, which gives $14,925 million. This figure is a residual and is therefore subject to the errors in both of its derivatives. It is obviously an indirect and crude estimate of unreported income.

ome tax rates account for 60–70 per cent f the wartime increase in currency.[22]

This evidence is admittedly circumtantial and for that reason unreliable. Three considerations underlie the importance that I nonetheless attach to this actor.

First, the foregoing argument rests on wo assumptions, both of which appear ighly plausible: (*a*) unreported business ncome involves the use of currency almost exclusively,[23] and (*b*) the amount of currency so used per dollar of income is ot less than the amount of money used per dollar of all income. If these two assumptions are correct, the preceding estimate of the effects of income tax evasion on the currency ratio is not overstated. Perhaps these assumptions are not entirely valid, but it is hard to believe that they are grossly inaccurate.

Second, it is likely that assumption *b* is far too conservative and that the amount of currency held against a dollar of unreported income is much greater, on the average, than the amount of money held against a dollar of regular income. Unreported income produces an abnormal demand for currency to hoard. The amount of currency hoarded by the tax evader reported in an earlier footnote does not seem unnatural under those circumstances, though it is very large by ordinary standards. Such hoarding on a wide scale would increase the use of currency enormously. For this reason it seems plausible to attribute three-fourths or even all of the wartime increase in the demand for currency to income tax evasion.

Finally, possible alternative explanations, even when taken together, seem unable to account for very much of the increase, or at least not for as much as the income tax variable by itself, as the following discussion shows.

2. BLACK MARKETS

Black-market activities, which increase the demand for currency in order to conceal transactions, were prevalent when price controls were in effect during and after World War II and to a lesser extent during World War I. Black-market operations in wholesale trade surely involved the use of large denominations of currency, say twenty-dollar bills and over, because of the large transactions required. Such operations can be dismissed as unimportant contributors to the wartime increase in currency for the following reason: Data on the denomination of the currency 1940–45 show that the value of bills of twenty dollars and over, not all of which by any means represented a demand arising from illegal activities, rose from 49 to 60 per cent of the total value of the currency.[24] This increase of 11 per cent of the currency outside banks in 1945 amounted to $2.8 billion, about one-quarter of the $10 billion abnormal demand for currency. Even this figure overstates the effect, as will be shown in a moment.

Insofar as black marketing involved

[22] These rates did not fall appreciably from wartime levels during 1945–55, and the moderate decline in the currency ratio in the postwar period must be attributed to other factors, such as the rise in interest paid on deposits and in per capita real income.

[23] In the case of retail stores and certain services where receipts are mostly in the form of currency, a proprietor or worker who wished to evade income taxes would make his expenditures with currency and not first deposit his receipts in a bank, as is usually done.

[24] From the *Federal Reserve Bulletin*. The corresponding percentage for bills of fifty dollars and over was roughly constant during 1940–45.

These figures cover currency in bank vaults as well as in public circulation and so are not entirely appropriate. But the denomination of currency in banks is likely to reflect demands to be expected from depositors' withdrawals and so to parallel the denomination of currency in public circulation.

evasion of income taxes—and much of it probably did—its effect was taken into account in the preceding subsection. Not all wartime tax evasion reflected black marketing, however, and the evidence on denomination of currency is one check on the importance of black marketing in wholesale trade as an independent factor. While tax evasion might also have involved some hoarding of large-denomination bills, most evasion probably involved transactions of average size that did not use large bills; thus the relatively small size of the increase in the amount of large bills does not mean that tax evasion was unimportant.

Of course, black marketing at the retail level would not use large denominations of currency, and it was reported to be widely prevalent during the war, especially in food sales. But retail transactions are typically made with currency in any event, and therefore the retail black market could not have produced a great increase in the use of currency.

Before dismissing this factor, we should consider the evidence further, because the increased use of large bills during the war was thought to be a glaring indication of widespread black marketing and tax evasion. In 1945 the Treasury hoped to discourage these illegal practices by having banks report exchanges involving substantial amounts of currency or large bills. In 1947 two laws were proposed in Congress, though never enacted, to exchange the currency outstanding for a new one.[25] The intention was to wipe out hoards acquired through illegal activities. It is not clear whether the exchange would have had the intended effect, but it might have if funds illegally acquired were held in large bills which presumably could not be quickly disposed of, and which would not have been redeemed for the new currency for fear of raising suspicion about their source.

It is extremely doubtful whether the basic premise of these proposals—that the increased demand for large bills involved illegal transactions—was true. What the argument underlying these proposals overlooks is that a rise in prices tends to raise the average denomination of the currency proportionately. Inflation increases the average dollar amount of transactions, and so the average payment uses larger bills than before. Thus some part, perhaps all, of the increase in the use of large bills was due to the inflation. This is confirmed by the following comparison.

The average denomination of the currency, weighting the value of each denomination by the number of bills or coins outstanding and excluding bills over $1,000, increased by 84 per cent from 1940 to 1945.[26] This overstates the desired increase by some undetermined amount because of the wartime limitation on the production of coins: dollar bills had to be substituted to some extent for coins in currency holdings, which raised the average denomination of currency in circulation. We may use the average denomination of checks cleared by Federal Reserve banks as a rough measure of the average size of transactions. The increase in the average denomination of checks from 1940 to 1945

[25] H.R. 5239 and H.J. Res. 315 (80th Cong., 2d sess.); see James J. Quinn, "New Money for Old—Hot or Cold?" in *Commercial and Financial Chronicle*, November 27, 1947.

[26] The number of one-cent and five-cent pieces outstanding is available, but the breakdown of subsidiary silver had to be approximated from figures on coinage (from *Annual Report of the Director of the Mint*). Estimates of the average denomination of coins outstanding derived by various methods are all roughly the same; the method used, therefore, is likely to be fairly accurate.

was 70 per cent.[27] The increase in the average denomination of currency exceeds this figure by a relatively small amount and perhaps would hardly exceed it at all if we were able to correct for the limitation on coin production. Thus there was little shift to the use of large bills that cannot be attributed to the concurrent inflation[28] and that could reflect instead increased demand arising from black marketing.

3. TRAVEL

As already mentioned, the per capita number of intercity passenger miles on all forms of transportation seems an accurate enough measure of travel, even though it is not entirely appropriate. This variable can be dismissed for present purposes, because the volume of travel declined during the early years of World War II, owing to the sharp curtailment of the use of automobiles, which accounted for almost 90 per cent of total intercity travel in 1940.[29] The volume was higher in 1941 than in 1945 but rose appreciably in the early postwar years. Only an increase in travel during the war and a subsequent decline would account for the behavior of the currency ratio.

4. THE SIZE OF THE ARMED FORCES

Servicemen lead an unsettled life in which bank connections are usually of little value. A man entering the armed forces will increase his use of currency per dollar of income, and a large rise in the number of servicemen may produce a substantial increase in the use of currency. This factor is not likely to be important, however, because new entrants to the armed forces also experience a substantial reduction in money income. In 1945 the average payroll of the entire armed forces was $1.77 billion a month higher than in 1940,[30] and only part of this difference was paid in United States currency or paid directly to servicemen. To a large extent foreign currencies were used overseas, and many servicemen had a substantial part of their pay sent directly to dependents or invested in savings bonds. Let us nevertheless suppose that the entire military payroll was paid monthly in currency and held in that form during each month until spent. As for hoarding, it is unlikely that servicemen typically carried much more than a

[27] Calculated from data on check clearings (excluding United States government checks) published in the *Annual Report of the Board of Governors of the Federal Reserve System.*

[28] The percentage increases in the average denomination of currency and the average amount of checks are much larger than the concurrent increase in price indexes. For example, the implicit price index of the Department of Commerce for gross private product increased by about 36 per cent from 1940 to 1945. This means either (1) that the average dollar amount per transaction for some reason rose more than prices during the war, or (2) that some of the price rise of about 30 per cent shown by the implicit price index from 1945 to 1948 occurred, in effect, before 1945 but was not reflected in quoted prices and so in the index until after the removal of price controls.

The subsequent decline in the average denomination of transactions partially supports the first possibility. The average denomination of checks fell 11 per cent from 1945 to 1953. That of currency fell about 30 per cent in the same period, but about half of this was probably due to the removal of restrictions on coin production. This evidence suggests that the average denomination of transactions rose about 11 per cent more than prices during the war. An alternative explanation, however, is that average prices actually paid declined 11 per cent after the war following the disappearance of wartime scarcities but that, because of price controls, the index of quoted prices did not show this decline, just as it may not have shown all the previous rise. Price controls could have caused a discrepancy to develop between the actual and the measured price movements by leading consumers to shift toward higher-priced or lower-quality items or to countenance retail black marketing.

[29] The index of the per capita volume of travel for the 1940's is as follows: 1940, 100; 1941, 111; 1942, 98; 1943, 93; 1944, 99; 1945, 108; 1946, 119; 1947, 116; 1948, 116; 1949, 122.

[30] *National Income Supplement* (1954), p. 181.

month's pay at any one time, and there is no reason to believe that the accumulated money savings that servicemen kept back home with their families contained a higher fraction of currency than the savings of civilians. On these assumptions, then, pay in currency remained with servicemen an average of about two weeks after it was received and so increased the amount in circulation by only $0.9 billion, and this takes no account of the currency that servicemen held when they were civilians. Even under more extreme assumptions, the possible increase in currency from this source seems negligible.[31]

5. CHANGES IN RESIDENCE

During World War II war industries paid high wages and attracted workers from peacetime employments; this shift in employment often involved a change in residence. In addition, many wives tried to live near the places in the United States where their soldier husbands were stationed. Migrants undoubtedly found the use of credit difficult until they became better known and so temporarily had to use more currency than before. This increased use of currency must have lasted from several months to a year or more after each change of residence. Many of the migrant war workers may also have been people who previously had low incomes and made little use of banking facilities; they would not immediately acquire the banking habit upon receiving high wartime wages. While this last factor works in the same way as a redistribution of income, the rise in the income of these people was associated with their change in residence, and the effects of the two are closely related.

One way to measure such changes in residence is by changes in state populations resulting solely from migration.[32] If we add up the increase in civilian population from migration of only those states showing a gain, we find that 2.3 million people moved between April 1, 1940, and July 1, 1942, and 2.8 million between July 1, 1942, and July 1, 1945. These totals understate the number of civilians changing residence, because intrastate movements are excluded and people leaving a state with net gains reduce the reported number of newcomers. This understatement does not seem to be great, however; most of the migrants took jobs in newly expanded war industries, the largest of which were concentrated in a few states. They therefore moved across state lines, primarily in one direction. Indeed, these figures, by including all members of a migrating family, probably overstate the movement of income earners.

What is the largest increase in currency that could conceivably result? Gross average weekly earnings in manufacturing, which exceeded average weekly take-home pay, were $44.39 in 1945.[33] Let us make the extreme assumption that the average migrant was paid as much as the average of all factory

[31] In an interesting recent work on the currency ratio, Stephen L. McDonald finds a close correlation during the period 1939–53 between the ratio of currency outside banks to demand deposits adjusted and military pay as a percentage of personal income; he attributes a large part of the wartime increase in currency to this factor ("Some Factors Affecting the Increased Relative Use of Currency since 1939," *Journal of Finance*, XI [September, 1956], 313–27). The high correlation proves little, however, for many other variables affecting the currency ratio rose during the war and would be highly correlated with the ratio. For the reason given in the text, I cannot believe that currency holdings of servicemen were important.

[32] Bureau of the Census, *Current Population Reports* (Ser. P-25, No. 72 [May, 1953]), Tables 5 and 6.

[33] *Statistical Abstract* (1956), p. 220.

workers and that migrants used no credit or banking facilities for three years but kept their entire weekly pay in currency for the full week between payments before spending it. The use of extra currency then amounts to only $124 million ($44.39 *times* 2.8 million). Even if all the workers who migrated between April, 1940, and July, 1945, did not use banks throughout the period, the rise in currency could have been, at most, $226 million ($44.39 *times* 5.1 million), a minute part of the $10 billion increase we want to explain.

It is possible, of course, that many migrants also kept their accumulated savings in the form of currency. Savings accumulated before moving would probably not raise the currency ratio, for there is no reason to believe that migrants lowered the fraction of their accumulated money savings previously held with banks, except perhaps temporarily while actually traveling. However, if many migrants kept all their savings from increased wartime earnings in currency, such hoards would raise the currency ratio. But it is doubtful whether migrants hoarded much currency in view of the attractive alternative available in United States savings bonds and of the strong pressures put on workers to enlist in payroll savings plans. The wide wartime participation in these plans[34] attests to their importance and creates serious doubt that hoarding by migrants was a major source of increase in the currency ratio.

[34] After a steady rise during 1943, the number of employees of firms offering payroll savings plans reached 85 per cent of all employees of business and industry by June, 1944. The average deduction from participating workers' pay was 9–10 per cent, and about half the employees in non-agricultural employments participated (see *Report of the Secretary of the Treasury* [1944], pp. 52–53).

III. STATISTICAL ANALYSIS OF TIME-SERIES DATA

One way to test the foregoing findings is by a correlation of time-series data. Such a correlation was run for the period 1919–55, using the interest, income, and income tax variables only. Other variables that may to some extent have been important, urbanization in particular, were disregarded. Urbanization correlates highly with the income variable, and the effects of the two cannot be disentangled in a time-series correlation. The income variable can serve as proxy for urbanization as well. The other variables examined for their contribution to the wartime increases in the currency ratio would probably correlate highly with the income tax variable and would, if used, also create multicollinearity in the regression. Since the income tax variable seems by all odds the most important for the wartime period, it alone was used.

1. DESCRIPTION OF THE DATA

Interest paid on deposits.—Judging from the behavior of the demand for commodities, we might expect the most important determinant of the demand for currency relative to deposits to be the cost of holding one in lieu of the other, or the net rate of interest on deposits. The data needed to construct a time series of this variable are available. Since 1919 there are comprehensive annual figures for member banks on interest paid on time and demand deposits, and on service charges on demand deposits. Since 1934 such data are available for all insured commercial banks. These can be used to represent all commercial banks. Before 1919 the data for commercial banks are too incomplete to be used with any confidence, and the correlations are therefore limited to the period 1919–55.

Much better figures for mutual savings banks are available back to 1875 and before. However, a comparison of interest payments by savings banks since 1919 with those paid on demand deposits indicates that short-run fluctuations in the two series do not correspond at all closely; thus the rate on savings deposits cannot serve as an estimate of the rate on demand deposits for the earlier period. The savings banks' rates are useful, however, in showing the general movement of interest payments before 1919.

Statistics on interest paid on deposits, as already noted, take no account of losses suffered by depositors in banks that become insolvent and so do not measure the net rates that depositors as a group expect to receive. In the past, these losses were not inconsequential. In twelve crisis years from 1865 to 1933, depositors suffered an average annual rate of loss of three-fourths of 1 per cent,[35] though in most other years the annual rate was fairly low. Since the late 1930's the great majority of banks have joined the Federal Deposit Insurance Corporation, and the loss to depositors has been negligible. Available data on the percentage of deposits lost through bank failures show actual past losses rather than the losses depositors expect in the near future. Naturally, expectations cannot be measured directly. Yet, since depositors must normally rely on past experience in forming their expectations, it seems reasonable that some average of past rates of loss, giving greater weight to rates more recent in time, would approximate the expected rate. An average using exponential weights has been employed elsewhere with apparent success to estimate the expected rate of change in prices and to estimate expected income;[36] there is every reason to believe that ex pectations are formed in a similar way i the present instance. Of course, an argu ment based on these other results is no conclusive; the main test is with th present data. Here an exponentially weighted average of past losses was use to estimate expected losses through 1933 For later years, when deposit insuranc rapidly came into effect and actual losse were negligible, expected losses were as sumed to be zero. While zero is obviously too low a figure for the period immedi ately following the introduction of de posit insurance, it is certainly more ac curate than a figure based on the experi ence of the previous years, and there i no basis for selecting an intermediate fig ure. As will be shown shortly, these esti mates give better results than use of th current loss rate throughout. Whethe the particular weighting pattern for th period before 1934 is the most appropri ate one need not concern us. Because th magnitude of losses is small compare with interest payments, the series de rived for the expected net return on de posits is little affected by the exact shap of the weighting pattern.

The resulting series is plotted in Figur 2 (it is inverted because of its inverse re lation to the currency ratio). Figure also shows the currency ratio and tw other series to be described presently The series are plotted on logarithmi scales to bring out their percentage varia tions.

Movements in the currency ratio an those in expected net interest payment correspond closely. In particular, thes payments account for a large part of th sharp rise in the ratio after 1930. Cor relation coefficients computed betwee

[35] *Annual Report of Federal Deposit Insurance Corporation* (1940), p. 63.

[36] See Friedman, *op. cit.*, Part II; and M. Fried man, *A Theory of the Consumption Function* (Na tional Bureau of Economic Research, 1957), p. 143

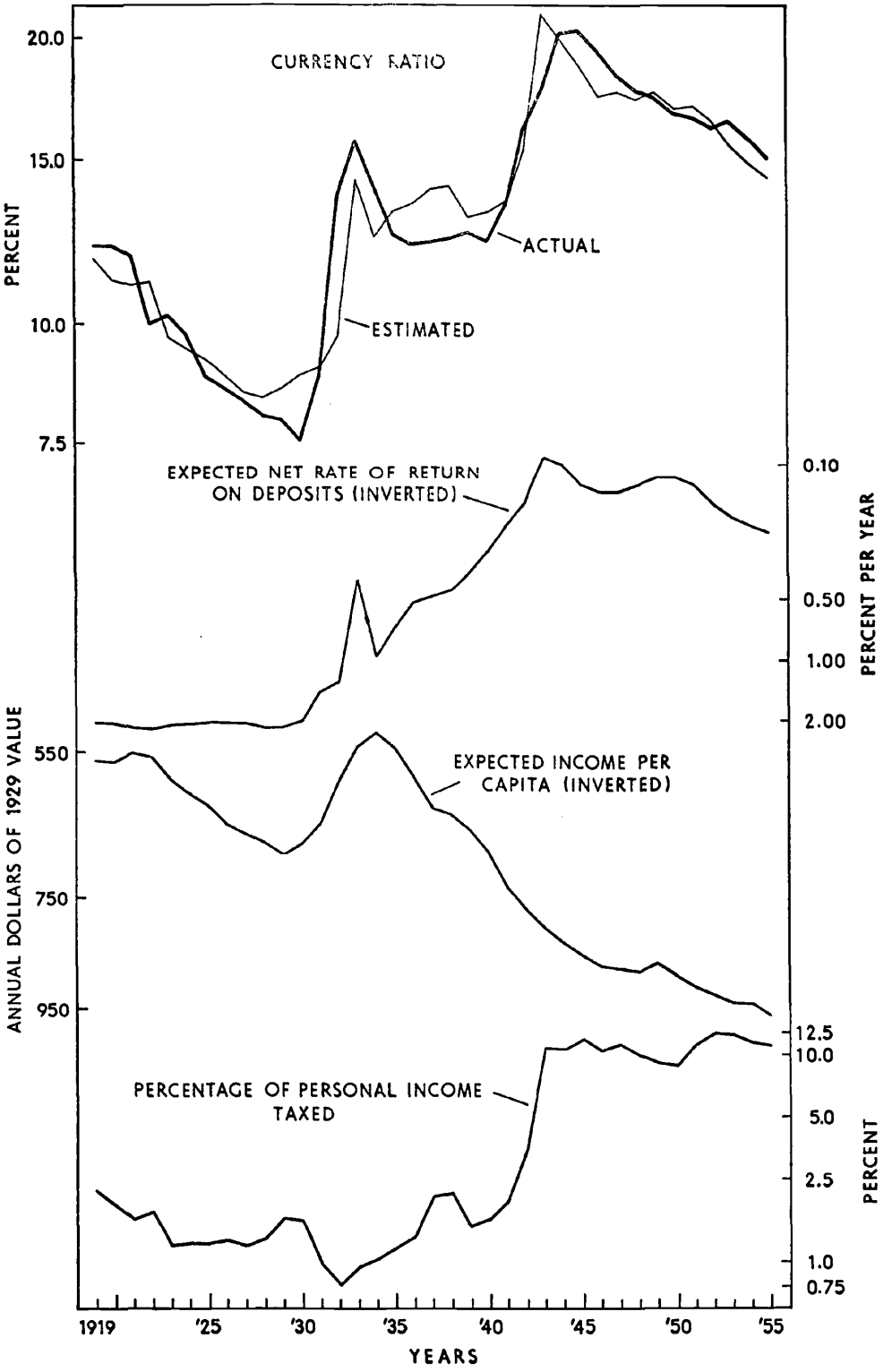

FIG. 2.—Determinants of the currency ratio annually, 1919–55. Ratio scales (adjusted by regression coefficients—see text).

logarithms of the two series show that the interest series accounts for 79 per cent of the total variation in the currency ratio since 1919. With correction for current losses only, instead of correction for the weighted average of past losses, the correlation is lower; that is, the estimated expected net return gives better results than the current net return.

Let us next see how much of the residual variance can be explained by the two other variables—expected real income per capita and the rate of tax on income. These variables are shown in Figure 2; the former is shown inverted because of its inverse relation to the currency ratio.

Expected real income per capita.—This variable is estimated from an average of past levels of net national product in constant prices, weighted by an exponential curve that gives greater importance to more recent levels and divided by the population. It would have been more appropriate to use national income than net national product, but the latter series had already been averaged by the exponential weights for another study and was used because it was readily available. In any event, the trends in the two series are very similar. The averaging procedure smooths out cyclical fluctuations in the underlying data, which seems appropriate because the use of currency relative to deposits is likely not to be adjusted for variations in real income that are not viewed as permanent. This method of deriving expected income has been used successfully elsewhere to explain aggregate consumption (see n. 36).

Rate of tax on income.—The use of currency to evade income taxes is measured by the annual percentage of personal income collected for income taxes. The use of this series presumes that the amount of tax evasion depends directly on the rewards. An ideal measure would be the marginal rate levied on the average level of income for which taxes are not withheld, permitting currency to be used to aid evasion. The measure used is not ideal, since it gives the *average* rate paid on *total* personal income and excludes evaded taxes, but it seems close enough for present purposes. The measure ignores other incentives to use currency for concealing illegal transactions that have varied appreciably in volume, such as the production and sale of alcoholic beverages during national prohibition. Also, there may be lags between the imposition of increased tax rates and attempts to evade them. The percentage of personal income taxed (see Fig. 2) reached a plateau in 1943, while the currency ratio continued to rise for another year, which may reflect such a lag. The sharp rise in the currency ratio in 1918 (see Fig. 1) may likewise reflect the increase in income taxes as a percentage of personal income from nearly zero in 1916 to about 1.8 in 1917, suggesting that tax evasion lagged by about a year. No attempt has been made to take account of such lags.

2. MULTIPLE CORRELATION OF THE TIME-SERIES DATA

The three variables just discussed were used in a multiple correlation to explain annual variations in the currency ratio for the period 1919–55. The multiple regression function, with the currency ratio and three independent variables in logarithmic form, accounts for 89 per cent of the variation in the ratio. In the two-variable regression of the currency ratio on interest payments, mentioned earlier, the latter accounted for 79 per cent of the variation in the ratio, so that the additional two variables account for about half of the remaining 21 per cent of the variation. Thus interest payments were the main determinant of the ratio in

his period.[37] In Figure 2, each independent variable is plotted on a vertical scale hat is proportional to the relative magitude of its contribution to changes in he currency ratio in the multiple regresion. The combined contribution of the hree variables is shown by the lighter ne. Comparison of the actual and the stimated ratio indicates that variations n the currency ratio during the war periods are largely accounted for by increases n the personal income tax. It does not ppear that any of the other variables onsidered, which were discarded beause of insufficient importance but night have had some influence, would xplain the differences between the acual and the estimated series for the curency ratio. The serial correlation displayed by these differences probably relects persistent errors in the data, the indequacy of the logarithmic regression unction, and perhaps cyclical factors not epresented by the independent varibles.

Even if too much importance has been ttributed to the income tax variable and ome combination of the discarded varibles in fact accounted for a sizable part f the wartime increases in the currency atio, the estimated regression coeffiients for the interest and real-income ariables are probably not greatly in eror. Time series for the discarded varibles would have a pattern much like hat of the income tax variable, so that he interest and real-income variables would still account for the same variaions in the currency ratio. Only a minor qualification of the results seems required. Since time series of the discarded variables, unlike income taxes, might decline after 1945, the interest and real-income variables may account for less of the decline in the currency ratio since World War II than the regression attributes to them. The future behavior of the ratio will show to what extent this qualification is called for.

3. ELASTICITIES OF DEMAND FOR CURRENCY

The variation in the currency ratio associated with each of the three variables used in the regression does not necessarily measure the magnitude of their influence. The amount of this association depends partly on the relative extent to which the variables happened to vary during the period covered. The regression coefficients, on the other hand, show the effect on the currency ratio of equal percentage fluctuations in each variable. These coefficients are given by the regression function derived from the multiple correlation:

$$\log \frac{C}{M} = -0.21 \log X_1 - 1.16 \log X_2 + 0.22 \log X_3 + \text{a constant}, \quad (1)$$

where C/M stands for the currency ratio and X_1, X_2, and X_3 stand for expected net interest paid on deposits, expected real income per capita, and the percentage of personal income taxed, respectively. The logarithmic form of the function may not give the best possible fit, but it was used because it allows us to measure elasticities easily.[38]

All the coefficients have the appropriate sign. Interest payments are negatively related to the currency ratio, indicating a shift to deposits when these payments rise; expected real income per

[37] This is also brought out by the square of the partial correlation coefficients, which is the fraction of residual variance in the currency ratio explained by the addition of a third independent variable to a regression on the other two independent variables. The square of this coefficient for interest payments is 0.69; for expected real income per capita, 0.47; and for the income tax variable, 0.43.

[38] The standard deviations of the regression coefficients are 0.02, 0.21, and 0.04, respectively.

capita is also negatively related, indicating that deposits are a superior asset to currency and are held in greater proportion as real income rises; the income tax variable is positively related to the currency ratio, indicating that a higher tax rate brings currency into greater use. The percentage changes in the ratio corresponding to a 1 per cent increase in each of the independent variables are roughly $-\frac{1}{5}$, -1, and $+\frac{1}{5}$, respectively.

These numbers measure the elasticity of demand for currency with respect to the three variables in the special sense that the quantity of money is held constant along the demand curve. A different elasticity would be obtained by using some more general restriction, such as constant total wealth. To derive the elasticity under the latter restriction, we should have to know how the demand for money changed with variations in the independent variables for a given total wealth. The present elasticity concept seems appropriate for most purposes, since the demand for currency is usually discussed in the context of a given demand for money.

From the point of view of commercial banks, however, these numbers are not entirely appropriate. Banks are interested in changes in the currency ratio as a possible source of drain on their reserves and therefore want to know what the change in the demand for currency would be if they were to keep the quantity of deposits unchanged. A fall in the interest rate on deposits, for example, both raises the demand for currency and lowers the demand for deposits, and the elasticity estimated here measures only the first of these two effects. To measure their combination, we add the absolute values of the effect on currency, $d \log C/d \log X_i$, and the effect on deposits, $d \log D/d \log X_i$, of a change in any one variable. The former quantity normally has a negativ sign with respect to interest payments o real income; so we reverse its sign t make it positive. Adding the resultin two quantities, we get[39]

$$-\frac{d \log C}{d \log X_i}+\frac{d \log D}{d \log X_i} \equiv \frac{d \log (C/M)}{d \log X_i}\left(\frac{M}{D}\right). \tag{2}$$

For the income tax variable, the signs i the preceding identity would be re versed. Thus the elasticity of demand fo currency (ignoring sign) with respect t any variable, the quantity of deposit held constant, can be found by raising b the factor M/D the absolute value of th corresponding elasticity with the quan tity of money held constant. The rang of this factor over the period since 187 was from 1.52 in 1878 to 1.08 in 1930 With deposits unchanged, the elasticity with respect to interest payments (ignor ing sign), therefore, ranged from 0.23 t 0.32, which is quite low, though consider ably above zero. The elasticity with re spect to income taxes had the same rang

[39] Another way to arrive at this result is to deriv the demand elasticity for currency with respect t any variable under the restriction that the quantity of deposits remains unchanged. This can be done a follows:

$$\frac{d \log C}{d \log X_i} \equiv \frac{dC/C}{d \log X_i};$$

if $dD = 0$,

$$\frac{dC}{C}=\left(\frac{M}{D}\right)\frac{DdC}{MC}=\left(\frac{M}{D}\right)\frac{(M-C)\,dC-Cd\,I}{(C/M)\,M^2}$$

$$=\left(\frac{M}{D}\right) d \log \frac{C}{M}.$$

Hence

$$\left(\frac{d \log C}{d \log X_i}\right)_{dD=0} \equiv \frac{d \log (C/M)}{d \log X_i}\left(\frac{M}{D}\right).$$

With respect to the income tax variable, the signs o both sides are positive, and with respect to the othe two variables, they are negative.

in absolute value. For expected real income per capita, the corresponding elasticity (ignoring sign) ranged from 1.25 to 1.76, well above unity.

IV. VALIDITY OF THE STATISTICAL RESULTS FOR THE EARLIER PERIOD

The foregoing analysis indicates that the main determinants of the currency ratio since 1919 are summarized by regression function (1). Let us see whether these findings are consistent with the evidence for the period before 1919. While an analysis of this early period is difficult because of the lack of reliable data on all the variables, the steady decline in the currency ratio greatly simplifies the problem: we can ignore the minor short-run movements in the ratio and deal only with its long-run rate of decline. A logarithmic function fitted by eye to the ratio for the period 1875–1919 has a slope between -2.6 and -2.7 per cent per year (compounded continuously). The trend selected depends to some extent on the interpretation given to the rise in the ratio from 1875 to 1878. Varying fractions of this rise were disregarded in calculating the range for the slope just given, for reasons to be discussed in a moment.

The next step is to compute trends for net interest paid on deposits and expected real income per capita in this period, to see whether these trends, on the basis of the regression coefficients for the later period, will explain the trend in the currency ratio. (There was no personal income tax during most of the early period.)

The difficulty of this task is lessened by the relatively small changes in interest paid on deposits from the 1880's through the 1920's. The evidence is meager and not entirely reliable, but most of it suggests that these rates stayed within a rather narrow range, except for a sharp fall from the mid-1870's to the early 1880's. This fall is associated with the major decline in short-term commercial rates in 1874 that followed the financial panic of 1873. If we can rely on the limited data available for that period, the fall in rates on deposits was approximately 30 per cent. Thereafter, there appears to have been a slight further decline in these rates from about 1889 to 1900 and a rise of similar size from 1900 to 1916. The data suggest that the size of this fall and the subsequent rise is roughly 15–20 per cent. There is no need to take account of losses on deposits in this period, since, except during occasional crises, they were relatively small.

The decline in interest rates beginning in the mid-1870's seems to explain part of the rise in the currency ratio from 1875 to 1878 (see Fig. 1). If we accept the estimate of 30 per cent for the size of this decline, an interest elasticity of $-\frac{1}{5}$ implies a 6 per cent rise in the currency ratio, which is about half its actual rise from 1875 to 1878. Part of the other half may be attributed to the aftereffects of the 1873 panic, which undoubtedly led to increased losses on deposits and temporarily made currency much safer to hold.[40] Consequently, I ignored half to three-fourths of this rise in calculating the long-run trend of the ratio.

[40] Suspensions of state (though not of national) banks rose moderately in 1873–76 and sharply in 1877–78. The annual number of suspensions in the latter two years was three times greater than in the years immediately following (see *Historical Statistics* [ser. N135–138]).

Passage of the Bland-Allison Silver-Coinage Act in February, 1878, might have created fears of inflation and of the failure of resumption scheduled for 1879. If it had, the public might have substituted gold coin for other money, thus raising the currency ratio. Gold coin in the hands of the public rose by roughly $20 million from 1878 to 1879, but this is too little to help in explaining much of the rise in the currency ratio.

The apparent decline in interest rates from 1889 to 1900 and the subsequent rise thereafter until 1916 appear to be quite small, and consequently the effect of these changes is difficult to judge. Assuming that the previous estimate of their size (15–20 per cent) is correct and applying an elasticity of one-fifth, we get, at most, a rise and fall of 4 per cent (or about half of a *percentage point*) in the currency ratio. Such variations would partly explain why the rate of decline in the ratio in the fifteen years following 1900 was more rapid than before. But the amplitude of these variations is too small and the evidence is too slim to warrant any firm conclusions.

Taking the period from 1875 to 1919 as a whole and neglecting deviations from trend, we can calculate whether the growth in expected real income per capita can account for the average decline in the ratio of 2.6 to 2.7 per cent per year, since interest-rate changes apparently cannot. The expected income series rises, on the average, about 2.0 per cent per year (compounded continuously) during this period. The two trends thus imply an income elasticity for the currency ratio between -1.3 and -1.4. Since the elasticity computed from the regression for the later period was -1.16 with a standard error of 0.21, the two elasticities are well within the range to be expected from random variation in the estimates. The effect of growth in income alone, therefore, as judged by its size in the later period, was sufficient to have caused the observed long-run decline in the currency ratio in the early period.[41] This effect, as noted earlier, probably incorporates any effects of a shift in the distribution of income.

This comparison of trends leaves open the possibility that a small part of the long-run decline in the ratio may have been due to other factors. Random variations may have made the regression coefficient of the real-income variable too large. In addition, as noted in the last section, this variable may account for less of the decline in the currency ratio since World War II than was attributed to it and so have a lower true coefficient than is indicated by the regression. If so, changes in real income cannot account for the entire decline in the currency ratio in the early period. Urbanization

[41] There is one piece of evidence on interest rates that suggests somewhat different conclusions. In 1870 the comptroller of the currency made a survey of the interest payments of all national banks. His findings imply that the average rate of interest paid on all deposits of these banks was 1 per cent per annum. The average rate paid in the 1920's by member banks was about 2.25 per cent. There is no indication that national or member banks had much different rates in the preceding decade. On the basis of this evidence the rate rose from 1870 to World War I by one and a quarter times.

There are several reasons for questioning the relevance of this rise for present purposes. The comptroller gave no details on his survey, so that its accuracy and even the exact definition of the data he reported are unknown. Furthermore, it is conceivable that banks gave services in those days (made non-pecuniary interest payments) that are no longer offered (it is difficult to form an accurate picture of banking practices so many years ago). Finally, a rate of 1 per cent for national banks is so far out of line with the rates paid by mutual savings banks in New York State and Massachusetts at the same time, as judged by the differential in later periods, that one feels compelled to question its comparability with the later data.

Let us nonetheless suppose that it is correct. The residual effect of real income can be readily calculated: With an elasticity of one-fifth, a rise in the interest rate from 1 to 2.25 per cent would account for 25 per cent of the decline in the currency ratio up to World War I. Since the downward slope in the ratio was 2.6–2.7 per cent per year and since 25 per cent of this may have been due to the interest-rate rise, about a 2.0 per cent per year decline can be attributed to real income. Real income rose at a rate of 2.0 per cent per year, so that the elasticity of its effect on the ratio might have been only -1.0 instead of -1.3 to -1.4, as reported in the text. This is much closer to the estimate of the elasticity for the period 1919–55 and gives stronger evidence that the entire decline in the ratio up to World War I can be attributed to the growth in real income.

whose effects were found to be minor but probably not negligible, may therefore account for a small part of the decline in the ratio. Possibly, too, a slight growth of banking in excess of the long-run effects of rising real income resulted in part from a gradual adoption of checking facilities until 1900 or later, for a variety of reasons connected with the nation's commercial growth and geographical expansion.[42] This is the usual explanation given in historical discussions of banking. While it cannot be tested, it seems plausible enough. But it appears to be far less important than many have thought.

This conclusion is not invalidated by the objection that the effects of general growth factors were included in the effect ascribed to the rise in real income. The size of the effect of a rise in real income was estimated from data for the later period, by which time the importance of other aspects of growth had certainly diminished greatly. The income effect was nevertheless large enough to account for substantially all the decline in the currency ratio in the early period, when the other factors contributing to the growth of banking were, from all indications, the strongest.

V. SUMMARY

The ratio of currency to the total money supply has fluctuated considerably since 1875, and no one variable can account for all its movements. While many variables could affect the currency ratio, only three seem to have played a major role. In terms of the usual demand analysis, a price and an income variable —the expected net rate of interest paid on deposits and expected real income per capita—have been major determinants of the demand for currency relative to deposits. These two variables cannot explain exceptional wartime increases in the currency ratio, however, and various other possible causes of these increases were considered. Only attempts to conceal income payments in order to evade high tax rates seem capable of creating enough additional demand for currency to account for the wartime increases. This finding, however, rests on indirect evidence and is tentative.

For the period 1919–55 a multiple regression of the currency ratio on the expected net rate of interest on deposits, expected real income per capita, and income taxes as a percentage of personal income yielded estimates of the elasticity of demand for currency with respect to these three variables. These estimates were found to be consistent with the data for the period from 1875 to World War I. In this period the rise in expected real income per capita accounted for most or all of a steady decline in the currency ratio.

The analysis can be summarized by hazarding a prediction of the probable future course of the currency ratio. Assuming no change of consumer habits in the use of currency, we may expect the ratio to decline proportionately with the growth in real income per capita. Any increase in the interest rate paid on deposits or any reduction in the personal income tax would hasten the decline. Thus, with no change in reserve requirements, commercial banks can look forward to a long-run expansion of their deposit liabilities in excess of the growth in Federal

[42] These perhaps include a growing familiarity with banking (related partly, no doubt, to the increase in white-collar employment) and an increasing fraction of total payments made through the mails between persons in separate parts of the country.

These factors pertain to the demand side. I know of no factors on the supply side that would produce a gradual growth of banking; presumably at any point in the nation's development, except perhaps for short periods of adjustment, the public could have had as many banking facilities as it was willing to pay for.

Reserve credit and Treasury currency. This expansion will reflect a decline in the currency ratio like that which occurred until 1930 and was subsequently interrupted, first by a fall in net interest rates paid on deposits during the depression and then by an increase in the personal income tax during World War II. Whether this decline in the ratio will continue much further or whether there is some level considerably above zero that marks the minimum extent to which deposits can be substituted for currency, the future course of the ratio will tell.

APPENDIX

Data and Sources

1. Ratio of currency to the total money supply

The annual figures shown in Figure 1 are for August, 1875–81, and June, 1882–1955. It would have been appropriate to use an annual average of monthly ratios for the multiple correlation reported in the text, since all the other variables refer to full years. However, such an average would have differed little from these mid-year ratios.

The numerator of the ratio is total currency outside banks and the Treasury. The denominator equals the numerator *plus* time and demand deposits with commercial banks held by the non-banking public. Traveler's checks of banks, which are a form of currency, are included with deposits in the basic data and cannot be separated. They are known to be small in amount, however, and cannot affect the figures appreciably. Deposits with mutual savings banks and the Postal Savings System, which are sometimes included in the money supply, were excluded.[43] In any event, the major movements in the currency ratio are not significantly altered by including them.

[43] For some evidence suggesting that they are not close substitutes for commercial bank deposits and a detailed explanation of the money figures, see Friedman and Schwartz, *op. cit.*

2. Expected net rate of return on deposits

For 1919–55, this series is shown in column 5 of Table A and equals the rate of return on deposits in column 1 *minus* the expected rate of loss on deposits in column 3. Earlier figures are presented in Tables B and C.

The rate of return on deposits is based on the rates of interest paid (*less* any charges received) by member or insured commercial banks on time and demand deposits. Since 1927, separate rates for time and demand deposits can be derived. For each year a weighted average of these rates was taken, using weights based on the distribution of the two kinds of deposits in all commercial banks on June 30. For 1919–26 no breakdown of rates on time and demand deposits is available, and an average rate paid by member banks on all deposits was used. The member-bank

TABLE A

DETERMINANTS OF THE CURRENCY RATIO, 1919–55

YEAR	INTEREST ON DEPOSITS	LOSSES ON DEPOSITS*			EXPECTED NET RETURN	EXPECTED REAL ANNUAL INCOME PER CAPITA (DOLLARS OF 1929 VALUE)	PERCENTAGE OF PERSONAL INCOME TAXED
		Actual	Exponential Average†	Linear Average†			
		Per Year as a Percentage of Deposits					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1919	2.06	0.02	0.02	0.02	2.04	561	2.25
1920	2.10	0.06	.04	.03	2.06	564	1.87
1921	2.23	0.18	.08	.08	2.15	553	1.60
1922	2.26	0.11	.09	.10	2.17	557	1.75
1923	2.24	0.16	.11	.13	2.13	584	1.20
1924	2.25	0.19	.14	.16	2.11	602	1.23
1925	2.22	0.14	.14	.16	2.08	618	1.23
1926	2.23	0.18	.15	.16	2.08	642	1.26
1927	2.24	0.13	.15	.16	2.09	657	1.20
1928	2.31	0.09	.13	.13	2.18	668	1.28
1929	2.30	0.15	.14	.13	2.16	688	1.61
1930	2.26	0.48	.25	.25	2.01	672	1.56
1931	1.92	0.88	.46	.47	1.46	643	0.98
1932	1.73	0.46	.46	.51	1.27	588	0.77
1933	1.23	1.62	0.84	0.91	0.39	545	0.94
1934	0.95	....	....	....	0.95	531	1.01
1935	0.68	....	....	....	0.68	548	1.16
1936	0.51	....	....	....	0.51	583	1.32
1937	0.47	....	....	....	0.47	624	2.06
1938	0.44	....	....	....	0.44	632	2.12
1939	0.36	....	....	....	0.36	653	1.47
1940	0.28	....	....	....	0.28	687	1.61
1941	0.21	....	....	....	0.21	737	1.95
1942	0.16	....	....	....	0.16	774	3.52
1943	0.09	....	....	....	0.09	803	10.7
1944	0.10	....	....	....	0.10	828	10.6
1945	0.13	....	....	....	0.13	852	11.8
1946	0.14	....	....	....	0.14	873	10.3
1947	0.14	....	....	....	0.14	875	11.0
1948	0.13	....	....	....	0.13	880	9.77
1949	0.12	....	....	....	0.12	866	8.93
1950	0.12	....	....	....	0.12	893	8.78
1951	0.13	....	....	....	0.13	914	11.0
1952	0.16	....	....	....	0.16	927	12.3
1953	0.19	....	....	....	0.19	942	12.2
1954	0.21	....	....	....	0.21	945	11.2
1955	0.22	....	....	....	0.22	970	11.3

* Negligible after 1933. In computing cols. 3 and 4, the following percentage rates of loss were used for earlier periods:1915–18, 0.02; 1901–14, 0.05.

† Assumed to be zero after 1933.

rate is slightly below the rate derived for all commercial banks, primarily because time deposits, which pay higher rates than demand deposits, are more important relative to demand deposits in non-member than in member banks. The figures for 1919–26 were therefore raised by 0.19 percentage points, which is the average difference between the two series for 1927–30.

The various rates of interest used were found by dividing the appropriate average quantity of deposits into the amount of interest payments (*less* service charges) as reported in aggregate earnings statements. For 1942–55 earnings statements are available for all insured commercial banks.[44] For 1934–41 these banks did not report service charges on demand deposits as a separate item but did show interest paid on time deposits. For the other rates, statements of all

[44] *Annual Report of the Federal Deposit Insurance Corporation.*

member banks were used[45] to derive rates on demand deposits, 1927–41; on time deposits, 1927–33; and, as already noted, on all deposits combined, 1919–26. Member-bank rates for demand and time deposits before 1942 were adjusted to the level of the corresponding later rates covering all insured commercial banks, using the difference between overlapping segments. This adjustment was similar to the adjustment for 1919–26 described in the preceding paragraph. The adjustment was small, indicating that the average rates for member banks were not altered much by including nonmember insured banks. The adjustment was nonetheless necessary to prevent a break where the two segments of the series were joined.

The denominator used for the rates was a weighted average of June and adjacent December figures for deposits; it was selected to correspond to the quantity on which interest was paid or service charges were imposed. For time deposits, this quantity was the total amount outstanding. For demand deposits, this quantity was individual demand deposits since mid-1933 (when interest on United States government deposits was discontinued), individual plus United States government demand deposits for 1927 to mid-1933, and all demand deposits for 1919–26. Interest paid on interbank demand deposits was reported separately after 1926 and was excluded from the numerator of the ratio for all later years. Cashier's and officer's checks were excluded from demand deposits in these computations, on the presumption that fees from these services are combined with other items in the earnings statement. There are no figures for estimating the average fee received per dollar of such checks outstanding, and this item was neglected altogether. It is not clear whether or not most of these checks act as a substitute for currency in much the same way as demand deposits do and whether, for our purposes, fees for them should be counted as a charge on deposits. Since the quantity of these checks is relatively small, fees for them, however treated, would have negligible effects.

The expected rate of loss on deposits is a weighted average of past rates of loss. The two alternative weighted averages shown in Table A give substantially the same results. The one in column 3 was used to derive the expected net rate of return shown in column 5. The series in column 3 is based on exponential weights. As explained in the text, these are the same weights as those used elsewhere to derive expected income from actual income. The alternative series in column 4 is based on the arbitrary assumption that expected losses are determined by actual average losses over the preceding five years; the weights of the years decline by an equal amount each year going backward in time. In comparison, the exponential pattern puts only 87 per cent of its weight on the first five years. Both weighted averages are dated as of the end of each year but were assumed to apply to the entire year. It was further assumed that *expected* losses immediately fell to zero after 1933 because deposit insurance was instituted on January 1, 1934.

These estimates of expected losses are not the best that can possibly be derived, whatever the criterion proposed. However, it seems appropriate to take account of past events in these estimates, and the preceding methods of doing so, which give almost identical results, are simple and reasonable. Thus both methods should give a much closer approximation to expected losses than the use of annual losses themselves without any weighting of past values.

The data on actual losses borne by commercial bank depositors were based on FDIC estimates.[46] The FDIC also publishes average deposits for the appropriate periods.

[45] *Banking and Monetary Statistics*, pp. 262–63; and *Federal Reserve Bulletin*. Before 1933 these statements do not give charges on demand accounts separately, and gross payments on these accounts therefore had to be used, but it can be presumed that such charges were relatively small. In any event, any service charges before 1933 could be imposed simply by paying a lower rate of interest and presumably were.

[46] *Annual Report* (1940), pp. 66 and 69.

rom which losses per dollar of deposits can e computed. These estimates of losses exlude all amounts eventually recovered by lepositors. Actual losses after 1933 were negigible, owing partly to the institution of leposit insurance.

The published estimates of losses cover ndividual years since 1920 and certain overapping segments of the preceding years. Only an average rate is given for the periods

TABLE B

RATE OF INTEREST PAID BY COMMERCIAL BANKS FOR VARIOUS YEARS, 1889–1912*

(Per Cent per Year)

Year	National Banks	Non-national Banks
1889.....	3.6	4.0
1894.....	3.5	3.9
1899.....	2.8	3.4
1910.....	3.7†	3.9‡
1911.....	...§	3.2‖
1912.....	3.0	...§

* Unless otherwise indicated, rates are for "other" deposits (presumably only time deposits, though possibly also including some or all demand deposits) as opposed to "savings" deposits. The distinction refers to the period of notice required for withdrawals. However, there is little difference between rates on time and savings deposits in years when both are reported separately by commercial banks.

† For time deposits only. The rate reported for demand deposits is 2.4 per cent.

‡ For time deposits of state commercial banks only. The rate reported for demand deposits is 2.6 per cent. For private banks, the reported rates are 3.9 per cent for time deposits and 2.9 per cent for demand deposits.

§ Not available.

‖ For state commercial banks only. The reported rate for private banks is 3.8 per cent.

1915–19 and 1901–20. In the weighted average of loss rates, the average rate for 1915–19 was assumed to apply to each of the years it covers. A rate was estimated for 1920 by interpolating between rates for adjacent years on the basis of the number of bank failures.[47] The rate so derived for 1920 and the published rate for 1915–19 were used to compute a figure for total losses for 1915–20. This in turn was deducted from the total given for 1901–20 to derive an average rate for 1901–14 that was used for each year of the period. The derived series of rates is shown in column 2 of Table A. Of course, the rates applied to individual years before 1920 are only approximate, but they are quite satisfactory for deriving the weighted averages because the weighting patterns attach less importance to rates more distant in time and thereby reduce considerably the effects of any errors in the earlier rates.

Tables B and C list the comparable rates readily available on interest payments before 1919.[48] The rates in Table B, which cover commercial banks, were taken from the *Annual Report of the Comptroller of the Currency*. The rates before 1900 come from a survey made by the comptroller in 1899 for selected years back to 1889.[49] All rates in Table B are for deposits not payable on demand, so far as their classification can be determined. However, the type of deposits covered by the data for 1889–99 and for 1912 is not specified, and they may be an average that includes some or all demand deposits as well.

In the 1870 *Annual Report* (p. xii) the comptroller gives figures on interest paid by all national banks for the year. From this an average rate of 1 per cent paid on all deposits with these banks can be derived, as reported in note 41. This is much lower than the rates in Table C for later years, presumably because it covers demand as well as other deposits, while those in the table apparently cover time and savings deposits only. Because of this and other possible incomparabilities, the 1870 rate was excluded from the table.

With this one exception, there are data only for mutual savings banks for the years

[47] *Banking and Monetary Statistics*, p. 283.

[48] Available figures covering state commercial banks in Kansas beginning with 1902 are not shown (see "Trends in Rates of Bank Earnings and Expenses," *Federal Reserve Bulletin* [1938], pp. 102–26, Appendix Table XII). These data point to a doubling in the interest rate on deposits from 1902 to 1914. This rise is much larger than that indicated by the rates for 1899 and 1912 in Table B and would largely explain a rate of decline in the currency ratio during that period more rapid than that indicated by the logarithmic trend line fitted to the whole period since 1875. It would be hazardous to draw any conclusions from these data, however, because of their limited coverage.

[49] *Annual Report* (1899), I, xxvii.

before 1889. These are shown in Table C beginning with 1870 and extended, in order to give comparable figures for a long period, through 1916. Several states have reports of mutual savings banks covering years before 1889, but only for New York and Massachusetts are the relevant data aggregated.[50] The rates in Table C are based on these data. The rates shown for the years 1889 and 1894–1916 cover all reporting mutual savings banks in the United States (including reporting stock savings banks before 1909) and are from the comptroller's *Annual Report.*

The available data on rates paid by commercial banks indicate a decline of one-sixth from 1889 to 1899; after that they are unclear. While the rates appear to be high in 1910, they are down to 1899 levels in 1911–12; such short-term movements obscure the trend of the rates from 1899 to 1912. The series for mutual savings banks indicate a sharp decline in interest rates paid, starting about 1875 and ending about 1880, and a slight further decline from 1889 to 1900 that was retraced by 1916. The decline from 1875 to 1880 was about 30 per cent.

The behavior of short-term commercial interest rates tends to confirm the movements in rates paid by mutual savings banks. After 1874 commercial rates fluctuated widely but do not exhibit the well-known long-run movements shown by bond yields. The trend of commercial rates is roughly horizontal from 1876 to 1891, slightly downward from 1891 to 1899, upward from 1899 to 1907, and downward again from 1907 to 1915.[51] These movements are similar to those in payments by mutual savings banks, except for the last segment, and even this could perhaps be interpreted a having a horizontal trend with large cyclica dips in 1908 and 1915.

The unanimity of the evidence on short term rates for the early period suggests tha

TABLE C

RATE OF INTEREST PAID BY MUTUAL SAVINGS BANKS, 1870–89 AND 1894–1916

(Per Cent per Year)

Year	New York State*	Massachusetts†	Year	United States‡
1870	5.5	§§	1889	4.0
1871	5.4	§§		
1872	5.7	§§	1894	3.7
1873	5.5	§§	1895	4.0
1874	5.4	§§	1896	4.0
1875	5.2	6.2	1897	3.7
1876	4.7	5.7	1898	4.0
1877	4.3	5.0	1899	3.4
1878	4.4	4.1	1900	3.5
1879	4.1	3.7	1901	3.5
1880	3.7	3.9	1902	3.5
1881	3.5	4.0	1903	3.5
1882	3.5	4.0	1904	3.5
1883	3.5	4.1	1905	3.6
1884	3.4	4.2	1906	3.5
1885	3.4	4.1	1907	3.6
1886	3.4	4.1	1908	3.6
1887	3.4	4.1	1909	3.8
1888	3.4	4.1	1910	3.9
1889	3.4	4.1	1911	4.0
			1912	3.9
			1913	3.9
			1914	3.9
			1915	3.8
			1916	4.0

* Interest paid during the calendar year divided by an average of deposits at the beginning and the end of the year. This series can be extended beyond 1889 and back to 1860. Between 1860 and 1869 the rates varied from 4.4 per cent in 1861 to 5.7 per cent in 1869.

† Reported average dividend on deposits for year ending October 31. This series can be extended beyond 1889. The only rate reported for years before 1875 is one of 4.8 per cent for 1865 (see *Report of the Superintendent*, [1876], p. 371). For a summary of data for 1892 to 1906 see the report for 1906, I, viii.

‡ Rates through 1908 are those of reporting mutual and stock savings banks and thereafter of mutual savings banks only.

§ Not available.

‖ Indicated in source to be slightly too high.

interest rates on commercial bank deposits followed the same general movements though certainly with much less amplitude A comparison of interest rates on deposits in mutual savings banks and in commercial banks since 1919 indicates that, although short-run variations in the two rates are likely to differ, the large variations reflecting long-run movements appear to correspond This agreement is reasonable, since interest

[50] See New York State, *Report of the Superintendent of the Banking Department Relative to Savings Banks and Trust Companies* (1891), pp. 10 and 11; and Massachusetts, *Annual Report of the Board of Commissioners of Savings Banks* (1876), and subsequent volumes.

[51] See Frederick R. Macaulay, *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States since 1865* (National Bureau of Economic Research, 1938), Chart 20, p. 217.

ayments depend on the return from earn-
ıg assets, all of which in the long run have
ields that move roughly together. It seems
afe, therefore, to assume that the decline
:om 1875 to 1880 and the following small
ecline and rise in interest paid by mutual
avings banks correspond to similar move-
ıents in interest paid by commercial banks.

3. EXPECTED REAL INCOME PER CAPITA

This series, shown in column 6 of Table A
or 1919–55, is an exponentially weighted
verage of annual figures for real net na-
ional product in 1929 prices,[52] divided by
he mid-year population residing in con-
inental United States. The movements in
ıet national product do not differ appre-
iably from those in national income except
luring wartime, and for these years the
›riginal series was replaced by an extrapola-
ion of its prewar trend. The series for net
ıational product, therefore, can be used to
epresent national income with sufficient ac-
:uracy for present purposes. No other esti-
nate of expected real income of this kind
:overing the entire period 1919–55 was
ıvailable when the regression reported in the
ext was computed, and it seemed unneces-
sary to compute one specially for this study.

The weighting pattern used was the same
ıs that developed elsewhere, as explained in
the text, except that no adjustment was
nade for an expected upward trend. As a
esult, the series is slightly lower than it
would be if adjusted for expected trend.
However, this downward bias has no effect
›n relative changes in the series and, there-
fore, on the regression coefficients.

References in the text to the trend of ex-
›ected real income per capita before 1919
refer to the trend of the series on expected
real income described above *minus* the
trend of population in continental United
States as reported in decennial censuses.

4. PERCENTAGE OF PERSONAL INCOME TAXED

This series, shown in column 7 of Table A
for 1919–55, is the ratio of personal income
taxes to personal income for each calendar
year.

The numerator is the sum of federal, state, and local income taxes. For 1929–55, Department of Commerce figures were used. These figures include the amount of refunds, which, although small, should, but cannot, be excluded. For 1925–28, collections of federal income taxes[53] for calendar years were used. Before 1925 these collections were reported together with those from corporate income taxes and could not be separated. Hence federal personal income tax liabilities[54] were used, instead, for 1919–24. For the years after 1924, actual collections generally exceeded these liabilities. For 1919–24, therefore, the liabilities were increased by 18 per cent to give a corrected estimate of collections; this percentage is the relative amount by which collections exceeded liabilities in 1925. Earlier figures used for the state and local income tax were collections as compiled for 1925–31 by Roy G. Blakey[55] and as estimated for 1919–24 by C. Harry Kahn.[56]

Department of Commerce estimates of total personal income were used in the denominator of the ratio. For 1929–55 they are official estimates published in the *National Income Supplement* to the *Survey of Current Business;* before that, they are unofficial estimates.[57] These earlier estimates differ conceptually from the later ones and for that reason are too low; they were raised by the relative amount of their understatement in 1929 (3.8 per cent).

From the same sources the ratio can be extended to earlier years. (State and local income taxes are unavailable before 1919 but are small and can be neglected.) For 1919, the ratio was 2.26 per cent; for 1917, 1.80 per

[52] Described and used by Friedman and Schwartz, *op. cit.*

[53] *Annual Report of the Secretary of the Treasury.*

[54] Bureau of Internal Revenue, *Statistics of Income.*

[55] See his *The State Income Tax* (Minneapolis: University of Minnesota Press, 1932), p. 65.

[56] In connection with a study of the National Bureau of Economic Research, as yet unpublished.

[57] Published by the National Industrial Conference Board in its *Economic Almanac* (1956), p. 443.

cent; and for 1916 back to 1913, the ratio was well below one-fourth of 1 per cent. The income tax amendment was passed in 1913, providing this source of federal revenue for the first time since the Civil War period.

5. VOLUME OF TRAVEL PER CAPITA

This series, shown in Table D for 1921–51, shows miles of intercity travel divided by the mid-year population residing in continental United States. Miles of intercity travel were compiled from several sources. While the figures are subject to considerable error, they probably give an accurate picture of the year-to-year direction of change in miles traveled. In the period covered, the series increases in every year except 1932–33, 1938, 1942–43, and 1947.

Beginning with 1937, estimates of the total volume of intercity passenger traffic from the *Annual Report of the Interstate Commerce Commission* were used with slight modification. In 1952 their coverage was substantially broadened. These recent figures are not shown, since they are not comparable with the earlier data. For the years shown in Table D, the figures are reasonably comparable and cover all forms of intercity travel: electric and steam railways, inland waterways, airways, buses, and automobiles. All the data except those for automobile travel were reported by the companies operating the facilities and cover their respective sectors with a fair degree of accuracy. "Intercity traffic" includes some commutation, most of which falls outside the meaning of travel as used in this study. The overstatement on this account may be appreciable, but it seems unlikely that the series grossly misrepresents the time pattern of travel. Some of this overstatement was eliminated by substituting for the series used by the ICC another series giving non-commutation traffic on Class I steam railways.[58] This substitution leaves the total series understated by the amount of intercity non-commutation traffic on electric railways, which is probably small, and overstated by commutation traffic of intercity bus lines and autc mobiles, the second of which is conceivabl quite large. In general, the ICC figures use to estimate travel, except for automobile are fairly representative of major move ments. These figures were extended back t 1921 with little loss in coverage or accu racy.[59]

However, the accuracy of these figure has little effect on that of the total travel se ries: automobile travel has been more tha 80 per cent of the total since 1928 and wa

TABLE D

ESTIMATED VOLUME OF INTERCITY TRAVEL PER CAPITA, 1921–51

(Miles per Year)

Year	Volume	Year	Volum
1921	670	1937	1,90
1922	730	1938	1,86
1923	860	1939	1,96
1924	980	1940	2,08
1925	1,080	1941	2,30
1926	1,220	1942	2,04
1927	1,280	1943	1,94
1928	1,340	1944	2,05
1929	1,490	1945	2,25
1930	1,520	1946	2,47
1931	1,560	1947	2,40
1932	1,430	1948	2,42
1933	1,420	1949	2,54
1934	1,540	1950	2,61
1935	1,620	1951	2,89
1936	1,760		

more than 50 per cent even in 1921. The figures on automobile travel are subject to substantial error, especially for the earlier years. Yet they are probably more reliable than one might expect them to be, knowing nothing of their derivation. After 1935 they are based on broad sample surveys conducted by the Public Roads Administration. Data for earlier years, also compiled by this

[58] From annual volumes of Interstate Commerce Commission, *Statistics of Railways*.

[59] Sources for the basic data are as follows: Non-commutation travel on Class I railways, previously cited, is available since 1922. For 1921, an estimate was made based on total railway travel (*Historical Statistics* [ser. K-41]). Travel on inland waterways before 1937 was negligible and was neglected. For air travel, domestic miles flown by revenue passengers (*Historical Statistics* [ser. K-254]) were used for 1930–36 and were assumed to be zero before 1930. For intercity bus travel, estimates were made from figures published in the magazine *Bus Transportation*.

ency, are published in *Historical Statistics* thout any explanation of their derivation. owever, they closely follow and presumly are based on the consumption of motor el. The figures on fuel consumption are deed from fuel-tax revenues. Fuel consumption multiplied by miles driven per gallon ves an estimate of total vehicle-miles. Fornately for our present purposes, though fortunately for automobile users, this ultiplier is known not to have changed uch over the years. Thus using the same timate of miles per gallon throughout the riod introduces little error.

Difficulties arise, however, when total ssenger vehicle-miles are divided into urn and rural travel and when the resulting gure for rural travel is enlarged by a factor presenting the average number of passngers per vehicle to give total rural passenger-miles. "Rural" here means "on rural roads" and undoubtedly refers to much more than non-commutation travel, but there is no way to improve the derivation of these figures, and rural travel was used as the closest available approximation. The conversion of total vehicle miles into rural passenger-miles is based on various surveys, some of which were first conducted only after 1941. In extending the series, trends indicated by these surveys were extrapolated back to 1921. This procedure is subject to considerable error, but these trends probably maintained a fair degree of year-to-year stability and could not, under any ordinary circumstances, have varied very much from the estimated levels.[60]

[60] The basic data on automobile travel were taken from *Historical Statistics* (ser. K-236 and K-236*a*) and Public Roads Administration, *Highway Statistics—Summary to 1945* (1947), p. 34.