What Was the Interest Rate Then? A Data Study

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"Whither must we go for a record of the 'rate of interest'?"—
(MacDonald, 1912, p. 361)

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I. Methodology

A. Objective

This study provides a complete description of the development of the interest-rate series in **What Was the Interest Rate Then?** The objective of the project was to generate interest-rate series for the United States and United Kingdom with specified properties, as follows:

1. The series are to end in 2001 and go back in time as far as data permit.

2. The series are to be continuous.

3. The series are to be annual in frequency.

4. The series are to be expressed, as is conventional, in percent per year and with two decimal places.

5. For a given interest-rate concept, the series should be symmetrical across the two countries, at least in a methodological sense.

6. Three interest-rate concepts are pursued: short-term interest rate for ordinary funds, short-term interest rate for surplus funds, and long-term interest rate.

Two of the concepts are short-term in nature, related to the money market. Pertinent features of the money market are gleaned from the following passage in Wilson (1992, pp. 797-798).

> A money market may be defined as a centre in which financial institutions congregate for the purpose of dealing impersonally in monetary assets.... From the point of view of the commercial banks it should be able to provide an investment outlet for any temporarily surplus funds that may be available....For a money market of some kind to exist, there must be a supply of temporarily idle cash that is seeking short-term investment in an earning asset. There must also be a demand for temporarily available cash either by banks (and other financial institutions)...or by the government.

In a similar vein, Lewis (1992, p. 271) defines the money market as "a network of brokers, dealers and financial institutions which transact in short-term credit, enabling large sums of money to be channelled quickly from suppliers of funds to those demanding funds for use over relatively short periods of time." Also, Haubrich (1992, p. 798) writes: "The modern wholesale money market brings together the many larger borrowers and lenders who manage short-term positions."

The important conclusion is that the money market involves transactions in short-term assets. In practice, the maturity of the asset or contractual arrangement runs to a

maximum of one year and can be as little as half a day. A second feature of the money market, emphasized by Wilson, is its geographical concentration, which remains true even in today's electronic environment. In particular, for the present study, the chief money markets are London, for the United Kingdom, and New York, for the United States. A third characteristic, as Wilson and others note, is impersonality. Transactions do not depend on personal characteristics, whether of the buyer or the seller. The buyer of a money-market asset does not care who is the seller, and vice-versa. This is the harbinger of an "open market."

A fourth characteristic—an *ideal* property—of a money market is competitiveness. The London and New York money markets are (and historically have been) competitive markets in respect of *private* transactions; but central-bank intervention can influence a money-market rate. The central bank acting alone affects price via its transactions with commercial banks and other parties in the private sector. Indeed, central banks traditionally set their own money-market rates (examples: Bank Rate of the Bank of England, discount rates of the Federal Reserve banks, federal-funds target rate of the Fed). These rates have a profound effect on the *market* rates of the money market; and it is the market rates—not the central-bank rates—on which this study is focused.

Two interest-rate concepts, then, emanate from the money market. The first concept pertains to the market for "ordinary funds;" the second to the market for "surplus funds." While both concepts refer to the short-term investment (or, on the other side, short-term lending) typical of the money market, the one operates under the ordinary course of business while the other involves the temporary acquisition or relinquishment of funds to satisfy a shortage (for liquidity or reserve purpose) or to obtain profitable use of a surplus (such as excess reserves of a commercial bank). A hallmark of the market for surplus funds is that transactions are readily and quickly reversible, either directly (the lender recalling the loan or the borrower initiating repayment) or indirectly (the lender or borrower engaging in a corresponding opposite transaction with a third party).

The third interest-rate concept is long-term in nature. Decidedly, this is not a money-market concept at all, but rather pertains to the bond market, indeed, the long-term bond market. The asset here has maturity much longer than the one-year limit of money-market instruments. The interest rate of concern is unambiguously market-determined in nature, as central banks do not have their own long-term interest rates—there is no long-term analogue to Bank Rate or Fed discount rates, for example.

B. Representativeness of Series

The operational manifestation of a given interest-rate concept is the corresponding interest-rate series. It is desired that this series be "representative," and such representativeness has three manifestations: (1) over a year, (2) across interest rates at a given point in time, and (3) over time, given a change in the selection of the interest-rate series.

1. Over a Year

The year is the adopted time unit of the study; but there remains the decision as to whether the interest rates should be recorded at a point in time (for example, mid-year or year-end) or as an annual average. Capie and Webber (1985, p. 305), in their pathbreaking work, argue that end-of-period (for their study, month-end) figures are indicated, for two reasons. First, it is the more-appropriate measure for calculating interest-rate differentials. Second, it corresponds to the timing of their monetary-aggregate series. Heim and Mirowski (1987, p. 119) have a similar view. They present an annual interest-rate series deliberately for one date (the first Wednesday of April) for each year. They reject a series obtained via a "smoothing procedure" (presumably including averaging) of the original data, because the "statistical properties" of the series are thereby affected.

However, most compilers of historical interest-rate series adopt an average over the selected time unit, for the obvious reason (so obvious, that it is rarely stated explicitly) that representativeness over the time unit is thereby enhanced.[1] The monumental works of Homer and Sylla (1991) and Macaualy (1938) are examples. The present study follows this practice. Carried to its logical extent, the average should be for the smallest time unit for which data are available, evenly spaced over the time unit (year, in the present study). For example, an average of weekly (say, week-end) figures is superior to an average of monthly (say, month-end) figures—and an average of daily rates even better.

2. Across Interest Rates

The criterion for the selection of the interest-rate series for a given period differs for the short-term and long-term concepts. For the short-term concepts, the criterion is market dominance. The most important asset, in a quantitative sense, provides the interest rate. Naturally, the asset for "ordinary funds" differs from that for "surplus funds." That asset (given either the ordinary or surplus-funds concept) is unique; its single interest rate, rather than an average of interest rates over several money-market instruments, is selected.

For the long-term concept, there are several complementary criteria that a series must satisfy. Two clear criteria that a series must fulfill to measure the long-term interest rate are (i) sufficiently long term to maturity and (ii) minimum default risk. Regarding the first criterion, Mitchell and Deane (1962, p. 437) and Mitchell (1988, p. 649) declare that "the [ideal] long-term rate of interest...demands a loan of infinite duration." In practice, an interest rate should not be considered long-term unless it has a sufficiently long term to maturity, say 15 years—and better 20, if data permit. However, it is a matter of judgment whether, in practice, a longer term to maturity is always preferred.

Regarding the second criterion, Mitchell and Deane (1962, p. 437), and Mitchell (1988, p. 649), state that the "theoretical abstraction" that constitutes the long-term interest rate should be "without any risk of default." The rule in practice is provided by

Macaulay (1938, p. 67): " The student of interest rates will tend to be primarily concerned with the yields of the very highest grade bonds rather than with the yields of those of lower grade....Bonds of the highest grade are bonds than which there are none better...in general, those bonds that have the lowest yields." Of course, by definition, the highest-grade bonds have the least risk of default.

The practical implication is that "Yields on the highest-grade obligations—those of governments and the best corporate obligations—represent more nearly than any other series the general level of interest rates."—*Banking and Monetary Statistics, 1914-1941*, p. 428.

Unlike the short-term series, the long-term interest rate could be measured either by the return on a single asset or derived from a set of bond rates (for example, by taking the average) If a single asset is dominant in the long-term bond market, its interest rate is chosen. Absent such an asset, a number of alternative methods of obtaining the representative series from a group of assets can be considered. Three such techniques are employed in the present study.

i. The *average of the interest rates* of the bonds in the chosen group of assets constitutes the selected series. This technique has the twin advantages of ease of computation and direct foundation on actual yields.

ii. A *zero-coupon yield* for a given maturity, say 20 years, is taken as the representative series. Anderson and others (1996, p. 13) state in effect that specialists would adopt this concept for the long-term interest rate: "the zero-coupon yield curve [relating the zero-coupon yield to the time to maturity] is the construct financial economists are usually referring when talking about the term structure of interest rates." Deacon and Derry (1994, p. 233) agree: "The term structure of spot rates, or *zero-coupon yield curve*, is the curve which is usually referred to when talking about the term structure of interest rates."

The problem is that a zero-coupon bond—one that involves no periodic interest payments but only the one payment upon redemption—is generally only a hypothetical concept. Therefore the yield must be obtained from an estimated "yield curve," and the appropriate method of estimation is by no means unambiguous.[2]

iii. The *par yield* for a given maturity, say 20 years, is selected as the representative series. The par-yield curve is a transformation of the zero-coupon yield curve. Now it is assumed that the bond involves regular coupon payments. For a given maturity, the par yield is the coupon yield that prices the bond at par (face-value).

3. Over Time

What should happen to the interest-rate series for a given concept when there is a change in the selected series, for superior representativeness as circumstances change over time?[3] Two standpoints—contemporary and consistent—are adopted for each

interest-rate concept; correspondingly, two alternative series are developed. From a contemporary standpoint, no adjustment to the values of the previously selected series is made. The *contemporary series* presents the interest rate as it appears to the observer of the moment (or rather, year), that is, to the "contemporary observer." From a consistent standpoint, the values of the previous series might warrant correction to make the total (joint) series uniform over time. The components of the series are re-expressed in terms of the current (most-recent, year-2001) component. From a layperson perspective, the *consistent series* is interpretable as applying to the standpoint of the "present-day" (year-2001) observer. From a scholarly vantage, the consistent series is the one usable for time-series analysis.

The procedure to achieve a consistent series involves three steps as follows.

Step 1: The years of potential breaks in the series are identified. This task is easily performed. Moving backward from the year 2001 (the series end) to the beginning of the series, every year in which there is a change in data source is highlighted.

Step 2: For each break, the annual overlap of the component-series segments is generated over a five-year period (data permitting—otherwise a lesser, but the maximum, period of overlap). A five-year overlap may be justified as a compromise between sufficiently short to incorporate representativeness of both series while sufficiently long to average out peculiar differences in the series. Then the annual basis-point differential of the components is computed.[4] Consider notation:

C_t = value of former ("current") component series in year t, percent per year

S_t = value of more-recent ("subsequent") component series in year t, percent per year

$D_t = 100 \cdot (S_t - C_t)$

b = break year

For a given b, the computation is D_b, D_{b+1}, D_{b+2}, D_{b+3}, D_{b+4}. It should be noted that, in principle (that is, absent any further breaks during the years considered), the *contemporary-standpoint series* has values over years b-m to b+n as follows: $C_{b-m},...,C_{b-1}$, S_b, S_{b+1}, S_{b+2}, S_{b+3}, $S_{b+4},..,S_{b+n}$, where b-m is the earliest (selected) year for which the observation on C is taken and b+n is the latest (selected) year for which the observation on S is taken.

The values of D_b, D_{b+1}, D_{b+2}, D_{b+3}, D_{b+4} determine whether or not there is a "genuine" break in the series. Clearly, judgment is involved. If the values are all "low in magnitude," then there is deemed to be no break. If the values, though not all low in magnitude, nevertheless sum algebraically to a number "close to zero," again there is no break. In other circumstances, there is deemed to be a break, and step 3 is pursued.

Step 3: Compute the annual ratios of the subsequent to the current series, and use the average ratio to link the current to the subsequent series. Let $T_t = S_t/C_t$ and compute ! = mean (T_b, T_{b+1}, T_{b+2}, T_{b+3}, T_{b+4}). The number ! may be called the "linking ratio."[5] Letting $\square_t$ = !·C_t, the *consistent series* has values over years b-m to b+n as follows: $\square_{b-m}$,..., $\square_{b-1}$, S_b, S_{b+1},...,S_{b+n}.[6]

Steps 2 and 3 are applied for each potential break identified in step 1. It may be assumed that, of the constituent series selected for an interest-rate concept, a more-recent series is superior to an earlier series. Then the order in which the breaks are considered is from the more-recent series going backward in time. That procedure has two advantages. First, the more-recent series has the length of its segment maximized relative to the preceding series. Second, information is always available to make the series fully consistent (meaning "year-2001 standpoint") for any break.

C. Order of Presentation

The overall arrangement is: (1) a given interest rate, (2) a specific country, (3) topics as follows: (i) identification of representative market instruments and the subperiods to which they apply (ii) description and/or history of the market instruments, (iii) selection of data series. After (3) is presented for a given interest rate and the specific country, it is redone for the other country. Then (1)-(3) are repeated for the subsequent interest rate.

(1) Interest Rate: The ordering of presentation of the three interest rates is: (a) short-term, ordinary funds, (b) short-term, surplus funds, (c) long-term.

(2) Country: The criterion for which country is to be first considered is that which experienced the earlier development of an asset market to which the interest rate pertains. That asset market typically experiences change over time. Generally, the asset considered for the criterion is that for the first component series. The exception is "short-term, surplus funds," for which the asset pertains to the more-recent component series. Specifically, the United Kingdom is the first country for short-term ordinary funds and long-term, the United States for short-term surplus funds.

(3) Topic (i), Market Instruments for Component Series: The discussion involves going forward in time (the earliest instrument discussed first). Evidence of market dominance (or other reason for inclusion as a component series) is presented for each representative instrument. Then, for each instrument separately, there generally follows a description and always some reference to its history.

Topic (ii), Timing of Changes in Component Series: Breaks in the series that occur pursuant to changes in the underlying asset or market instrument are identified.

Topic (iii), Selection of Data Series: Existing compilations of data series of the return on the component assets or market instruments are presented. As far as knowledge permits, the compilations are comprehensive, with two exceptions. First, series published

by international organizations or by a national government other than the government of the country to which the series pertains are excluded. The reasons are that such series are generally inconsistent over time, or are not well documented, or provide no new data. The only departures from this exception are the U.K.-interest-rate series published by (i) the U.S. National Monetary Commission, in 1910, or (ii) the Board of Governors of the Federal Reserve System, for which the reasons for exclusion do not apply. Also, occasionally an international-organization series, though not formally tabulated with other compilations, is mentioned in the text. Second, isolated data or overly short series are omitted from the table, but are considered in the text if pertinent.

Thus the available data sources to measure the interest rate are explicit. Ideally, ordering by market instrument goes forward in time (earlier instrument considered first), while ordering of the selected series for a given instrument would go backward in time. The reason for the latter ordering is that, as mentioned in section B.3, the more-recent series generally provides superior data and so that series should be extended as far into the past as permitted by data availability.[7] Partial exceptions to these rules are (a) U.K. short-term interest rate, surplus funds, for which characteristics of the data series for the first (earlier) asset component lead to reverse ordering of the data series, (b) U.S. long-term interest rate, for which changing characteristics of U.S. government bonds require an adjusted ordering of the instruments, and (c) U.K. long-term interest rate, for which data problems require amendment to the ordering rule.

Selection of the data series is based on several criteria: data reliability (obviously, higher-quality data are superior), number of significant digits (one decimal place is inferior to two), length of series (longer is preferred), deviation from subsequent series (less deviation is preferred).

II. Short-Term Interest Rate, Ordinary Funds: United Kingdom

A. Market Instruments

1. Representative Market Instruments and Applicable Subperiods

The bill-of-exchange discount rate was representative of the U.K. short-term interest rate for ordinary funds until 1919, when it was succeeded by the interest rate on three-month treasury bills. Qualitative and quantitative evidence supporting that statement follow.

In the London money market, the earliest dominant instrument was the bill of exchange and the corresponding representative interest rate was the bill's discount rate. These facts are universally recognized in the literature. Capie and Webber (1985, p. 310) write: "In the eighteenth and early nineteenth centuries, bills of exchange were widely used to obtain credit, primarily in the financing of domestic trade. Discounting of bills by banks was the major form of bank lending....By the third quarter of the nineteenth century the relative importance of bill finance in internal trade had declined as that of the bank

overdraft grew." Of course, the bank overdraft was not a money-market instrument. The dominance of the bill in the money market continued into the twentieth century (see below).

Homer and Sylla (1991, p. 205) describe British short-term interest rates in the 19th century as "short-term market rates of interest of the sort quoted on prime commercial bills." Calmoris and Hubbard (1996, p. 194) observe that "the money market instrument quoted in English financial newspapers [in 1879-1914] is the prime discount rate on bankers' bills (bankers' acceptances)." In a similar vein, Goodhart (1986, p. 90) declares: "the open-market discount rate...has normally been taken as the leading rate in the money market [for the period 1891-1914]." Pressnell (1956, p. 85) states: "the discount market [for bills of exchange]...in the nineteenth century became the most distinctive and most valuable institutional feature of the London money market."

Replacement of the bill of exchange by the treasury bill in 1919 also is an accepted fact. Moggridge (1972, pp. 34-35) writes:

> Before the war the sterling bill was supreme as a source of international trade finance. On the other hand, the Treasury bill represented the 'small change' of the London market, the total outstanding in 1913 being no more than 1 per cent of the value of commercial bills outstanding. After the war...the value of commercial bills rarely rose far above the pre-war level of £500 million, whereas the value of Treasury bills outside the Government Departments and the Bank of England stood between £425 and £575 million....[A]fter the war...[there occurred] the relative decline of the commercial bill.

Similar statements are made by others. "The great increase in the use of the Treasury bill to finance government borrowing [in the First World War] allowed the discount market to survive by making these its main asset."—Capie and Webber (1985, p. 310). "During the First World War...the market...increased its holdings [of Treasury bills] until they became its main asset."—Anonymous (1967a, p. 144). "By the end of the war the amount of Treasury bills far exceeded that of commercial bills in the portfolios of the discount houses and the banks....Already [by 1921-1925], however, Treasury bills had come to occupy a central place in Britain's monetary arrangements and constituted a main element in the regulation of banking liquidity."—Wadsworth (1973, pp. 146, 145). Brown (1940, pp. 643, 654) notes "in the post-war years...the replacement of the bankers acceptance by the treasury bill...the substitution of the treasury bill for the sterling acceptance."

Balogh (1947, pp. 174, 202) declares that in the financial (April-March) year 1913-1914 average bill circulation was roughly £500 million, of which bankers acceptances constituted £350 million, whereas in July 1914 less than £5_ million of Treasury bills were outstanding. In 1922-1923 (the earliest postwar year for which data are provided), £919 million of Treasury bills were outstanding, compared to £429 of bills of exchange.[8]

2. Descriptions of Market Instruments

a. Bill of Exchange

The bill of exchange is traditionally described as an "order to pay" a specified sum of money at a specified future date. It is essentially a check drawn by one party (the drawer) on another party (the drawee); but the drawee is not necessarily a bank. The drawee could be a bank (whence the instrument is called a "bank bill"), or an individual or firm (yielding a "trade bill"). A "first-class" or "high-class," bank bill indicates that the drawee is a bank of high financial standing; a "best" or "prime" bank bill suggests a bank of the highest standing. Similar adjectives and implication apply to the trade bill. "Acceptance" is the written acknowledgement of the debt (on the bill) by the drawee (now the "acceptor"), upon which the bill becomes an "acceptance."

The acceptance is a negotiable instrument, and can be sold (naturally at a lower price—the discount—than the face-value) to obtain funds prior to maturity. Typically, each seller endorses the bill, which provides additional protection for the purchaser, should the bill not be paid by the acceptor. The amount of discount of a bill or acceptance relative to its face-value, whence the discount rate is calculated, depends on several factors: (1) the quality of the bill, meaning the financial standing of all parties to it, (2) the remaining time to maturity of the bill, and (3) the configuration of market discount rates. The discount rate is lower the higher the quality of the bill, the shorter the time to maturity, and the lower market discount rates. Bank acceptances are generally of higher quality than trade acceptances, with acceptances eligible for rediscount at the Bank of England (acceptances of "eligible" banks) the highest quality of all.[9]

b. Treasury Bill

The Treasury bill, introduced in 1877, was modeled after the bill of exchange. The Treasury bill sells at a discount at weekly tenders (auctions), though it has also been sold at a fixed rate. The usual maturity since 1917 has been three months. As a government security, the Treasury bill is default-free, comparable to (or even better than) prime bank acceptances. The secondary market in Treasury bills is comparable to the discount market for bills of exchange and would provide a "market yield" analogous to the market discount rate for bills; but such yield data are limited.[10] Further, the secondary market became illiquid.[11]

Capie and Webber (1985, pp. 309-310) distinguish three interest rates associated with the Treasury bill. Letting PMAT = price at maturity, PPUR = purchase price, and PMKT = market price, the interest rates are:

allotment rate = 100•(PMAT – PPUR)/PPUR

discount rate = 100•(PMAT – PPUR)/PMAT

yield = 100•(PMAT – PPUR)/PMKT

B. Compilations of Series

1. Bill of Exchange

Existing compilations of series of the London market discount rate on bills of exchange from the earliest date for which a series exists (1800) to the year 1923 are listed and their salient characteristics summarized in Table 1. Although the bill of exchange was succeeded by the Treasury bill as the dominant money-market instrument in 1919 (see section A.1) rather than 1923, the latter is the ending date. The reason is the necessity for a five-year overlap with the Treasury-bill interest-rate series, to compute a consistent series.

Table 1
Compilations of London Market Discount Rate on Bills of Exchange, 1800-1923

Author	Description	Period	Frequency	Observation	Source
I. Overend-Gurney Series					
Report (1857, pp. 463-464)	first-class[a]	1824-1857[b]	monthly, annual	"average rates," average of monthly series[c]	records of Overend and Gurney
Mitchell and Deane (1962, p. 460)[d]	same	1824-1856	annual	average of monthly series[e]	*Report* (1857)
Bigelow (1862, pp. 204-205)	same	1831-1858	monthly	average rates	unstated, but clearly *Report* (1857)
II. National-Monetary-Commission Series and Extensions via *The Economist*					
NMC (1910, pp. 43-62)	6-month, 60-day	1889-1908, 1890[f]-1908	weekly	specific day	*The Economist*
NMC (1910, p. 143)	first-class; 60-day, 90-day, 6-month	1888-1907	annual	"average rates"	prepared by Palgrave
Mitchell (1911, p. 307)	60-day	1890[f]-1908	annual	average of weekly series	NMC (1910)
Mitchell (1913a, pp. 166-167)	60-day	1890[f]-1911	annual	average of weekly series	NMC (1910), *The Economist*
Goodhart (1986, pp. 591-611)	60-day[g]	1891-1914	monthly	average of weekly series	NMC (1910), *The Economist*
III. Palgrave-Williams Series					

Table 1
Compilations of London Market Discount Rate on Bills of Exchange, 1800-1923

Author	Description	Period	Frequency	Observation	Source
Palgrave (1903, p. 33)	high-class[h]	1845-1900	annual	average of monthly observations[i,j]	unstated
Williams (1912, pp. 382, 384)	3-month bank bills	1845-1911	annual	average of monthly observations[i]	Palgrave (1903), *The Economist*
IV. Other Individually Compiled Series					
Silberling (1923, p. 257)	"best bills"	1824-1850	quarterly	average of monthly figures	*Report* (1857), *The Economist*
Peake (1923, pp. 59-62)	3-month, 6-month bank bills	1882-1914	monthly	first Friday	*The Economist*
Paish (1966, p. 26)	3-month	1890-1899	annual	"average"	unstated
Nishimura (1971, pp. 112-128)	3-month bank bills	1855-1913	annual[k]	average of weekly figures[l]	*The Economist*
same	same	1855-1914	monthly	same	same
same	6-month bank bills	1858-1914	monthly	same	same
King (1936, pp. 300, 310, 312)	3-month bank bills	1883-1889, 1890-1913	semi-annual, annual	average (presumably of daily figures)[j,m]	*Bankers' Magazine*
V. Composite Series					
Mitchell and Deane (1962, p. 460)[n]	3-month bank bills	1845-1910, 1911-1923	annual	average of monthly observations[i], averages of monthly averages of daily high and low figures	Williams (1912), *Bankers' Magazine*
Capie and Webber (1985, pp. 494-515)	prime bank bill rate	1870-1923	annual, quarterly; monthly	average of monthly series; month-end	*The Economist*
Sheppard (1971, p. 190)	high-class	1860-1923	annual	see entries for Palgrave and Mitchell-Deane	Palgrave (1903), Mitchell and Deane (1962)

Table 1
Compilations of London Market Discount Rate on Bills of Exchange, 1800-1923

Author	Description	Period	Frequency	Observation	Source
Homer and Sylla (1991, pp. 208-209, 456)	first-class, 3-month[o]	1800-1900	annual	average, low, high	NBER, *Report* (1857), *The Economist*
same	3-month bankers' bills	1900-1923	annual	average, low, high	AAS, *Financial Statistics*
Officer (1996, pp. 70-71)	first class, 3-month bank bills	1824-1878	quarterly	average of monthly series, see text	*Report* (1857), Bigelow (1862), Williams (1912)

[a]Incorporates both 60-day and 90-day bills, with data separate only in October 1855 - May 1856 and in October 1856. Described as [uniformly] three-month bills by Mitchell and Deane (1962, p. 460), and Mitchell (1988, p. 683).

[b]Ending in May. 1824-1856 for annual series.

[c]Annual series expressed as £, s, d per £100.

[d]Reprinted in Mitchell (1988, p. 683).

[e]Expressed conventionally as percent per year.

[f]Beginning May 16.

[g]For 1909-1914, uncertain whether 60-day or 3-month bankers' bills.

[h]Described as three-month bank bills by Williams (1912, p. 380), Mitchell and Deane (1962, p. 460), and Mitchell (1988, p. 683).

[i]One observation per month, "usually...on or near the first of the month" (Williams, 1912, p. 380).

[j]Expressed as £, s, d per £100.

[k]Year ending March 31.

[l]Stated by Capie and Webber (1985, pp. 320-321).

[m]Inferred from Mitchell and Deane (1962, p. 460) or Mitchell (1988, p. 683).

[n]Reprinted in Friedman and Schwartz (1982, pp. 130-132), and Mitchell (1988, p. 683).

[o]Prior to 1855, non-uniform maturity of a few months.

Abbreviations: *Report* = *Report from the Select Committee on Bank Acts*, NMC = National Monetary Commission, NBER = National Bureau of Economic Research, AAS = *Annual Abstract of Statistics* (formerly *Statistical Abstract for the United Kingdom*)

In general, the series in a compilation-table are divided in logical groups, with the series within each group arranged in ascending order of time. In Table 1 there are five groups. The first group pertains to the series provided to a Parliamentary committee in 1857 by David Barclay Chapman, managing partner in the discount house of Overend and Gurney. This "Overend-Gurney" series is the average discount rate charged by the firm. The second group is based on series published by the U.S. National Monetary Commission in 1910, extended by some authors via data in *The Economist*. The third group consists of the series developed by Palgrave and adopted by Williams, who extends it beyond 1900 again via *The Economist*.

The fourth group is a collection of other individually compiled series. The fifth and final group is called "composite series," although a series in the group could be from only one source. These series either are published in a volume devoted to historical statistics (Mitchell and Deane, Capie and Webber, Sheppard, Homer and Sylla) or are generated via special computation using diverse data sources (Officer).

Some information not included in the table is of interest for certain entries:

(1) It is not clear how Bigelow extends the Overend-Gurney series, that ends in May 1857, to the end of 1858.

(2) Some contemporary series are expressed as pounds, shillings, and pence (£, s, d) per £100 invested. Re-expressing the formulation as pounds with a decimal component would be equivalent to percent per year.

(3) Though the Nishimura series is described as pertaining to three-month bank bills, sometimes they are rather two-month and three-month bills or specified in the source generally as "short bills." Similarly, the Goodhart series may refer either to 60-day or three-month bills, as stated in the table (note g); but Goodhart (1986, p. 90, n. 38) observes that the series would be very similar in any event.

(4) The Silberling series suffers from four incorrect observations (Officer, 1996, p. 298, n. 32).

(5) Because it is in part specially constructed, the Officer series warrants some attention. For 1824 to 1857 (May), the series is the average of the Overend-Gurney

(monthly) series. For 1857 (June) – 1858, it is computed from Bigelow. For 1859-1878, the Officer series is constructed as QBR·(AMR/ABR), where QBR is the quarterly Bank Rate (from Clapham, 1945, vol. 2, pp. 430-431), AMR is the annual market discount rate (from Williams, 1912, p. 382), and ABR the annual Bank Rate (average of QBR).[12]

2. Treasury Bill

Compilations of the interest rate on U.K. three-month Treasury bills are shown in Table 2. There are two groups: private or Federal-Reserve series, and officially compiled series. Extreme precision should be noted. The Balogh series has only one decimal place, while the Bank-of-England series—obtained by the author directly from the Bank of England—involves four decimal places and LCES three. Excluded from the table is the series of the International Monetary Fund, available on the organization's *International Financial Statistics* CD-ROM and existing annually 1956-2001 and monthly 1964-2001.

Table 2
Compilations of Interest Rate on U.K. Three-Month Treasury Bills, 1919-2001

Author	Description[a]	Period	Frequency	Observation	Source
I. Private or Federal-Reserve Series					
Balogh (1947, p. 202)	discount rate	1922-1937	annual[b]	average[c]	unstated
Morgan (1952, p. 153)	discount rate	1919-1925	monthly	average[c]	Treasury records
BMS, *1914-1941* (pp. 656-661), *1941-1970* (pp.1030-1034)	discount rate	1924-1970	monthly	average[d]	*The Economist*
LCES (1971, p. 16)	discount rate	1919-1969	annual	average[d]	FS
Sheppard (1971, p. 190)	discount rate[e]	1919-1966	annual	average[d,f]	LCES
Howson (1975, pp. 50, 150)	discount rate	1920-1929	annual	average[d]	LCES[f]
same	discount rate	1919-1938	quarterly	average[d]	Morgan (1952); BMS, *1914-1941*[g]
Pember and Boyle (1950, p. 324)	discount rate	1921-1949	annual[b]	average[d,h]	Pember and Boyle

Table 2
Compilations of Interest Rate on U.K. Three-Month Treasury Bills, 1919-2001

Author	Description[a]	Period	Frequency	Observation	Source
Capie and Webber (1985, pp. 494-527)	allotment rate	1923-1982	annual, quarterly, monthly	month-end (or last tender in month)	*The Economist*, BESA, FS
same	discount rate	1919-1974	same	same	*The Economist*, BESA
same	yield	1960-1982	same	same	FS
II. Official Compilations					
Bank of England	discount rate	1975-2001	monthly	average[d]	Bank of England[i]
National-Statistics website[j]	discount rate	1963-2001	monthly	month-end (or last tender in month)	Bank of England
same	yield	1972-2001	monthly	same	same
AAS, various issues	allotment rate	1935-1956	monthly	average[d]	same
same	discount rate	1946-2001	monthly	average[d]	same

[a]Some entries inferred from statment "data are available for the Treasury bill allotment rate at the weekly tender only from 1923" (Capie and Webber, 1985, p. 309).

[b]Year ending March 31.

[c]Presumably of all issues.

[d]Of weekly figures (at tenders, except rate fixed until April 11, 1921).

[e]Apparently misreported by Capie and Webber (1985, p. 320) as allotment rate.

[f]For 1963-1966, average of monthly averages of weekly tenders.

[g]Source apparently misreported by Capie and Webber (1985, p. 321).

[h]Expressed as £, s, d per £100.

[i]Provided directly to author.

[j]statistics.gov.uk

Abbreviations: BMS = *Banking and Monetary Statistics*, LCES = London & Cambridge Economic Service, FS = *Financial Statistics*, BESA = Bank of England *Statistical*

Abstract, AAS = *Annual Abstract of Statistics* (formerly *Statistical Abstract for the United Kingdom*)

C. Contemporary Series: Selection of Data

1. Bill of Exchange (1790-1918)

Selection of data for the U.K. ordinary-funds short-term interest rate, contemporary series, is summarized in columns 1-2 of Table 3. Considering first the discount rate for bills of exchange, beginning in 1918 and going back in time, and referring to Table 1, chosen first are series of the *Bankers' Magazine* data, highly regarded for reliability. For 1911-1918, the Mitchell (1988), also the Mitchell and Deane (1962), series is used, in the form of the mean of the high ("maximum") and low ("minimum") series. For 1883-1910, the King series is taken, with its £, s, d denomination converted to percent per annum and the semi-annual component (1883-1889) averaged to obtain an annual series.

Table 3
Components of U.K. Short-Term Interest Rate: Ordinary Funds, 1790-2001

		Overlap for Consistent Series		
Component	Period	Period	Annual Divergences[a] (basis points)	Linking Ratio[b]
I. Bills-of-Exchange Discount Rate[c]				
Silberling (1923), King (1936), Cope (1942)[d]	1790			
Cope (1942), Pressnell (1956)[d]	1791-1792			
Silberling (1923), King (1936), Cope (1942)[d]	1793-1799			
Homer and Sylla (1991)	1800-1823			
Mitchell (1988)[e]	1824-1854	1855-1856	-27, -36	0.9404
Nishimura (1971)[f]	1855-1882	1883-1887	-2, 1, -1 –1, 1[g]	_____
King (1936)[h]	1883-1910	1911-1913	-1, 2, 0[g]	_____
Mitchell (1988)[e,i]	1911-1918	1919-1923	-45, -20, -60, -7, -10	0.9354
II. Treasury-Bill Discount Rate[j]				
LCES	1919-1969	1965-1969	0, -2, 2, 1, 1[g]	_____
AAS[f]	1970-1974	1975-1979	1, 3, -2, 0, 3[k]	_____
Bank of England[f]	1975-2001			

[a]Subsequent series minus current series. See section I.B.3 of text.

[b]Average of annual ratios of subsequent series to current series. See section I.B.3 of text.

[c]Component series described in Table 1 and in section B.1 of text.

[d]Authors provide non-tabular information, see text.

[e]Also, Mitchell and Deane (1962).

[f]Annualized by author, see text.

[g]Averaging less than one-half basis point.

[h]Converted to percent per annum and annualized by author, see text.

[i]"Maximum" and "minimum" series averaged by author.

[j]Component series described in Table 2 and in section B.2 of text.

[k]Averaging one basis point.

Abbreviation: AAS = *Annual Abstract of Statistics*

Palgrave is a famous author, his market-discount-rate series is ensconced in the literature, and that series exists from 1900 all the way back to 1845. So it would be logical to adopt that series for 1845-1882. However, the Palgrave (1903) series has been criticized as too high by two knowledgeable specialists separated by forty years. King (1936, p. 299, n. 3) observes that "Palgrave cites bill rates which were appreciably above the fine 'competitive' rates." Harley (1976, p. 101, n. 3) states:

> The rate of interest on three months' bills reported in the same source [Mitchell and Deane (1962, p. 460)] is also unsatisfactory. The rates reported from 1884 to 1900 are from R. H. I. Palgrave, *Bank Rate and the Money Market* (1903), p. 33. No source is given for these rates and curiously, although Palgrave was a leading contemporary observer of the money market, these rates are substantially above those reported in contemporary issues of the *Economist* and *Bankers' Magazine*.

Although the portion of Palgrave's series that was examined by King and Harley is post-1882, prudence suggests that an alternative be selected for the pre-1883 period. The Nishimura (1971) series, implicitly praised by Harley (1976, p. 101, n. 3) and judged by Capie and Webber (1985, p. 321) as (along with other series) Nishimura's "major contribution to interest rate data," is chosen for 1855-1882. The series is annualized by taking the annual average of the monthly figures.

For 1824-1854, the Overend-Gurney series provides the best available data. Mitchell (1988) [and Mitchell and Deane (1962)] correctly computes the annual average of the original Overend-Gurney series, and his series is selected for that subperiod.[13] Coincidentally, the Usury Laws were repealed in 1854. From 1714 to 1854, there was a

legal interest-rate ceiling of five percent per year.[14] In 1833, short bills were exempt (Homer and Sylla, 1991, pp. 205-206); in effect the Usury Laws no longer constrained the market discount rate. From 1824 to 1833, the market rate was below five percent; so the ceiling was ineffective.

However, for the pre-1824 period, there are two problems. First, even though King (1936, pp. 1, 4) traces the existence of the bill of exchange in England to the 12th century and the discounting of bills to the 1660s, market discount data are scarce prior to 1824.[15] The interest-rate series for **What Was the Interest Rate Then?** cannot be extended back in time as far as the existence of bill discounting, indeed not even close to the 17th century.

Second, when the measured market rate was at the ceiling of five percent (from 1714 onward), it is unknown whether that rate was a constrained or unconstrained market rate. Only in the latter situation does the rate represent a market-determined rate. True, if the Usury Laws were obeyed, then an observed rate of five percent is in fact the actual-transactions bill rate, albeit constrained by the ceiling, and the contemporary series is legitimately continued in that sense. However, it is controversial whether the Usury Laws were obeyed. Ashton (1955, p. 28; 1959, p. 175) states: "though evasion was by no means unknown, the penalties were high and the law was generally respected....There is a good deal of evidence that the Usury Laws were respected." In contrast, Clapham (1945, vol. 2, p. 15) writes: "[The] 5 per cent which the Usury Laws, still in force, made the permitted maximum...could be circumvented....Money brokers, quite legitimately, might charge a commission which raised the cost of borrowing through them to 5_ or 6. Private bankers could refuse to lend to those who did not keep substantial balances on current account."

Fortunately for interpretation of the contemporary series prior to 1824, there were two important forces that helped enforcement of the Usury Laws. First, violation was potentially costly, involving "a fine of three times the capital of the transaction" (Ashton, 1959, p. 175). Second, "[the Bank of England's] uniform rate of discount was that 5 per cent [of the] Usury Laws....The laws could be circumvented, but that was not for the Bank" (Clapham, 1945, vol. 2, p. 15). Clapham concludes that the Bank lost business when market interest rates fell below five percent. Another implication is that a five-percent market rate could very well have been effective, because, in effect, the Bank had an interest-rate target at the interest-rate ceiling. That is an interpretation of Officer (2000, p. 200). If correct, then a five-percent rate was effective, and that rate can be viewed as determined by a perfectly elastic demand for bills on the part of the Bank.

There is, however, an argument on the other side, also made by Officer (2000, p. 199): "First, only 'good' bills—a minority of bills—were acceptable by the Bank of England. A 'good' bill bore at least two London names and had a maximum of 65 days until maturity. Also, the submitter of a bill had to be on the Bank of England's list of clients. Second, there is good evidence that the Bank of England effectively regulated discounts via a rationing system." Under this interpretation, the Bank's demand, while

elastic at five percent, existed only up to a fixed volume of transactions, and an observed five-percent market discount rate could have reflected an effective Usury Law.

It is possible to carry the market discount rate continuously back to 1790 (but no further) with reasonable confidence, subject to the variance in interpretation just discussed, and that will be done. An important fact is the general agreement (or, at least, non-disagreement) among both historians and contemporary or near-contemporary market participants that the market rate was normally five per cent from 1790 to 1821:

John Twells, a London banker, declared: "The rate of discount was 5 per cent.; from about 1800 up to 1822 it never fluctuated...there was only one rate of discount of 5 per cent. for all purposes; we never thought of any other rate....The Bank rate and the bankers' rate; we had no other rate...we never charged above five per cent. in any single instance...." And in response to the question "The commercial [bill discount] rate remained the same throughout the whole period of the Bank Restriction Act [1797-1821]?" "Certainly, there is no doubt about it."—*Report from the Select Committee on Bank Acts* (1857, p. 434).

Silberling (1923, p. 241) writes: "The Usury Laws fixed the maximum rate of interest and discount at five per cent, and contemporary literature indicates that this rate was, at least from 1790 to 1822, the prevailing and unvarying rate of discount throughout the country."

King (1936, pp. 12, 14, 66) asserts: "Except for a few isolated instances between 1797, discount was at an invariable 5 per cent. throughout the country, and this fixed rate, the maximum allowed under the Usury Laws, prevailed for some years after 1810....the *normal* market rate was also the maximum rate....the rate was generally a fixed 5 per cent." He cites Hudson Gurney, who had "a special knowledge of bill broking," and who declared before the Lords' Resumption Committee in 1819 that "there never was an instance" of discount by private banks at under 5 per cent. until 1817." He also quotes Samuel Gurney, who in response to a question in the Commons' Resumption Committee in 1819, said that he had heard that "it [rates lower than five percent] used to be done in former years [before the war with France, that is, before 1803]."

Cope (1942, p. 186) observes that "discount rates applied by the Bank of England and the private banks changed rarely and usually the rate was 5 per cent." Referring to the 18th century, Joslin (1954, p. 186) states that "discount rates appear to have been particularly inflexible; 5 per cent [the Bank rate from 1742 to 1823] was normal for inland bills...[and] the foreign bill, a more reliable instrument, was discounted by the Bank...at 5 per cent [from 1773] until 1823."Pressnell (1956, pp. 85, 89) declares: "from 1789...to 1815...with rare exceptions 5 per cent. was the rate, the time-honoured rate, at which bills of exchange were discounted."

Then what were the exceptional years, between 1790 and 1821, when the five-percent rate did not hold, and what was the rate during these years, as well as in 1822-1823? Thus the series would be completed. Pressnell (1956, p. 93) states that "the author of a pamphlet published in 1821 remembered the Goldsmids [bill-broking firm] in

1791 and 1792 discounting bills at 4 per cent. plus commission of 1/8 per cent." Similarly, Cope (1942, p. 185) notes that "in 1791 and 1792 they [the Goldsmids bill-broking firm] were discounting bills at 4 per cent. per annum [plus commission]," and he identifies the pamphleteer as "J. Lancaster, who was broker to a banking house which failed in 1806." So it is reasonable to accept a discount rate of four percent for 1791-1792, with the "normal" five percent (exclusive of commission) for the remainder of the 1790s.

King (1936, pp. 29, 66) recognizes two periods of market rate below five percent in the 1810-1825 period: 1817-1818 and 1822-1825. He notes that Gurney, in his testimony in 1819, declared that in 1818 he had discounted bills at 4_ percent. Pressnell (1956, p. 104), too, observes that "rates of interest were low in 1817 and 1818." Officer (2000, p. 199) sees the low discount rate as existing only for one full year—the last half of 1817 and the first half of 1818. However, Duffy (1982, p. 79) declares that "in 1817...market rate was generally below five per cent." In effect supporting King's statement for 1822-1825, Pressnell (1956, p. 104) reports that "in 1822...the Bank of England initiated a cheap money policy, which was to be maintained for some three years, by reducing Bank Rate to 4 per cent...[and there were] low market rates."

The Homer and Sylla (1991) annual-average market-discount-rate series for 1800-1823 is consistent with the views of these authorities, and so is selected to complete the series for **What Was the Interest Rate Then?** Their average series is 5.00 percent for these years, with the exceptions of 1817-1818 and 1822-1823. For 1817-1818 their figure is 4.50, with annual lows of 4.00 and highs of 5.00—thereby consistent with both the King-Pressnell and Officer views. For 1822-1823, their figure is 4.00—average, low, and high.

2. Treasury Bill (1919-2001)

Consider now selection of series for the interest rate on Treasury bills, shown in columns one and two of Table 3. Only the Treasury-bill discount rate—and not its allotment rate or market yield—is available for the full 1919-2001 period. The most-reliable (ultimate source) and most-precise (four decimal places) data are those obtained directly from the Bank of England, covering 1975-2001. The LCES series, for reason of its precision of three decimal places, is chosen next, and applies to 1919-1969. The gap of 1970-1974 is closed via the (two-decimal-places) data of the AAS. The Bank of England and AAS series are annualized by taking twelve-month averages.

D. Consistent Series: Linking of Component Series

To obtain a consistent short-term (ordinary-funds) interest-rate series for the entire period 1790-2001, the component series must be linked as indicated by divergences between adjacent series. Then all component series except the most recent (Bank of England, for 1975-2001) must be extended to compute an overlap (ideally of five years), in accordance with the methodology developed in section I.B.3 above. For each component series, the period of overlap with the subsequent component series, the

annual divergences from the subsequent series (going forward in time, during the period of overlap), and the linking ratio (where applicable) are shown in columns 3-5 of Table 3.

Consistency is not an issue for 1790-1823; because the adopted data for this subperiod constitute essentially a single component series. Also, both the Homer-Sylla and Mitchell series for 1824-1828 are annual averages of the Overend-Gurney series; so again there is no need to compute an overlap.[16] However, from 1855 onward, consistency must be checked and, if necessary, imposed via adjustment of the current component series to the subsequent series. For lack of data (see Table 1), the Mitchell [or Mitchell-Deane] series antedating that of Nishimura can be lengthened only two years, and the King series antedating Mitchell [or Mitchell-Deane] can be extended only three years.

As shown in column 4 of Table 3, in three overlaps the divergences are sufficiently small that the current and subsequent component series have no substantive difference, and there is no linking ratio.[17] The deviations between the current and subsequent series can be easily explained via rounding differences. In two cases—Mitchell to Nishimura, and Mitchell to LCES—a linking ratio is warranted. It is not surprising that such a linking ratio applies to the latter case, because it involves a switch from the bill-of-exchange discount rate to the Treasury-bill rate.

Because of the forward-linking procedure, the resulting "consistent" series has the interpretation of the Treasury-bill discount rate extended back to 1790—though the rate is hypothetical rather than actual prior to 1919. Alternatively, the consistent series can be treated as the short-term ordinary-funds interest rate over 1790-2001 from the viewpoint of a contemporary, 1975-2001, observer.

III. Short-Term Interest Rate, Ordinary Funds: United States

A. Market Instruments

1. Representative Market Instruments and Applicable Subperiods

The commercial-paper interest rate represents the U.S. short-term ordinary-funds interest rate through 1930, replaced in 1931 by the Treasury-bill interest rate. The origin of commercial paper goes back to colonial times. Greef (1938, p. 4) states that the use of promissory notes as a negotiable instrument [that is, commercial paper] "seems to have become fairly common" in the colonial period. However, a *market* interest (discount) rate for commercial paper requires the existence of an open market, and that happened later, probably in the 1790s.

Greef (1938, pp. 5-6, 8-10) declares: "any open market for commercial paper must have been narrowly limited throughout the colonial period...actual records of dealings in such paper during the decade of the 1790's are available...the earliest dealings in promissory notes of which any record is readily available cannot be traced back much farther than 1793." He presents "sufficient evidence...to indicate that dealings in negotiable paper had been begun in a few of the more important commercial towns in the

United States by about 1790, if not earlier," and declares that "dealers in several of the leading commercial centers of the United States had begun to buy and sell commercial paper in the market before the close of the eighteenth century."

Alongside the promissory note (commercial paper) was the bill of exchange (acceptance). However, unlike in England, it was commercial paper rather than the bill of exchange that became the earliest dominant money-market instrument. As Myers (1931, p. 48) writes: "Early discussions of bank credit indicate that the promissory note was the usual form of business paper discounted by banks during the first quarter of the nineteenth century." Myers (1931, pp. 49-52, 201, 316) provides various reasons why the acceptance did not come to dominate, whereas it did in England: the demise of the Second Bank of the United States (that had fostered an acceptance market), the lower place held by trade in economic activity (compared to Britain), no central bank (after 1836), unsettled conditions after the Civil War, the difficulty of determining if a bill was founded on a sale of produce or was camouflage for an unsecured loan. There was also a lack of tradition (very unlike England): use of the acceptance was infrequent until the Second Bank.

Another reason is provided by Calmoris and Hubbard (1996, p. 215, n. 5): the American unit banking system. In other countries, bank branches provided financing to customer via bankers' acceptances. A market in bankers' acceptances did not occur until the 1920s, after the creation of the Federal Reserve System, and very much fostered by the Federal Reserve banks.[18]

Competent authority is unanimous that commercial paper was the dominant ordinary-funds money-market instrument and that the interest rate of this asset clearly represents the short-term interest rate for ordinary funds (as distinct from that for surplus funds, for which the rate on stock-exchange call loans or possibly time loans applied). Beckhart (1932, pp. 246, 257) observes: "Changes in commercial paper rates have long been regarded as accurate reflectors of changes in the money market as a whole, of fluctuations in the increments or decrements of money market funds." He refers to "the short-term money markets possessed by the United States in 1913, the call loan or the commercial paper markets." In a similar vein, Macaulay (1938, p. A336) states that "three rates...those for call money, time money and commercial paper...are indices of money market conditions in New York City."

Balles and others (1959, p. 21) declare: "Prior to the formation of the Federal Reserve System, the principal instruments in the short-term money market were commercial paper and call and time loans on security collateral at the New York Stock Exchange. These instruments continued to account for most of the activity in the money market even after 1914." Morgenstern (1959, pp. 118-119) writes that "the commercial paper rate...was one of the most important American short-term rates, at least up to 1914, at which a large volume of domestic and foreign business was transacted." Goodhart (1969, p. 18) notes: "The second [focus of the New York money market, after call and time loans, in 1900-1913] was the open market for commercial paper." Also, Willis (1970, p. 1) states: "Prior to the formation of the Federal Reserve System, the American

short-term money market included only commercial paper and call and time loans on security collateral at the New York Stock Exchange."

Further, Homer and Sylla (1991, p. 365) assert: "In the nineteenth century, commercial paper dominated the [U.S. money] market." Calmoris and Hubbard (1996, p. 194) write: "The most frequently used US interest rates [in 1879-1914] are single-name and double-name commercial paper rates of high-quality paper."

The importance of commercial paper as an investment outlet for "ordinary funds" of banks is well recognized by historians. Myers (1931, p. 135) observes that "banks invested in commercial paper…all the funds which they dared to tie up for a considerable length of time." James (1978, pp. 176, 178) notes that "commercial paper made a very good secondary reserve asset." A reason is that "with such a range of short-term maturities [four to six months], banks found it quite easy to select commercial paper of appropriate duration to cover their slack demand periods which matured as the time loan demand increased." Elsewhere, James (1995, pp. 223-224, 247) restates his argument: "Commercial paper was considered an attractive secondary reserve asset. It was safe, self-liquidating, and short-term. The impersonality of the market ensured that it was paid off at maturity and never extended, unlike commercial loans….[Commercial paper] fulfilled the role of a secondary reserve asset in bank portfolios fairly well because of its short-term, self-liquidating nature."

The switch from commercial paper to Treasury bills as the representative ordinary-funds money-market interest rate occurred around the early 1930s, according to all authority on the matter. Consider first historical-statistics volumes and government publications. "During the 1930's the supply of open-market paper declined sharply and banks invested an increasing amount of funds on United States Government obligations, particularly those of short (or intermediate) maturities."—*Banking and Monetary Statistics, 1914-1941*, p. 425. "Until…the 1930's…4- to 6-month commercial paper [and stock-exchange time and call loans]…were the most important short-term open-market instruments."—*Historical Statistics of the United States, 1789-1945*, p. 259.

"Prior to the thirties, open market commercial paper and bankers' acceptances were the principal money market instruments other than call loans. Government deficits in the thirties and particularly in World War II resulted in marked increases in the supply of 91-day Treasury bills and other short-term Treasury obligations….short-term securities became an important outlet for [commercial banks'} excess reserves."—Balles and others (1959, p. 15).

The view of private historians is consistent with that in the historical-statistics and official publications. "In the 1930's…the commercial paper market shrank in significance….Treasury bills, however, have dominated the money markets both here [in the United States] and abroad since the 1930's."—Homer and Sylla (1991, p. 365). "By late 1929 the commercial paper market had virtually disappeared."—James (1995, p. 220).

Quantitative information enables determination of the exact year in which the Treasury bill became the dominant short-term ordinary-funds money-market asset. Table 4 lists the amounts outstanding of commercial paper, bankers' acceptances, and Treasury bills in the New York money market at year-end for 1925-1933. Interestingly, the table shows that bankers' acceptances briefly overtook commercial paper as the dominant asset, just prior to acceptances themselves replaced by Treasury Bills in that role. That first event occurred in 1928. In 1931, outstanding Treasury bills exceeded not only outstanding bankers' acceptances for the first time but also exceeded the sum of outstanding acceptances and outstanding commercial paper. The temporary recovery of acceptances in 1932 is best viewed as an aberration or transitional occurrence. Therefore 1931 is judged the year in which Treasury bills became (and remained) the representative short-term ordinary-funds money-market asset.

Table 4
Outstanding Instruments in New York Money Market, 1925-1933
(millions of dollars)

Year-End	Commercial Paper	Bankers' Acceptances[a]	Treasury Bills[b]
1925	621	332	0
1926	526	319	0
1927	555	462	0
1928	383	471	0
1929	334	793	100
1930	358	788	127
1931	120	418	576
1932	81	666	642
1933	109	632	1003

[a]Data not available prior to 1925.

[b]Excluding holdings of Federal Reserve Banks.

Source: *Banking and Monetary Statistics, 1914-1941*, pp. 465-467, 509.

Strictly speaking, then, commercial paper was the dominant asset until 1928, bankers' acceptances from 1928 to 1930, and Treasury bills from 1931 onward. However, it appears ridiculous to deem an asset representative for only a three-year period, a small fraction of the time of the representativeness of commercial paper or Treasury bills. Therefore commercial paper will continue to be viewed as representative not only from the 19th century through 1927 (when it was in fact the dominant asset in terms of amount outstanding) but also from 1928 to 1931 (when its dominance was not yet replaced by that of the Treasury bill but was indeed overcome by that of the bankers' acceptance).

2. Descriptions of Market Instruments

a. Commercial Paper

Commercial paper is similar to the bill of exchange in its short-term nature (with six months the most common maturity), its sale on a discount basis, and its negotiable characteristic. Further, just as for the bill of exchange, the discount rate on a commercial paper varied with the quality of the paper (similarly described, with adjectives such as "first-class," "prime" and "choice" denoting most-preferred paper), the time to maturity, and the constellation of discount rates.

However, two differences between commercial paper (in the United States) and the bill of exchange (in England) are striking. First, commercial paper is a "promise to pay" as distinct from the bill's "order to pay." It is true that commercial paper that is endorsed becomes "two-name paper," thereby closer to the bill of exchange in that now two parties are responsible for payment. However, only in the antebellum period was two-name rather than single-name paper predominant. Further, unlike in England, for two-name paper typically "only general information—often too general—was available regarding the financial responsibility represented by each name" (Foulke, 1931, p. 217). So it evolved that single-name paper was the preferred form of paper.

The second difference between New York commercial paper and the London bill of exchange is that there was no secondary market for commercial paper until after the Federal Reserve System was established.[19] Under certain conditions, consistent with the Federal Reserve Act, commercial paper became rediscountable at the Federal Reserve banks. However, as discussed in section A.1, it was not until 1928 that the bankers' acceptance—the epitome of a rediscountable instrument—surpassed commercial paper per se in quantitative importance.[20]

b. Treasury Bill

U.S. Treasury bills are in many respects similar to U.K. Treasury bills: the usual three-month maturity, the discount nature of the return, the lack of default risk (emanating from central government as the issuer), and issuance at weekly auctions (though sometimes U.S. auctions have occurred at irregular times, and sometimes U.K. bills have been sold at a fixed discount). This parallelism is not surprising, because the U.K. Treasury bill was the clear model for the U.S. bill.

However, there are two important differences between U.S. and U.K. Treasury bills. First, U.S. bills were not initiated until 1929, some 52 years after the British Treasury bills came into existence. So in Britain the Treasury bill became dominant in the money market after World War I, in 1919, whereas in the United States this did not occur until 1931—admittedly only two years after introduction of the Treasury bill. Second, unlike in the United Kingdom, at least since 1934 there always has been a liquid secondary market for Treasury bills.

Observers have commented on the phenomenon of a secondary market: "Once issued, U.S. Treasury Bills continue to enjoy an active market....Even the large banks sell as well as buy, unlike the London banks, which are ordinarily only buyers of Treasury Bills."—Sayers (1957, p. 139). "Because of the large quantity of Treasury bills outstanding, their homogeneous nature, and their lack of default risk, there is a very active and efficient secondary market."—Cook (1992, p. 696). "The [secondary] market for Treasury bills is the largest and most efficient for any money market instrument."—Cook (1993, p. 86).[21]

B. Compilations of Series

1. Commercial Paper

Compilations of series of the U.S. commercial-paper interest rate from 1831 (the earliest data for which a figure is offered) to 1935 (thereby allowing for a five-year overlap from the 1931 switch to Treasury bills as the representative instrument) are presented in Table 5. The table consists of six groups of compilations. Group I are those series published in the 19th century: Bigelow (1862) and Martin (1898). There are three issues regarding these compilations.

First, although (in Macaulay's description) the series are "almost identical" for 1831-1860, the relationship between the two series is not entirely clear. Macaulay (1938, p. A341, n. 13) notes that Bigelow's series antedates Martin's series in publication and so judges that "for the period 1831-1860 Martin seems to have copied, or at least used, Bigelow's table....it seems fair to assume that Martin's early figures were taken from Bigelow's book." However, he concedes that it is possible that "Bigelow obtained his interest rates from *unpublished* material collected by Martin." The evidence favoring Bigelow as the original series is factual, that favoring Martin is conjectural. Therefore it is reasonable to select Bigelow over Martin for originality. Also, the Martin data are not in precise monthly form, and indeed there is "frequent lack of clarity in Martin's mode of expression" (Smith and Cole, 1935, p. 76). The tabular presentation of Bigelow is in contrast to the narrative form of Martin, and is perhaps suggestive of superior data. These are good reasons to consider the Bigelow series as superior to that of Martin for the common period of 1831-1860.

Table 5
Compilations of U.S. Commercial-Paper Interest Rate 1831-1935

Author	Description[a]	Period	Frequency	Observation	Source
I. 19th-Century Series					
Bigelow (1862, pp. 204-205)[b]	first-class[c]	1831-1860	monthly	end-of-month[d]	"street rates"
Martin (1898, pp. 52-92)[e]	3-6 months bankable	1831-1897	monthly[f]	varies[g]	unstated
II. Mitchell Series					

Table 5
Compilations of U.S. Commercial-Paper Interest Rate 1831-1935

Author	Description[a]	Period	Frequency	Observation	Source
Mitchell (1916, p. 155)[h]	choice 60-90 days, good 4-6 months	1890-1915	annual	average of weekly figures	*Financial Review*
Mitchell (1913a, pp. 147-149; 1913b, p. 512; 1916, p. 146)[i]	choice 60-90 days, good 4-6 months	1890-1915	quarterly	average of weekly figures	*Financial Review*
Mitchell (1913a, pp. 150-156; 1913b, p. 512; 1916, p. 146)[j]	choice 60-90 days, good 4-6 months	1890-1915	monthly	average of weekly figures	*Financial Review*
Persons (1919, pp. 94-95, 98-99)	choice 60-90 days, good 4-6 months	1890-1918	monthly, annual	average of weekly figures[k]	Mitchell (1913a, 1913b, 1916), FR, CFChr
III. Other Pre-Macaulay Series					
Andrew (1910, pp. 119-138)	choice 60-90 days	1890-1909	weekly	unstated	CFChr
same	choice 4 months	1890-1896	weekly	unstated	CFChr
same	good 4-6 months	1890-1909	weekly	unstated	CFChr
same	prime 4-6 months	1894-1909[l]	weekly	unstated	CFChr
Persons, Tuttle, and Frickey (1920, p. 43)	prime	1866-1880	monthly, annual	high and low series, averages of weekly figures[m]	*Financial Review*, CFChr, HMM, BM
Crum (1923, p. 28)	prime 1866-1889, choice 60-90 day thereafter	1866-1922	monthly	average of weekly highs and lows	Andrew (1910), *Financial Review*, CFChr
Owens and Hardy (1930, pp. 176-178)	prime 1866-1889, choice 60-90 day 1890-1924, 4-6 months thereafter	1871-1929	monthly	1922-1924 computed from weekly ranges, 1925-1929 "averages"[n]	Crum (1923), CFChr, *Standard Statistical Bulletin*

Table 5
Compilations of U.S. Commercial-Paper Interest Rate 1831-1935

Author	Description[a]	Period	Frequency	Observation	Source
Greef (1938, pp. 80-82)	prime 1886-1889, choice 60-90 day 1890 - March 1924, 4-6 months thereafter	1866-1935	monthly	average of weekly highs and lows	Crum (1923), *Standard Statistical Bulletin*[o]
IV. Macaulay Series					
Macaulay (1938, pp. A142-A161)[p]	choice 60-90 day 1857-1923, prime 4-to-6 months thereafter	1857-1935	monthly	average of "weekly averages" or other figures for month	CFChr, FR, JC, HMM, BM, other New York newspapers
Friedman and Schwartz (1982, pp. 122-124)	same	1867-1935	annual	average of monthly figures	Macaulay (1938)
V. Federal Reserve Series					
BMS, *1914-1941* (pp. 448-451)[q]	prime 4-6 months	1890-1935	monthly, annual[r]	1919-1935: mid-month[s], average of monthly series	Persons (1919), Federal Reserve Bank of New York
VI. Composite Series					
Balke and Gordon (1986, pp. 781-782, 789-795)	choice 60-90 day 1869-1889, prime 4 -6 months thereafter	1869-1935	quarterly,[t] annual	component-series linked in 1890	Friedman and Schwartz (1982); BMS, *1914-1941*
Homer and Sylla (1991, pp. 318-320)	see Bigelow, Macaulay entries	1831-1900	annual	average of monthly series	Macaulay (1938)[u]
HSUS, *Millenial Edition* (2002)	see Bigelow, Macaulay entries	1831-1900	annual	average of monthly series	Macaulay (1938)[u]

[a]Location is New York except where otherwise noted.

[b]Reprinted fully in Smith and Cole (1935, pp. 192-194) and Macaulay (1938, pp. A248-A250). Reprinted partially—1840-1860, end-of-month—in Davis (1960, pp. 27-28).

[c]Location stated as "Boston and New York;" but see text.

[d]For some months, two observations (middle and end of month); for some, three (beginning, middle, and end of month).

[e]Reprinted 1861-1862 in Smith and Cole (1935, p. 194) and 1831-1860 in Macaulay (1938, pp. A246-A247).

[f]Narrative rather than tabular form.

[g]Range for month, or beginning and end of month, or other.

[h]Also, 1890-1909 in Mitchell (1911, p. 273), 1890-1911 in Mitchell (1913a, p. 146), and 1890-1912 in Mitchell (1913b, p. 521).

[i]Also, 1890-1909 in Mitchell (1911, pp. 274-275).

[j]Also, 1890-1909 in Mitchell (1911, pp. 276-280).

[k]Except that annual series is average of monthly series.

[l]Separated into 4 months and 6 months 1894-1896.

[m]Annual series are averages of monthly series.

[n]Presumably, of daily rates.

[o]And like publications of Standard Statistics Company.

[p]Reprinted (monthly series) 1902-1913 in Goodhart (1969, pp. 206-220).

[q]Reprinted 1890-1935 (annual series) in HSUS: *1789-1945*, p. 278; *Colonial Times to 1957*, p. 654; *Colonial Times to 1970*, p. 1001; *Millenial Edition* (2002). Also reprinted in Homer and Sylla (1991, pp. 358-359).

[r]Also, weekly 1919-1935 (pp. 452-458).

[s]Inferred by author from weekly data.

[t]Quarterly series begins in 1875.

[u]For 1830-1856, Bigelow series as quoted by Macaulay.

Abbreviations: FR = *Financial Review*, CFChr = *Commercial and Financial Chronicle*, HMM = *Hunt's Merchant Magazine*, BM = *Bankers' Magazine*, JC = *Journal of Commerce*, BMS =*Banking and Monetary Statistics*, HSUS = *Historical Statistics of the United States*

The second Bigelow-Martin issue is the location of the market to which the series pertain. Bigelow(1862, p. 204) declares that his series is "the 'Street Rates' on first-class paper in Boston and New York." Martin's (1898, p. 52) series is under the heading "The course of the Boston Money Market." Macaulay (1938, p. A342, n. 13) believes that the two series refer to Boston rather than New York: "an examination of the newspapers and periodicals has convinced me that the Bigelow-Martin rates are Boston and not New York rates." However, Cole (1928, p. 188) treats Bigelow's series as pertaining to New York and Martin's to Boston. Along the same line, Smith and Cole (1935, pp. 76, 125) state: "Bigelow's data reflect, at least in part, conditions in the nationally important New York money market" and "Probably Bigelow's data are representative of short-time interest rates in New York City."

Later writers are more guarded on New York versus Boston. Davis (1960, p. 11, n. 18) acknowledges uncertainty on the matter, writing "if Bigelow's series refers to New York...," followed by "if his figures are for Boston...." Olmstead (1974, p. 482, n. 2) is also agnostic, but apparently leaning to New York: "the [Bigelow] series most likely represents discount rates for the New York and (or) the Boston markets." On balance, the Bigelow series probably refers to New York, at least in part.

The third issue concerns the source of the Bigelow and Martin series. The authors themselves are unhelpful on this matter. Bigelow (1962, p. 204) assures the reader only that his series are "compiled from authentic Sources," while Martin makes no comment about source. As Davis (1960, p. 11, n. 18) observes: "The source of Bigelow's series remains unknown."

Group II consists of the series compiled by Mitchell (1911, 1913a, 1913b, 1916) and a series based on the Mitchell series, while Group III is comprised of the remaining pre-Macaulay compilations. Mitchell (1913a, p. 149, n. 52) is to be commended for extending his series consistently over several publications and for taking care to compute averages in a representative way over any given time period: "The averages by quarters and by years were not computed from the monthly figures, but directly from the original figures by weeks. Of course this is the more accurate method...." However, Crum (1923, p. 29) criticizes Mitchell's method of averaging as not self-consistent, and it appears that Crum is correct.[22]

The pathbreaking, carefully constructed Macaulay series is the subject of Group IV, and the Federal Reserve series that of Group 5. Composite series are listed in Group VI. It is a tribute to the great work of Macaulay that the compilations in this group are all based, in whole or in part, on his series. The precision of the Homer and Sylla series is questionable. It is also not clear how Homer and Sylla compute the annual average of the Bigelow series, when Bigelow provides more than one observation for a month (see note d of Table 5). Further, regarding the Homer-Sylla annualization of Macaulay's own series, spot checking shows a high proportion of incorrect—or at least imprecise—computations of the annual average.

2. Treasury Bill

Compilations of the three-month Treasury-bill secondary-market yield are shown in Table 6. All the series emanate from data collected by the Federal Reserve Bank of New York. The basic data are daily bid prices of dealers in the New York money market. There is an inconsistency in the Federal Reserve data, with website and published figures differing over 1955-1979; but the maximum divergence is only two basis points (see note b of Table 6). It is reasonable to assume that the cause is transcription or rounding errors on the website.

Table 6
Compilations of U.S. Three-Month Treasury-Bill Secondary-Market Yield, 1934-2001

Author	Period	Frequency	Observation	Source
I. Federal Reserve Series				
BMS, *1914-1941* (p. 469)	1934-1941	annual	average of monthly figures	Federal Reserve Bank of New York
same	1934-1941	monthly	average of daily rates	same
BMS, *1941-1970* (pp. 693-707)	1941-1970	annual	average of monthly figures	same
same	1941-1970	monthly, weekly	average of daily rates	same
ASD, *1970-1979* (pp. 162-172)	1970-1979	annual, monthly	average of monthly figures, average of daily rates	same
ASD, *1980-1989*, (pp. 141-150)	1980-1989	annual, monthly	same	same
ASD, *1990-1995*, (pp. 92-97)	1990-1995	annual, monthly	same	same
FRB, various issues	1996-2001	annual, monthly	same	same
BGFRS website[a]	1954-2001	annual[b]	average of monthly figures	same
same	1934-2001	monthly	average of daily rates	same
II. Historical Statistics Series				
HSUS, *Colonial Times to 1957* (p. 654)	1941-1957[c]	annual	average of monthly figures	Federal Reserve publications

Table 6 Compilations of U.S. Three-Month Treasury-Bill Secondary-Market Yield, 1934-2001				
Author	Period	Frequency	Observation	Source
HSUS, *Colonial Times to 1970* (p. 1001)	1941-1970[d]	annual	average of monthly figures	Federal Reserve publications
HSUS, *Millenial Edition*	1941-1997[d]	annual	average of monthly figures	Federal Reserve publications

[a]federalreserve.gov

[b]Series differs from that in Federal Reserve publications as follows: one basis point for 1955, 1957, 1958, 1961, 1964, 1972, 1973, 1976, 1977, 1978; two basis points for 1959, 1974, 1975, 1979.

[c]Listed figures for 1931-1940 are, correctly, stated as rate on new issues—HSUS, *Colonial Times to 1957* (p. 654, n. 3).

[d]Listed figures for 1931-1940 pertain to rate on new issues, but are included (without explanation) in both new-issues and market-yield series.

Abbreviations: BMS = *Banking and Monetary Statistics*, ASD = *Annual Statistical Digest*, FRB = *Federal Reserve Bulletin*, BGFRS = Board of Governors of the Federal Reserve System, HSUS = *Historical Statistics of the United States*

C. Contemporary Series: Selection of Data

1. Commercial Paper (1831-1930)

Selection of data for the U.S. ordinary-funds short-term interest rate, contemporary series, is summarized in the first two columns of Table 7. The best commercial-paper series is that of the Federal Reserve from 1919 onward, for which the data are directly collected by the Federal Reserve Bank of New York. For 1890-1918, the Federal Reserve (in *Banking and Monetary Statistics, 1914-1941*) adopts the series of Persons (1919), which thereby achieves "official" status. It is noteworthy that in *Banking and Monetary Statistics, 1914-1941* the Macaulay (1938, p. 430) volume is referenced and a series obtained therefrom (to represent long-term interest rates). So the Federal Reserve was aware of the Macaulay work. Further, it may be indicative that the Persons series terminates in 1918, and the Federal Reserve series commences in 1919. One can only conclude that the Federal Reserve viewed the Persons series (rather than Macaulay or any other known alternative) as consistent with its own directly collected data, and one does not want to argue with that decision.

Table 7 Components of U.S. Short-Term Interest Rate: Ordinary Funds, 1831-2001				
		Overlap for Consistent Series		
Component	Period	Period	Annual Divergences[a] (basis points)	Linking Ratio[b]
I. Commercial-Paper Interest Rate[c]				
Bigelow (1862)[d]	1831-1856	1857-1860	-177, -17, -44, 47	0.9573
Macaulay (1938)[d]	1857-1889	1890-1894	129, 109, 129, 85, 218	1.3171
BMS, 1914-1941	1890-1930	1931-1935	-99, -170, -113, -74, -59	0.3695
II. Treasury Bills: New-Issues Interest Rate[e]				
BMS, 1914-1941	1931-1933	1934-1936	2,3,3	1.1745
III. Treasury Bills: Market Yield[f]				
BMS, 1914-1941	1934-1941			
BMS, 1941-1970	1941-1970			
ASD, 1970-1979	1970-1979			
ASD, 1980-1989	1980-1989			
ASD, 1990-1995	1990-1995			
FRB, various issues	1996-2001			

[a]Subsequent series minus current series. See section I.B.3 of text.

[b]Average of annual ratios of subsequent series to current series. See section I.B.3 of text.

[c]Component series described in Table 5 and in section B.1 of text.

[d]Annualized by author, see text.

[e]Component series described in text.

[f]Component series described in Table 6 and in section B.2 of text.

Abbreviations: BMS = *Banking and Monetary Statistics*, ASD = *Annual Statistical Digest*, FRB = *Federal Reserve Bulletin*

Therefore, notwithstanding the fact that the Persons series is founded on the Mitchell series, which has a computational inconsistency (see section B.1), the judgment of the Federal Reserve compilers as to the continuation of the Federal Reserve series prior to 1919 (that is, via the Persons series) is accepted here. Thus the "official" Federal Reserve commercial-paper interest-rate series is selected for its maximum length, which begins in 1890. The final year for the Federal Reserve series is, of course, the final year for commercial paper as the representative instrument, that is, 1930.

It is natural, going back in time, to continue the contemporary series with the Macaulay series, which then provides data for the 1857-1889 period.[23] The Macaulay

series is monthly; so it is annualized here by taking the average of the twelve monthly figures.

Earlier than 1857, the available series previously discussed are Bigelow (1862) and Martin (1898). It was concluded that they constitute essentially one set of data, and that Bigelow is likely the true source and is readily chosen as the preferred presenter of the series.

There exists another alternative to the Bigelow series. Davis (1960, pp. 24-26) developed a monthly series of the average rate of interest paid by New England cotton textile firms on 2385 loans over 1840-1860. Most of the loans are from the Boston market. It is true that these data pertain to direct loans rather than commercial paper. Nevertheless, Davis (1960, p. 21) argues that "collateral evidence seems to support the new series rather than Bigelow's earlier estimates" to represent short-term credit conditions. However, Olmstead (1974, p. 485) resurrects the Bigelow series, arguing that "contrary to Davis' contention, a substantial amount of collateral evidence exists to support Bigelow." He argues as follows:

> The primary reason the Bigelow and Davis series differ stems from the fact that they represent different markets which were subject to both widely varying supply and demand pressures and elements of risk. The uncertainty surrounding the failures and political unrest in Europe which caused discount rates to soar in Bigelow's series had relatively little direct effect on the industrial loans which comprise Davis' series.—Olmstead (1974, p. 489)

Olmstead (1974, p. 491) concludes: "The serious doubts raised about the accuracy of Bigelow's series are unfounded and until future research proves otherwise it remains our best source for antebellum discount rates. Furthermore, even if Davis' series accurately reflects alternative market rates in the Boston area, one must be cautious in applying it to other cities or to other types of financial paper."

The Olmstead study supports the decision, made here and now, to employ the Bigelow series to represent the commercial-paper interest rate for 1831-1856. The Bigelow series is monthly in nature, but includes up to three observations per month (see note d of Table 5). To obtain a unique monthly figure where there are two or three observations in a given month, the average of these observations is taken. Then the series is annualized by averaging the 12 monthly figures.

2. Treasury Bill (1931-2001)

The market yield on three-month Treasury bills is a consistent Federal Reserve series and is the obvious selection to represent the ordinary-funds short-term interest rate after 1930, as shown in Table 7. The published series is selected over the Federal Reserve website (see section B.2). There is the problem, however, that market-yield data are not available prior to 1934. For the missing years, 1931-1933, the average interest rate on

new issues of Treasury bills is used. Although new-issues interest-rate data pertain to all issues of Treasury bills, during 1931-1933 only three-month Treasury bills were issued, consistent with the yield data thereafter.[24]

D. Consistent Series: Linking of Component Series

To convert the contemporary short-term (ordinary-funds) interest-rate series to a consistent series for 1831-2001, the component series listed in Table 7 must be linked. Ideally, "current" component series are to be connected to subsequent series via five-year overlaps. For the overlap of Bigelow with Macaulay, only four years are available, as Macaulay's series begins in 1857 with the Bigelow series ending in 1860. For the overlap between the Treasury-bill new-issues interest rate and the subsequent market yield, a three-year (1934-1936) overlap is indicated. The reason is that new issues provide the contemporary interest rate for only three years (1931-1933). It appears incongruous to utilize a longer overlap.

For each component series (except for the final series, the Treasury-bill market yield), Table 7 shows the overlapping period with the subsequent series (column 3), the annual divergences from the subsequent series (column 4), and the linking ratio (column 5).

Two further comments regarding the overlap for Treasury-bill new issues are in order. First, the overlapping interest rate pertains to three-month bills only until February 16, 1934. Subsequently, the rate is for six-month bills to February 23, 1935, then for nine-month bills.[25] In effect, the market yield for three-month bills over 1931-1933 is estimated from the new-issues rate for bills of varying maturity over 1934-1936; but the maturity is unique for subperiods of the overlap.

Second, there is the anomaly of extremely low annual divergences (only two or three basis points) leading to a linking ratio substantially different from unity (1.1745). The explanation is the exceptionally low level of Treasury-bill interest rates during the 1934-1936 period. In this situation, it is reasonable to have an exception to the rule that low annual divergences for the overlapping period imply a consistent series without the need for linking (see section I.B.3).

IV. Short-Term Interest Rate, Surplus Funds: United States

A. Market Instruments

1. Representative Market Instruments and Applicable Subperiods

Stock-exchange call loans were the dominant asset for "surplus funds" of financial institutions in the 19th century and well into the 20th century. The views of all commentators are consistent with that statement. Woodlock (1908, pp. 35, 37) writes: "the call-money market consists largely of the fluctuating surplus cash of lenders and the

fluctuating requirements of borrowers....the call-loan market is really the storage place for the nation's surplus credit." Myers (1931, pp. 135, 275) writes:

> Into the call loan market they [banks] put only those funds which they were holding against the possibility of momentary withdrawal....Except for times of crisis, the call loan was quite safe and bank reserves invested in that way were promptly realizable....It is a curious commentary on the banking system that the call loan which was looked upon by the general public as the most speculative type of loan because it was based chiefly upon common stocks, should be considered from the banking point of view, the safest way to dispose surplus funds.

Myers' argument is echoed by Officer (1996, p. 162): "These [call] loans were considered by the banks (but not the public) as a conservative investment, the banks giving up higher interest in commercial paper or securities for greater availability of funds."

The importance of the call loan is reflected in Beckhart's (1932, p. 257) reference to "the [two] short-term money markets possessed by the United States in 1913, the call loan or the commercial paper markets." He writes: "From the point of view of funds absorbed, of the magnitude of fluctuations in funds employed, in rates of interest, and of popular interest and controversy, the brokers' [call] loan market is the most important of all the money markets of New York" (1932, pp. 20-21).

Willis (1970, p. 11) observes: "Call loans...during the 1920's, were considered among the safest and most liquid available use for temporary surplus funds of banks and others." James (1978, pp. 66, 118) states: "Call loans...were regarded as a desirable secondary reserve [in the postbellum United States] because they were easily convertible into cash (in nonpanic periods)....Call loans, payable on demand, were the most liquid asset in which the banks could invest."

Goodhart (1969, pp. 20-22), in his study of the New York money market over 1900-1913, does not hesitate to ascribe greater importance to the call-loan market than either the corresponding stock-exchange time-loan market or the commercial-paper market:

> Even so, after all the necessary qualifications it remains clear that in New York, the market for loans secured by collateral, especially the call loan market, was considerably more important than the commercial paper market....It is difficult to try to estimate accurately the relative volume of call, as compared with time, loans made on stock exchange collateral in the New York money market, but the statistics for loans secured by collateral on demand and on time show that at this time national banks in New York held more secured loans on demand than on time. Such quantitative evidence is heavily reinforced by qualitative evidence from the period. The call loan market and the rate of interest on call loans were

> the focus of contemporary interest and analysis. From the relative importance attributed by economists and financial observers in the two markets, one must conclude that the call loans market was pre-eminent.

Referring to the work of Myers (1931), Goodfriend and Whelpley (1993, p. 17) take a position on when call loans became important: "Since the middle of the nineteenth century, banks had made a significant fraction of their loans to stock brokers, secured by stock or bond collateral on a continuing contract, overnight basis."

When did the call-loan market cease to be of importance? Authors are unanimous that this happened in the early 1930s. "In the early thirties...the volume of call loans declined, and such loans came to involve customer relationships so that, in actual practice, banks rarely called them to meet reserve deficiencies."—Balles and others (1959, p. 31). "In the 1930s...developments drastically changed the character of the call loan market....The call money rate in recent decades has been relatively sticky, remaining unchanged in months when other short-term rates have fluctuated."—Friedman and Schwartz (1982, p. 109). "In the 1930's...the call loan market shrank in significance. Call loans never recovered their importance."—Homer and Sylla (1991, p. 365).[26] Sayers (1957, p. 135) declares that "the [impersonal] call-money market...had substantially disappeared before the second war, and was officially terminated in 1946."

The common view of these authors—call loans ceasing to have importance by the early 1930s—is supported by quantitative evidence. Table 8 shows outstanding brokers' loans made by New York City banks, end-of-year, for 1926-1941. The precipitous drops in 1930, 1931, and 1932 are noteworthy. The minimum value in 1932 was superseded in 1941. The break in the series after 1934 is insignificant.

Table 8
Brokers' Loans Made by New York Banks, 1926-1941
(millions of dollars)

Year[a]	Amount
1926	2788
1927	3718
1928	5091
1929	3424
1930	1926
1931	591
1932	394
1933	801
1934	772
1935	1028[b]
1936	1080[c]
1937	719[c]
1938	681[c]
1939	551[c]

Table 8 Brokers' Loans Made by New York Banks, 1926-1941 (millions of dollars)	
Year[a]	Amount
1940	419[c]
1941	364[c]

[a]Last Wednesday.

[b]Of which 1014 for own account.

[c]For own-account only.

Source: *Banking and Monetary Statistics, 1914-1941*, pp. 182-194, 497-500.

Another indication of the unimportance of the call-loan market in the 1930s and beyond is the stickiness of its interest rate, as mentioned by Friedman and Schwartz (see above). Call-loan rates (both new and renewal—see section 2.a) were stuck at one percent from December 1933 to April 1935 and again from May 1936 to August 1946.

The successor to the call-loan market as the dominant surplus-funds money-market instrument was the federal-funds market. As stated by Goodfried and Whelpley (1993, pp. 17, 26): "The call loan market was thus the functional equivalent of the federal funds market for [banks'] reserve adjustment purposes....The federal funds market today, together with the RP [repurchase-agreements] market, is in many ways a functional equivalent of the call loan market of the 1920s and earlier." Sayers (1957, p. 137) writes: "The really important sections of the New York money market are those dealing in government securities, including Treasury Bills, and those dealing in Federal Funds."

Goodfriend and Whelpley (1993, p. 7) state: "Federal funds are the heart of the money market in the sense that they are the core of the overnight market for credit in the United States. Moreover, current and expected interest rates on federal funds are the basic rates to which all other money market rates are anchored." Similarly, Lewis (1992, p. 271) observes: "the rate for [federal-funds] overnight transactions is the single most closely watched interest rate in the United States."

When did federal funds succeed call loans as the dominant surplus-funds money-market instrument? The federal-funds market developed and grew during two separate decades: the 1920s and the 1950s. However, "the volume of Federal funds transactions in the 1920's was small compared to the volumes in other segments of the money market."—Balles and others (1959, p. 27). Table 9 compares outstanding call loans and federal-funds purchases during the 1920s. Clearly, outstanding call loans not only remained at a substantially higher level than federal-funds transactions but also experienced about the same growth over 1922-1928. So federal funds cannot be construed as superseding call loans during the 1920s.

Table 9 Outstanding U.S. Surplus-Funds Money-Market Instruments[a], 1920s (millions of dollars)		
Year	Call Loans	Federal Funds[b]
1922	800-1200	40-70
1925	1400-2100	100-175
1928	3510-3980	100-250

[a]Range during year.

[b]Average daily volume.

Source: Willis (1970, p. 12).

The federal-funds market did not continue its growth after the 1920s. As Beckhart (1972, p. 71) states: "The Federal funds market, developed in the 1920s, became moribund during the banking difficulties and the excessively low money rates of the 1930s, continued moribund during the era of pegged interest rates of the 1940s, and finally revived vigorously after the Treasury-Federal Reserve Accord of 1951." The 1950s as the decade in which federal funds became important is stated also by other authors. "It was not really until the 1950s that it [the federal-funds market] developed into a national market...now used by banks large and small in the US both as an outlet for surplus funds and as a source of borrowings."—Wilson (1993, p. 119). "In the 1950s, higher market interest rates increased the opportunity cost of holding excess reserves, making more frequent reserve adjustment necessary. Consequently, the volume of trading in federal funds grew sharply."—Goodfriend and Whelpley (1993, p. 18).

So one is faced with the dilemma that federal funds were not an important instrument until the 1950s, while call loans became unimportant in the early 1930s. Therefore the market for "surplus funds" was unimportant from the early 1930s to sometime in the 1950s. Nevertheless, for consistency with the other series in **What Was the Interest Rate Then?** one must determine the year in which the "switch" from call loans to federal funds occurred.

Quantitative information can help provide an answer. In terms of data comparable to Tables 8 and 9, federal funds exceeded brokers' loans in 1956, with a range of 600-1200 versus 500-800 (in millions of dollars)?[27] Federal-funds transactions averaged 350-450 in 1951-1953 and 800-1200 in 1955-1957.[28] These figures suggest that the "switch" may have occurred around 1954-1955.[29]

2. Descriptions of Market Instruments

a. Stock-Exchange Call Loan

Call loans were typically made by banks to securities brokers. These loans, unlike purchases of commercial paper, were secured by stock or bond collateral. Also different from commercial paper, there was no predetermined date of maturity. Rather, call loans were subject to "call," that is, repayment on demand of the lending institution. Symmetrically, a borrower could repay the loan at will.[30]

The interest rate on a call loan was set for only one day and so was determined, and subject to change, daily. There were two call-loan rates, the rate on new loans (the "new rate") and the rate on renewal of existing loans (the "renewal rate"). The renewal rate was by far the more important. As Macaulay (1938, p. A339) observes: "in ordinary times some 95 per cent of the call loans, new and renewed, carry the renewal rate," reflecting the fact that "the volume of new money is relatively small" (Beckhart, 1932, p. 53).[31]

b. Federal Funds

Federal funds are excess-reserves balances of member banks at the Federal Reserve Banks that are borrowed ("purchased") or lent ("sold") at a stipulated rate of interest ("the federal-funds rate"). Member-bank balances do not themselves earn interest, which is one reason for the existence of the federal-funds market. This market enables a bank with excess reserves to earn interest on them, and a bank with a reserves deficiency to obtain the needed reserves. Federal funds are also used in transactions involving Treasury bills, certificates of deposits, and other instruments. Unlike call loans, federal-funds borrowings are unsecured. This feature is viewed as an advantage, because funds are immediately available. The usual maturity is one day, but longer maturities also occur.

The federal-funds rate became the instrument by means of which the Federal Reserve implements monetary policy. As Poole (1992, p. 11) states: "The best shorthand description of Federal Reserve policy is that the Fed pegs the federal funds rate day by day in a narrow range, and changes its peg from time to time in pursuit of its monetary policy objectives."[32]

B. Compilations of Series

1. Stock-Exchange Call Loan

Compilations of the interest rate on call loans at the New York Stock Exchange from 1857 (the earliest available date) to 1959 are listed in Table 10. There are six group. Group I consists of the Mitchell series, comparable to the Mitchell series on commercial paper. Group II is comprised of other series published prior to Macaulay (1938), and Group III is the Macaulay series itself. Group IV is the Federal Reserve "official" call-

loan interest-rate series. Figures are collected by the Federal Reserve Bank of New York, except for the renewal rate 1890-1918, for which data are obtained from Persons (1919). The Federal Reserve series is reprinted in historical-statistics volumes, shown as Group V. Other post-Macaulay series are in Group VI.

Table 10
Compilations of Interest Rate on Call Loans at New York Stock Exchange, 1857-1959

Author	Description	Period	Frequency	Observation	Source
I. Mitchell Series					
Mitchell (1916, p. 155)[a]	unstated	1890-1915	annual	average of weekly figures	*Financial Review*
Mitchell (1913a, pp. 147-149; 1913b, p. 512; 1916, p. 146)[b]	unstated	1890-1915	quarterly	average of weekly figures	*Financial Review*
Mitchell (1913a, pp. 150-156; 1913b, p. 512; 1916, p. 146)[c]	unstated	1890-1915	monthly	average of weekly figures	*Financial Review*
Persons (1919, pp. 102-103)	unstated	1890-1918	monthly, annual	average of weekly figures[d]	Mitchell (1913a, 1913b, 1916), FR, CFChr
II. Other Pre-Macaulay Series					
Andrew (1910, pp. 119-138)	unstated	1890-1909	weekly	average, range	CFChr
Persons, Tuttle, and Frickey (1920, p. 41)	unstated	1866-1880	monthly, annual	high and low series, averages of weekly figures[e]	*Financial Review*, CFChr, HMM, BM
Owens and Hardy (1930, pp. 146-148)	1925-1929: renewal rate	1866-1929	monthly	1866-1924 mean of high and low or computed from weekly ranges, 1925-1929 average of daily rates	Persons (1919), Persons, Tuttle, and Frickey (1920), FR, CFChr, *Standard Statistical Bulletin*
III. Macaulay Series					

Table 10
Compilations of Interest Rate on Call Loans at New York Stock Exchange, 1857-1959

Author	Description	Period	Frequency	Observation	Source
Macaulay (1938, pp. A142-A161)[f]	renewal rate	1857-1935	monthly	average of "weekly averages" or other figures for month	JC, HMM, Mitchell (1903), CFChr, FR, FRB
IV. Federal Reserve Series					
BMS, *1914-1941* (pp. 448-451)	new and renewal rates separate 1919-1941	1890-1941	monthly, annual[g]	average of daily figures, average of monthly series	Persons (1919), Federal Reserve Bank of New York
BMS, *1941-1970* (pp. 674-676)	new and renewal rates separate, 1941-1956 and Jan. 1941 – Feb. 1957	1941-1970	monthly, annual[h]	average of daily figures	Federal Reserve Bank of New York
V. Historical Statistics Series					
HSUS, *1789-1945* (p. 278)	renewal rate	1890-1945	annual	average of monthly series or of daily figures[i]	Federal Reserve publications
HSUS, *Colonial Times to 1957* (p. 654)	new and renewal rates separate, 1919-1956	1890-1957	annual	average of monthly series or of daily figures[i]	Federal Reserve publications and BGFRS
HSUS, *Colonial Times to 1970* (p. 1001)	new and renewal rates separate, 1919-1956	1890-1959	annual	average of monthly series or of daily figures[i]	Federal Reserve publications and BGFRS
HSUS, *Millenial Edition*	new and renewal rates separate, 1919-1956	1890-1959	annual	average of monthly series or of daily figures[i]	Federal Reserve publications and BGFRS
VI. Other Post-Macaulay Series					

Table 10
Compilations of Interest Rate on Call Loans at New York Stock Exchange, 1857-1959

Author	Description	Period	Frequency	Observation	Source
Nishimura (1971, pp. 113, 120-128)	unstated	1881-1914	monthly	average of weekly figures[j]	*The Economist*
same	unstated	1881-1913	annual[k]	average of monthly series	*The Economist*
Friedman and Schwartz (1982, pp. 122-125)	renewal rate	1867-1959	annual	average of monthly series[l]	Macaulay (1938), BMS, *1914-1941*
Homer and Sylla (1991, pp. 318-320, 358-359)	renewal rate	1857-1945	annual	high, low, average: averages of monthly series	Macaulay (1938), Federal Reserve publications
same	unstated	1866-1945	annual	high, low quotations	FR, Owens and Hardy (1930), Martin (1886), Andrew (1910), Library of the New York Stock Exchange

[a]Also, 1890-1909 in Mitchell (1911, p. 273), 1890-1911 in Mitchell (1913a, p. 146), and 1890-1912 in Mitchell (1913b, p. 521).

[b]Also, 1890-1909 in Mitchell (1911, pp. 274-275).

[c]Also, 1890-1909 in Mitchell (1911, pp. 276-280).

[d]Except that annual series is average of monthly series.

[e]Annual series are averages of monthly series.

[f]Reprinted (monthly series) 1902-1913 in Goodhart (1969, pp. 206-220).

[g]Also, weekly (average of daily figures) 1919-1941 (pp. 452-459).

[h]Also, weekly (average of daily figures, pp. 675-689).

[i]Statement in HSUS, *Colonial Times to 1970* (p. 1001, n. 3) and in HSUS, *Millenial Edition*, that series is "seven-day average for week ending Wednesday" makes no sense.

[j]Stated by Capie and Webber (1985, p. 321).

[k]Year ending March 31.

[l]The statement of Friedman and Schwartz (1982, p. 128)—with a similar pronouncement on page 109)—that the monthly series underlying their annual average are "based on weekly renewal rates until 1923; thereafter, daily renewal rates" is not supported by the sources.

Abbreviations: FR = *Financial Review*, CFChr = *Commercial and Financial Chronicle*, HMM = *Hunt's Merchant Magazine*, BM = *Bankers' Magazine*, JC = *Journal of Commerce,* BMS = *Banking and Monetary Statistics*, HSUS = *Historical Statistics of the United States*, BGFRS = Board of Governors of the Federal Reserve System

2. Federal Funds

Compilations of the federal-funds rate are presented in Table 11. The compilations all have the Federal-Reserve series—that is, the "official" series—as the source, even those the source of which is unstated. The compilations are divided into two groups: Federal-Reserve publications, that formally present the series, and other publications. The (official) federal-funds rate reflects actual transactions in the market. Originally, it was described as a "consensus" rate of market participants and distinctly not an average; subsequently, it was computed as an average rate.[33]

Table 11
Compilations of Federal-Funds Rate, 1954-2001

Author	Period	Frequency	Observation	Source
I. Federal Reserve Series				
BMS, *1941-1970* (pp. 689-692)	1955-1970	annual	average of monthly series	Federal Reserve Bank of New York
same	1954-1970	monthly	average of daily figures	same
ASD, *1970-1979* (pp. 162-172)	1970-1979	annual, monthly	average of monthly series, average of daily figures	same
ASD, *1980-1989* (pp. 141-150)	1980-1989	same	same	same
ASD, *1990-1995* (pp. 92-97)	1990-1995	same	same	same
FRB, various issues	1996-2001	same	same	same
BGFRS website[a]	1955-2001	annual[b]	average of monthly series	same

Table 11 Compilations of Federal-Funds Rate, 1954-2001				
Author	Period	Frequency	Observation	Source
same	1954-2001	monthly	average of daily figures	same
II. Other Publications				
Homer and Sylla (1991, pp. 388-389)	1955-1989	annual	average of monthly series	Federal Reserve publications
same	1954-1989	annual	high and low series (averages of monthly values)	Federal Reserve publications
IFS, publications and CD-ROM	1955-2001	annual	unstated	unstated
same	1957-2001	monthly	unstated	unstated
HSUS, *Millenial Edition*	1995-1997	annual	average of monthly series	Federal Reserve publications

[a]federalreserve.gov

[b]Series differs from that in Federal Reserve publications as follows: one basis point for 1955, 1959, 1960, 1961, 1969, 1970, 1971, 1972, 1973, 1974, 1976, 1978, 1979; three basis points for 1962.

Abbreviations: BMS = *Banking and Monetary Statistics*, ASD = *Annual Statistical Digest,* FRB = *Federal Reserve Bulletin*, BGFRS = Board of Governors of the Federal Reserve System, IFS = *International Financial Statistics*, HSUS = *Historical Statistics of the United States*

C. Contemporary Series: Selection of Data

1. Stock-Exchange Call Loan (1857-1954)

Components of the U.S. surplus-funds short-term interest rate are listed in Table 12, columns 1-2. For the call-loan interest rate, the renewal rate is the obvious preferred rate concept (see section A.2.a), and it is adopted for **What Was the Interest Rate Then?** So the component series pertain to the renewal rate.

Table 12 Components of U.S. Short-Term Interest Rate: Surplus Funds, 1857-2001				
		Overlap for Consistent Series		
Component	Period	Period	Annual Divergences[a] (basis points)	Linking Ratio[b]
I. Call-Loan Interest Rate[c]				
Macaulay (1938)[d]	1857-1889			
BMS, 1914-1941	1890-1941			
BMS, 1941-1970	1941-1954	1955-1959	-142, -130, -139, -215, -92	0.6258
II. Federal-Funds Rate[e]				
BMS, 1941-1970	1955-1970			
ASD, 1970-1979	1970-1979			
ASD, 1980-1989	1980-1989			
ASD, 1990-1995	1990-1995			
FRB, various issues	1996-2001			

[a]Subsequent series minus current series. See section I.B.3 of text.

[b]Average of annual ratios of subsequent series to current series. See section I.B.3 of text.

[c]Component series described in Table 10 and in section B.1 of text.

[d]Annualized by author, see text.

[e]Component series described in Table 11 and in section B.2 of text.

Abbreviations: BMS = *Banking and Monetary Statistics*, ASD = *Annual Statistical Digest*, FRB = *Federal Reserve Bulletin*

The official series is chosen for the maximum extent, 1890 to 1954. For the years prior to 1890, the Macaulay series—just as carefully constructed for the call-loan interest rate as it is for the commercial-paper rate—is selected. The Macaulay series also has the advantage of beginning in the year 1857, earlier than any other series. The series is annualized by averaging monthly observations.[34]

Just as for the commercial-paper interest rate, there is the alternative of using the Macaulay series until 1919, the year in which the Federal Reserve Bank of New York. The judgment in this case is immaterial, because the Macaulay and official series—the latter again emanating from Persons (1919) for 1890-1918—are consistent (see section D).

2. Federal Funds (1955-2001)

The Federal Reserve is the only source of the federal-funds rate. The Federal Reserve Bank of New York first estimated the federal-funds rate in July 1954. The

federal-funds component of the contemporary series begins in 1955, thus providing a full year of data in the beginning year (as distinct from a half-year should July 1954 be the start). The data-driven implication is that the switch from the call loan to federal funds occurred at the beginning of 1955—consistent with the previous finding that the switch from the call loan to federal funds may have occurred in 1954-1955 (see section A.1).[35]

D. Consistent Series: Linking of Component Series

The annualized-Macaulay and the Federal-Reserve series are identical (to two decimal places) over 1890-1894; so the two series are deemed consistent, and no overlap is shown in Table 12. Therefore a consistent series requires only an ovelap between the call-loan and federal-funds components of the surplus-funds interest rate. For this purpose, the official call-loan interest-rate series is extended five years, to 1955-1959, and the overlap with the federal-funds-rate series computed. As shown in Table 12, columns 3-5, the difference between the series is substantial, with the federal-funds series markedly lower and a linking ratio almost as low as three-fifths. A consistent surplus-funds short-term interest rate over 1857-2001 is thereby achieved.

V. Short-Term Interest Rate, Surplus Funds: United Kingdom

A. Market Instruments

1. Representative Market Instruments and Applicable Subperiods

Just as for the United States, the original instrument for surplus funds was the call loan. Call loans existed in the second half of the eighteenth century (Ashton, 1955, p. 179). Even earlier, "by 1730...there was something analogous to loans on call and at short notice in the use made of Exchequer Bills of various kinds" (John, 1953, p. 140). However, the call-loan *market* began later, in the 1820s (King, 1936, pp. 67-68; Hawtrey, 1938, pp. 10-11; Pressnell, 1956, p. 104). Then, "toward the end of the [19th] century, call loans became increasingly important" (Homer and Sylla, 1991, p. 206). So the rate of interest on call money was the representative and dominant surplus-funds money-market instrument. However, unlike in the United States, call money lost its dominance not to a U.K. federal-funds equivalent (which never came into existence) but rather to the interbank deposit.

The identity of the interbank deposit as successor instrument to the call loan is clear: "whereas in earlier times they [the non-clearing banks] might have adjusted balances with the clearing banks by selling bills, by calling in funds lend to the discount market against security, or in other ways, nowadays they may lend and borrow between themselves on an unsecured basis."—Wadsworth (1973, p. 169). In these earlier times, "the clearing banks lent surplus funds to the discount houses, which met subsequent withdrawals by attracting surplus funds from another bank. Thus interbank borrowing and lending occurred indirectly through the agency of the discount houses."—Lewis and Davis (1987, p. 84). The Bank of England describes the interbank market as "the

wholesale market in which banks and others lend and borrow money for predetermined periods ranging from overnight to one year, to accommodate short-term liquidity needs or for the lending on of surplus funds."—*Annual Statistical Abstract*, Part 1, 2001, Explanatory Notes, p. 195.

The year in which the interbank deposit replaced the call loan as dominant surplus-funds instrument is not so clear, because data on outstanding amounts of the instruments do not exist. Wadsworth (1973, p. 169) writes: "an active [interbank] market has developed since 1960 in sterling funds." The Bank of England observes: "The unsecured interbank deposit market began to develop in the 1960s....This market was given further impetus by the deregulatory reforms of the early 1970.—*Annual Statistical Abstract*, Part 1, 2001, Explanatory Notes, p. 195. These statements suggest that the "switch" from call loan to interbank deposit as dominant surplus-funds asset occurred sometime in the 1960s.

2. Descriptions of Market Instruments

a. Call Money

Just as in the United States, call loans were made without fixed maturity, with either party to the transaction able to initiate termination of the loan. However, unlike in the United States, the loans were made by banks typically not to stock-exchange brokers but rather to discount houses that dealt in bills of exchange. In part for this reason, the call-loan market remained important in the London market long after the experience of the stock-market crash in 1929 led to U.S. legislation that rendered the U.S. call-money market inconsequential.[36]

b. Interbank Deposit

Transactions in the interbank-loan market involve "deposits, placed by one institution with another for a specified period at an agreed rate" (Wadsworth, 1973, p. 165). While technically different from federal-funds transactions, the effect is basically the same: the borrowing bank has access to more reserves and liquidity, while the lending bank earns interest on funds that might otherwise lie idle. Just as in the federal-funds market, interbank loans are not secured, enabling speed and convenience in transactions. Maturity of the loans is generally up to three months, although transactions formally can be up to one year.

Most transactions are overnight, as in the federal-funds market. However, there is an important qualification: "It [overnight money] may be 80 per cent or more of total turnover. But it must be remembered that in calculating this statistic, overnight money is turned over every day; one-month money, for example, is only turned over once in the month, and similarly for other 'period' money."—Wilson (1993, p. 393, n. 20). In terms of outstanding lending at a point in time, it may be that "period" money of a certain maturity—say, one month or three months—is dominant.[37] Thus Wilson (1993, p. 13)

further writes: “The main items in ‘period’ money would be borrowed for 1 month and 3 months.”

B. Compilations of Series

1. Call Money

Compilations of the London call-money rate are summarized in Table 13. There are three groups: series based on figures in *The Economist*, other privately compiled series, and official series. The earliest date of a continuous series is 1855, the beginning of the Nishimura series; but there are scattered call-loan interest rates in the testimony of Lord Overstone in 1857 before a Parliamentary committee (*Report from the Select Committee on Bank Acts*, 1857, p. 334).

Table 13
Compilations of London Call-Money Rate, 1855-1972

Author	Period	Frequency	Observation	Source
I. *The Economist* Data				
NMC (1910, pp. 43-62)[a]	1889-1908	weekly	specific day	*The Economist*
Peake (1923, pp. 59-62)[b]	1882-1914	monthly	first Friday	*The Economist*
Nishimura (1971, pp. 114-128)	1855-1914	monthly	average of weekly figures[c]	*The Economist*
II. Other Privately Compiled Series				
BMS, *1914-1941* (pp. 656-661), *1941-1970* (pp. 1030-1034)	1924-1970	monthly	average of daily figures	*The Economist*, *Financial Times*
Sheppard (1971, p. 190)	1891-1908	annual	average of monthly high and low figures	Goodhart (1963)
same	1919-1966	annual	average of daily figures[d]	LCESMB, BESS, AAS
Capie and Webber (1985, pp. 494-525)	1870-1972	annual, quarterly, monthly	month-end or last week or last Friday[e]	*The Economist*, BESA
Homer and Sylla (1991, p. 206)	1889-1900	annual	averages of monthly high and low figures	unstated
III. Official Series				
Annual Abstract of Statistics[f]	1919-1938	monthly	averages of daily high and low figures	*Bankers’ Magazine*

Table 13 Compilations of London Call-Money Rate, 1855-1972				
Author	Period	Frequency	Observation	Source
same	1935-1958	monthly	average of daily figures	Bank of England
same	1948-1971[g]	specific periods	minimum rate	Bank of England

[a]Reprinted 1891-1908 in Goodhart (1986, pp. 591-606).

[b]Reprinted 1891-1914 in Goodhart (1986, pp. 591-611).

[c]Stated by Capie and Webber (1985, p. 321).

[d]1963-1966: average using duration in weeks as weights

[e]Where range of rates, average taken.

[f]Formerly *Statistical Abstract for the United Kingdom*.

[g]September 30.

Abbreviations: NMC = National Monetary Commission, BMS = *Banking and Monetary Statistics*, LCESMB = London & Cambridge Economic Service *Monthly Bulletin*, BESS = Bank of England *Statistical Summary*, AAS = *Annual Abstract of Statistics*, BESA = Bank of England *Statistical Abstract*

The compilations vary in the name given to the instrument: “call money,” “money on call,” “money at call,” “floating money,” “day-to-day money,” “day-to-day loans,” “short loans,” “clearing-bank lending rate against approved bills, “lending rate of clearing banks to discount market.”

The Capie-Webber series is for the last working day of the month, except : (i) January 1870 - May 1890, last week of the month (with the average taken where there is a range of rates), (ii) 1945-1974, last Friday of the month (data for this period are presented as a range of rates, and the average is taken).

The 1948-1971 series of the *Annual Abstract of Statistics*, the final entry in Table 13, is unique in providing not an average or actual interest rate, but rather the minimum lending rate of clearing banks to the discount market. In the range of rates that underlie the Capie-Webber series for 1945-1974, the lower rate is this minimum lending rate.

2. Interbank Deposit

Compilations of the three-month interbank-deposit rate are shown in Table 14. The Bank of England series is obtained directly by the present author from the Bank. The *Annual Abstract of Statistics* series logically is identical to the Bank series, and both are consistent with the series on the National Statistics website, except that the last series is end-of-month rather than daily average for the month.

Table 14
Compilations of Three-Month Interbank-Deposit Rate, 1968-2001

Author	Period	Frequency	Observation	Source
Bank of England	1978-2001	monthly	average of daily rates[a]	Bank of England[b]
National-Statistics website[c]	1978-2001	monthly	month-end: bid rate, offer rate	Bank of England
Annual Abstract of Statistics	1968-2001	monthly	1968-1970: month-end daily rate; 1971-2001: average of daily rates[a]	Bank of England

[a]Daily rate is midpoint of bid and offer rates.

[b]Provided directly to author.

[c]statistics.gov.uk

There exist interest rates for other than three-month maturity; but the three-month rate is available further back in time than the rate for any other maturity.[38] So three months is the maturity for the series in Table 14, that will underlie components of the surplus-funds money-market interest-rate series for the U.K.

C. Contemporary Series: Selection of Data

1. Call Loan (1855-1967)

Components of the U.K. surplus-fund short-term interest-rate contemporary series are shown in Table 15, columns 1-2. The earliest data on the interbank-deposit rate is for 1968; so, of necessity and consistent with the argument in section A.1, 1967 is construed to be the final year for which the call-loan rate is the representative interest rate for surplus funds. The first part of Table 15 lists the selected components of the call-loan segment of the interest-rate series.

Table 15 Components of U.K. Short-Term Interest Rate: Surplus Funds, 1855-2001				
		Overlap for Consistent Series		
Component	Period	Period	Annual Divergences[a] (basis points)	Linking Ratio[b]
I. Call-Money Rate[c]				
Nishimura (1971)[d]	1855-1913	1909-1913	-38, -44, -33, -50, -55	0.8444
Capie and Webber (1985)	1914-1918	1919-1920	-23, -20	0.9426
AAS[d]	1919-1944			
Capie and Webber (1985)	1945-1967	1968-1972	160, 230, 183, 140, 174	1.3070
II. Interbank-Deposit Rate[e]				
AAS[d]	1968-1977			
Bank of England[d]	1978-2001			

[a]Subsequent series minus current series. See section I.B.3 of text.

[b]Average of annual ratios of subsequent series to current series. See section I.B.3 of text.

[c]Component series described in Table 13 and in section B.1 of text.

[d]Annualized by author, see text.

[e]Component series described in Table 14 and in section B.2 of text.

Abbreviation: AAS = *Annual Abstract of Statistics*

For 1945-1967, the Capie-Webber annual series is selected, even though it is the average of month-end figures (rather than, the preferred, monthly figures that are themselves intra-monthly averages, say of daily or weekly rates). Explanation is required. Capie and Webber (1985, p. 527) note that there is a break in the call-money series. The old series, which exists to 1946 but which they take to 1944, is from *The Economist*. The new series, available from 1945, is from the Bank of England *Statistical Abstract* (BESA).

The Economist series is too low for consistency with the BESA series. Resort must be had to the *Annual Abstract of Statistics* (AAS) series. The 1919-1938 version of this series (see Table 13) is annualized by taking a 24-observation average (high and low figure for each of the 12 months). The 1935-1958 version is annualized by taking the 12-month average.

The 1935-1958 AAS series is higher than *The Economist* series (as it appears in Capie-Webber) from 1938 to 1944 (and identical to it from 1935 to 1937) and appears consistent with the BESA series.[39] Therefore the *AAS* series is used instead of the Capie-Webber (*The Economist*) series for 1919 to 1944. Then, for 1945-1967, the Capie-Webber series is employed. For 1935-1938, one of the *AAS* versions must be selected.

The 1919-1938 version is taken, because for three of the four years it differs from Capie-Webber, whereas the 1935-1958 version is identical to Capie-Webber for three of the years.

For 1855-1913, the Nishimura series is selected. This series is longer than any other for the pre-World War I period, and is an intra-monthly average—two good reasons to choose it over alternatives. The series is annualized via twelve-month averaging. Call-loan interest-rate data prior to 1855 are too scattered to continue the series for earlier years. For 1914-1918, the Capie-Webber series is the only choice, as no other compiled series covers this full period.

2. Interbank Deposit (1968-2001)

It is only logical to choose the Bank of England series for its available span, 1978-2001, preceded by the AAS series for 1968-1977. These series are annualized via twelve-month averages. Thus the contemporary surplus-funds money-market interest-rate series for the United Kingdom is obtained for 1855-2001.

D. Consistent Series: Linking of Component Series

Component series must be extended ideally by five years, for generation of an overlap, thus enabling linking to subsequent series and creation of a consistent over-all series. The overlaps are shown in Table 15, columns 3-5. Linking of the Nishimura series to the Capie-Webber series (1909-1913), and linking Capie-Webber to the AAS series (1968-1972) are done in standard fashion. The overlap of Capie-Webber to AAS involves only a two-year (1919-1920) overlap, for two reasons. First, Capie-Webber is used currently for only a five-year period (1914-1918); an overlap that long is incongruous. Second, for 1919-1920 the Capie-Webber series is greater than AAS; for the following twelve years (1921-1932), Capie-Webber falls below AAS. It is assumed that the 1919-1920 experience is indicative of that of earlier years.

It does not seem appropriate to have an overlap linking the AAS to the Capie-Webber series; because AAS exceeds Capie-Webber in 1941-1944, while Capie-Webber exceeds AAS in 1946-1950. Also, the shift from the 1919-1938 version of AAS to the 1935-1958 version in 1939 is done without overlap, because the annual overlaps for 1935-1938—not shown in Table 12—are small (2, -1, 0, -1 basis points) and sum to zero. Finally, the interbank-deposit-rate series of the Bank of England and AAS are consistent (the latter series emanating from the former as source), with any difference explainable via rounding.

VI. Long-Term Interest Rate: United Kingdom

A. Market Instruments

1. Representative Market Instruments and Applicable Subperiods

From the time consols came into existence, in the mid-18th century, until World War I, the yield on consols was the representative British long-term interest rate. Acceptance of the representativeness of the consols yield was universal, as authors have commented. "It has long been customary to measure the changes in the rate of interest in England by the calculated yield upon 3 per cent Consolidated Anuities."—Silberling (1919, p. 289). "The yield on Consols...is almost exclusively used as the measure of the long-term rate of interest."—Harley (1976, p. 101). "The consol rate is often used as a measure of long-term market interest rates."—Solomou (1996, p. 168).

Individual authors are specific about the representative quality of the consols yield. Pressnell (1956, p. 89) refers to "the market rate of interest, as reflected in the yield of 3 per cent. Consols." Ashton (1959, p. 112) writes of "the Consolidated 3 per cents., the yields on which may be taken as representing rates on long-term investment [in the 18th century]." Mitchell and Deane (1962, p. 437) assert: "As a measure of the long-term rate of interest it [the yield on consols] comes as close as we can to that theoretical abstraction....no better indicator of the long-term rate of interest exists."[40] Capie and Webber (1985, p. 317) declare: "During the nineteenth century and until the outbreak of the First World War, Consols were representative of long-term and British gilt-edged yields, when they comprised a very large part of the National Debt."

Homer and Sylla (1991, pp. 160, 442) state: "Their [consols'] yield...gave a rough picture of the level and also of the fluctuations of long-term prime interest rates in eighteenth- and nineteenth-century England....The reliance on the yield of one issue was permissible during a good part of the eighteenth century and most of the nineteenth century, when consols comprised a very large part of the national debt."

The term "consols" is an abbreviation of "consolidated annuities." Prior to the availability of a market yield on consols (1753), that paid a coupon rate of 3 percent (whence the term "three-percent consols)," the yield on (non-consolidated) annuities—in particular, "old three-percent annuities"—legitimately serves as the representative rate. Bonds were called "stocks," still the nomenclature in the United Kingdom. So Ashton (1955, p. 27; 1959, p. 88), referring to both consols and the predecessor annuities and to the 18th century, writes: "The yield on government stocks gave the ply to the whole system of interest rates....The yield on government stock is, then, the chief representative of a whole family of long-term rates."

One reason for the representativeness of consols and earlier annuities is that, as the return was computed as the yield on a varying price, the usury laws did not apply. As Pressnell (1960, p. 180) observes: "The return on such means of payment [bonds] was calculated as a yield on their prices, which were free to fluctuate; this quite legitimately

short-circuited the usury laws." Ashton (1955, p. 28) writes: "there was no limit to the yield on government stock; it is an accurate index of the supply of loanable funds at all levels." As Homer and Sylla (1991, p. 184) note, "government bonds were called the 'funds' or the 'gilt-edged.'" So they state: "The market yield on the funds usually set the minimum rate of interest for long-term loans of all sorts" (1991, p. 162).

After World War I, consols lost their exclusive representativeness of the long-term interest rate. While the yield on government bonds ("gilt-edged securities" or "gilts") remains the pertinent concept, from 1919 onward that yield is properly measured by a broader measure than the yield on consols. This judgment is made by all historians that have commented on the matter, as follows:

"It [consols] is less representative of the long-term market since World War I than it was earlier. Until World War I, the United Kingdom national debt consisted largely of consols. Since then, the government has floated many issues with limited maturities."—Friedman and Schwartz (1982, p. 120).

"Both world wars were in part financed by the issue of a great variety of bonds with differing rates and terms, and the old concept of perpetual funded debt was gradually replaced by a concept of funding and re-funding. Most of the new issues, with higher nominal rates of interest, commanded higher yields in the market than yields on Consols most of the time. Thus from the First World War the yield on Consols can no longer be taken as typical of the market, although the difference was usually not large."—Capie and Webber (1985, p. 317).

"The history of the yields of British funds in the twentieth century can no longer be based solely on consol yields....The world wars of the twentieth century, however, were financed by a great variety of bond issues with all sorts of rates and terms....Most of these issues with higher nominal rates commanded higher yields in the market most of the time than the yields of the consol 2_s....The yield on consols after 1918, therefore, can no longer be taken as typical of the market, although the difference usually was not large."—Homer and Sylla (1991, pp. 442-443).

2. Descriptions of Market Instruments

a. Pre-Consol Annuities

In the first half of the 18th century, prior to creation of consols, the British government obtained long-term funding via a variety of annuities sold to the public. Some annuities were perpetual, anticipating the consols.[41]

b. Consols

The two most important characteristics on consols are (1) they were perpetual, at least in the sense that they had no maturity date, and (2) they carried a fixed rate of interest. "In essence, they were perpetual annuities and were often called just that"

(Homer and Sylla, 1991, p. 185). On the one hand, these properties were advantageous to holders of the asset, because interest at the fixed rate could be earned indefinitely, at least in principle. On the other hand, holders were not guaranteed recovery of the full principal (that is, the face-value of the security); for, absent a fixed redemption date, selling the asset in the open market was the only option, and that might involve a capital loss.[42]

The combinations of (1) infinite maturity, (2) fixed interest rate, and (3) fluctuating price in the market, imply a straightforward computation of the market yield on consols. The yield (percent per year) is 100·(I/P), where I is the interest rate (percent per year) and P the market price (where par = 100). Consols were created in 1751 via consolidation of several existing annuities paying 3% interest. The interest rate on consols was 3% from 1751 to April 4, 1888, 2_% from April 5, 1888, to April 4, 1903, and 2_% from April 5, 1903 onward.[43]

There are two problems with the representativeness of consols for the long-term interest rate even before 1919. First, even though no fixed maturity date was associated with consols, the security was subject to call and redemption by the government at par at the option of the government (after allowing for notice, if any, associated with the particular consols issue). Hawtrey (1938, p. 155) refers to "consols, being repayable at par at the option of the Government." Harley (1976, p. 101) writes: "Consols...have always been redeemable at par after some specified interval."

Clearly, when the price of consols rose above par, implying a market yield below the fixed interest rate, it would be feasible—and in the interest of the Treasury—to call in the consols, redeem them at par, and replace them with new issues of consols at a lower fixed interest rate. The consols price is depressed below that of an equivalent truly perpetual security, and therefore the consols yield overstates the long-run interest rate. The consols yield, then, while still reflecting the market's valuation of the security, is no longer representative of the long-run interest rate.

As Hawtrey (1938, pp. 155-156) states: "Consols...ceased to give a reliable guide to the long-term rate of interest, for when the [market] rate fell below 3 Consols could never rise far above 100." Similarly, Harley (1976, pp. 101; 103, n. 2), who provides the most thorough discussion of the issue, observes: "As the price of Consols rises above par the possibility of redemption limits subsequent increases. At the same time Consols effectively cease to be perpetual bonds...Consols...being held near par by the threat of conversion."

Homer and Sylla (1991, pp. 160, 192) concur: "When the price of consols was high, that is, not far below 100 or at a premium, their yield was apt to be higher than other long-term rates because of the possibility of redemption, which might not apply to funds selling at a lower price....[When]...the 3% consols were selling around 100. At such prices, the consols were no longer a good guide to the market rate of long-term interest, because they were redeemable by the government at 100."[44]

In 1881 the prices of the three outstanding issues of 3% consols went above par and stayed above par for much of the 1880s.[45] Two of these issues were redeemable without notice; one issue upon twelve-months' notice. "Threats of conversion thus eliminated the 3 per cent Consols as a long-run security and as an indicator of the long-run rate of interest" (Harley, 1976, p. 102).[46]

The second problem with the representative nature of consols is associated with the so-called "new" or "Goschen" Consols, created in "Goschen's great conversion of 1888" (Harley, 1976, p. 103). In his capacity as Chancellor of the Exchequer, George Joachim Goschen replaced existing consols with a consol that earned 2_% interest to April 1903, followed by 2_% interest perpetually—except that in 1923 the consol was redeemable on demand by the Treasury with no notice given. The standard computation of the yield, 100·(2.75/P), does not apply and in fact is biased upward, because of the temporary nature of the 2_% rate.[47]

A further possible complication—emphasized by Harley (1976, pp. 103-104), followed by Capie and Webber (1985, pp. 317-318)—is the fact that in 1894 the Goschen Consols rose above par, making apparent the possibility of redemption. However, such redemption could occur not until over a quarter-century had passed, in 1923, which suggests that this issue is unimportant.

In sum, the consols yield as traditionally measured is questionable as the representative long-term interest rate from 1881 to 1902. Certainly, consideration should be given to possible adjustment or replacement of the consols yield during this time period, for **What Was the Interest Rate Then?** The entire issue of the nonrepresentativeness of consols is summarized well by Capie, Mills, and Wood (1991, p. 260):

> The usual Consol yield series...has traditionally been miscalculated for the years 1880 to 1903. It overestimates the true yield on Consols for two reasons. The price of Consols in this period rose above par, thus increasing the possibility of redemption at par and decreasing the true yield; and the details of Goschen's conversion of the National Debt in 1889 affected the way in which Consol yields were calculated.

c. Gilt-Edged Securities

The broad U.K. government-bond market, called the "gilt-edged market," is applicable from 1919 for **What Was the Interest Rate Then?** The description and history of this market are provided in Llwellyn (1992) and Shepperd (1992).[48]

B. Compilations of Series

1. Pre-Consol Annuities

Compilations of the market price or yield of pre-consol annuities are shown in Table 16. The series of Sinclair (1803), Rogers (1902), and Ashton (1955, 1959) are relevant. In these series the figures on pre-consul annuities simply continue back in time the corresponding data for consols.

Table 16
Compilations of Annuities/Consols Price or Yield, 1729-1923
Series Not Spanning 1881-1902

Author	Description	Period	Frequency	Observation	Form[a]	Source
I. Pre-1881 Series						
Sinclair (1803, pp. 28-46)	old annuities,[b] consols[c]: price	1731-1802	monthly	"medium rate"	2	periodicals, stock-exchange books
Rogers (1902, pp. 884-940)	old annuities, consols[d] : price	1729-1793	varies, daily by mid-18th century	specific dates	fract.	"original and contemporan-eous records"
Silberling (1919, p. 289)	consols: price, yield	1790-1830	annual	average of mean of monthly high and low prices, at average price	2, 1	*Gentlemen's Magazine*
Hawtrey (1938, pp. 281-288)	consols: price	1844-1878	day preceding change in Bank Rate	specific dates	fract.	unstated
Ashton (1948, p. 229)	consols: yield	1756-1830	annual	unstated	1	unstated
Ashton (1955, p. 251)	old annuities,[e] consols[f]: price	1727, 1729-1800	annual	September	2	Sinclair (1803), Rogers (1902)
Ashton (1959, p. 187)	old annuities,[e] consols[f]: yield	1731-1801	annual (July-June)	"medium rate"	1	Sinclair (1803)

Table 16 Compilations of Annuities/Consols Price or Yield, 1729-1923 Series Not Spanning 1881-1902						
Author	Description	Period	Frequency	Observation	Form[a]	Source
Heim and Mirowski (1987, p. 120)	consols: yield	1780-1825	annual	first Wednesday in April	2	*Course of the Exchange*
II. Post-1902 Series[g]						
Morgan (1952, p. 152)	consols: yield	1914-1923	monthly	"calculated from average prices"	2	*Annual Abstract of Statistics*[h]

[a]Number of decimal places, or "fract." = fractional part.

[b]To March 1758.

[c]From April 1758.

[d]Division of period between old annuities and consols not specified. Series incorrectly described as "Consolidated Three Per Cents" for entire period.

[e]To 1757.

[f]From 1758.

[g]Series that begin after 1919 excluded.

[h]Formerly *Statistical Abstract for the United Kingdom*.

2. Consols

Compilations of the consols market price or yield fall into five categories, each with its own summary table:

a. Compilations that end before 1881 or begin after 1902 (Table 16)

These compilations avoid the issues with the consols yield elucidated in section A.2.b. The two parts of the table, quite naturally, separate the pre-1881 from the post-1902 series (for which Morgan is the only entry, with series that begin after 1919 excluded from the table—in fact, from all the consols tables). Sinclair (1803) deserves praise for providing a central-tendency price for each month rather than a month-end (or other specific date) or high/low price. As he writes: "Price is in general at a medium Rate, neither the highest nor the lowest" (1803, p. 18).

There is a problem with each of Ashton's compilations. His (1948, 1959) series have only one decimal place. His (1955) series has an entry for 1727 (but not for 1728) that is not supported by the stated sources. Neither Sinclair nor Rogers have a figure for 1727. So it is not apparent how Ashton (followed by the Homer-Sylla series in Table 20 below) obtained a figure for 1727. Also, Ashton's (1955) figure (91) for 1730 is different from that of Rogers (97), the source for that year.

Excluded from Table 16 (and like tables throughout the study) are unpublished series. Noteworthy in this category is the data set described in Brown and Easton (1989, p. 64) and Mitchell, Brown, and Easton (2002, pp. 301-302). This is a daily series consisting of closing prices of consols for 1821-1860. The source is *Course of the Exchange*. While the series—composed as it is of over 10,000 observations—is not published, the authors do provide a dozen summary statistics of the series (2002, p. 302).

b. Compilations that ignore 1881-1902 issues (Table 17)

Compilations in Table 17 span part or all of the problem-laden 1881-1902 period, but ignore the matter. The series are separated by the time period covered: pre-World War I, 20th century, 19th-20th century, and 18th-20th century. Gibson (1908, p. 53) is noteworthy for figures that are explicitly averages of daily figures, "the middle prices at 1 o'clock on each day averaged for the year," except that his figure for 1907 is the mean of the high and low for the year. Mitchell (1911) uses Gibson's figure for the year 1903.

Table 17
Compilations of Consols Price or Yield, 1753-1923
Series That Ignore 1881-1902 Issues

Author	Description	Period	Frequency	Observation	Form[a]	Source
I. Pre-World-War-I Series						
Van Oss (1898, pp. 28-29)[b]	price	1789-1897	annual	high, low	fract.	unstated
Sauerbeck (1886, p. 648)	price	1846-1885	annual	"average price"	fract.	"actual figures"
Gibson (1908, pp. 51-54)	price	1840-1907	annual	average of daily figures; annual high, annual low	fract.	unstated
same	yield	same	annual	at average price	£, s, d	same

Table 17
Compilations of Consols Price or Yield, 1753-1923
Series That Ignore 1881-1902 Issues

Author	Description	Period	Frequency	Observation	Form[a]	Source
same	price	1790-1906	5-year periods	averages: annual high, low, mean of high and low	fract.	same
same	yield	same	same	at mean price	£, s, d	same
same	price	1840-1906	5-year periods (except 1905-1906)	averages: annual average of daily figures, high, low	fract.	same
same	yield	same	same	at average price	£, s, d	same
Andrew (1910, p. 281)	yield	1878-1909	annual	at average price	2	MZP
Mitchell (1911, p. 303)[c]	yield	1890-1909	annual	at average price	2	Andrew (1910), Gibson (1908)
Williams (1912, pp. 399-400)[d]	price, yield	1849-1910	annual	see entry for AAS below	2	AAS
Pember and Boyle (1950, p. 145)	price	1900-1923	annual	high, low, year-end	fract.	Pember and Boyle
same	yield	same	same	year-end	£, s, d	same
Tinbergen (1956, fold-out)	yield	1870-1914	annual	average of monthly figures[e]	2	AAS
Goodhart (1986, pp. 591-611)	price	1891-1914	monthly	average of monthly figures[e]	fract.	AAS
II. 20th-Century Series						
LCES (1971, p. 16)	yield	1900-1923	annual	at average price	2	*Financial Statistics*
Paish (1966, p. 32)[d]	yield	1902-1914	quarterly	Jan., April, July, Oct.	1	unstated
III. 19th-20th-Century Series						

Table 17
Compilations of Consols Price or Yield, 1753-1923
Series That Ignore 1881-1902 Issues

Author	Description	Period	Frequency	Observation	Form[a]	Source
Editor of *The Statist* (1921, p. 255)	price	1873, 1896, 1900-1920	annual	"average price"	fract.	Editor of *The Statist*
Hawtrey (1938, pp. 290-296)[f]	price	1889-1923	day preceding change in Bank Rate	specific dates	fract.	unstated
AAS	price	1852-1923	monthly, annual	"average" for month, average of monthly series	fract.	Bank of England
Sheppard (1971, p. 190)	yield	1860-1923	annual	average of monthly figures[e]	2	AAS
Capie and Webber (1985, p. 318)[g]	yield	1870-1923	annual, quarterly; monthly	average of monthly series; month-end	3	*The Economist*
IV. 18th-20th-Century Series						
Warren and Pearson (1933, p. 403)[h]	yield	1753-1923	annual	see entries for Sauerbeck, Silberling, AAS	2	Sauerbeck (1886), Silberling (1919), BM, JRSS[i], *Bradstreet's*
Mitchell and Deane (1962, p. 455)[g, j]	yield	1756-1923	annual	See entries for Ashton, Warren and Pearson, AAS	1	Ashton (1948), Warren and Pearson (1935), AAS[k]

[a]Number of decimal places, or "fract." = fractional part, or "£, s, d" = £, s, d per £100.

[b]But see Table 18.

[c]Reprinted in Mitchell (1913a, p. 165).

[d]But see Table 20.

[e]Themselves average price for month.

[f]But see Tables 18 and 19.

[g]But see Tables 18 (note f) and 19 (note d).

[h]Reprinted in Warren and Pearson (1935, p. 403).

[i]For 1852-1923, equivalent to AAS data. See note k.

[j]Reprinted in Mitchell (1988, p. 678).

[k]AAS source redundant, as Warren and Pearson "also contains the figures up to 1934" (Mitchell and Deane, 1962, p. 455; Mitchell, 1988, p. 678).

Abbreviations: MZP = *Materialien zur Beurteilung der Zusammenhänge zwischen dem öffenlichen Schuldenwesen und dem Kapitalmarkie*, AAS = *Annual Abstract of Statistics* (formerly *Statistical Abstract for the United Kingdom*), LCES = London & Cambridge Economic Service, BM = *Bankers' Magazine*, JRSS = *Journal of Royal Statistical Society*

c. Compilations that address redemption possibility in 1880s (Table 18)

All the authors listed in Table 18 adopt the same solution to the issue of the pre-Goschen consols rising in price above par in the 1880s: replacement of the price of 3% consols with the price of a pre-existing 2_% consols.[49] This solution was discovered by contemporary observers and market participants, and later noted by Hawtrey (1938, p. 150): "in the period from 1879 to 1888 when their [consol's] price was tied close to parity by the Government's option of repayment. In those years the 2_ per cent. annuities take the place of Consols." Harley (1976, pp. 102-103) eloquently describes the situation:

> The absence of an indicator of the long-run rate of interest was as inconvenient to the stockmarket of the 1880's as it is to the economic historian of today and the market appears to have found a fairly satisfactory solution. There was in existence a "Two and a half per cent" Consol that had been created by Gladstone's partially successful conversion of South Sea Stock in 1853. Only some £3 million of this stock had been taken up by the public in 1853 and thus the market in the stock was extremely thin. Before 1879 this stock was not regularly quoted in the *Economist*, but as the price of the 3 per cent Consols approached par, the market in the 2_ per cent Consols became active and their price was regularly quoted. By early 1881, the *Economist* was using the yield on the 2_ per cent stock as the long run rate of interest. Trading of this stock appears to have remained active through the 1880's. The amount of the stock in the hands of the public was increased to nearly £10 million, and the stock guaranteed against redemption until 1905, by Childers's unsuccessful conversion scheme of 1884.

Table 18
Compilations of Consols Price or Yield, 1753-1923
Series That Address Option to Redeem at Par in 1880s

Author	Description[a]	Period	Frequency	Observation	Form[b]	Source
Van Oss (1898, pp. 28-29)[c]	price[d]	1865-1897	annual	high, low	fract.	unstated
Hawtrey (1938, pp. 288-290)	price[e]	1879-1888	day preceding change in Bank Rate	specific dates	fract.	unstated
Harley (1976, p. 105)[f]	price, yield[g]	1879-1899	annual	average of price last week of each month, yield at average price	2	*The Economist*
Homer and Sylla (1991, pp. 196-197)	price, yield[h]	1865-1900	annual	high, low	fract., 2	Fenn (1883), AAS, *Bankers' Almanac*

[a]All series pertain to 1853 2_ % consols.

[b]Number of decimal places, or "fract." = fractional part.

[c]Explanation of use of 2_% consols not provided.

[d]Listed in addition to price of 3 % consols.

[e]Listed in lieu of price of 3 % consols.

[f]Yield reprinted 1879-1899 in Capie and Webber (1985, p. 318) and 1879-1888 in Mitchell (1988, p. 678).

[g]Listed in addition to "consol yield as usually calculated." For 1894-1899, computation of yield assumes redemption in 1905. Yield for 1881-1888 presented in Harley (1977, p. 87) in lieu of "the yield usually reported" [that is, the yield on 3 % consols], with the latter yield provided for 1873-1880.

[h]Listed (to 1888) in addition to price and yield for 3 % consols.

Abbreviation: AAS = *Annual Abstract of Statistics* (formerly *Statistical Abstract for the United Kingdom*)

Homer and Sylla (1991, p. 192) note: "The new 2_s now began to provide a better guide [to the market long-term interest rate]." Similarly, Capie and Webber (1985, p. 317) write: "An alternative long-term indicator is Gladstone's 2_ per cent Consol, used to convert the South Sea Stock in 1853 and guaranteed until 1905, which began to be quoted in *The Economist*." Mitchell (1988, p. 678) describes Harley as "using the yield on 2_% Consols for 1879-88...[which is] preferred to the conventional yield on Consols for most purposes." Of the authors entered or noted in Table 18, only Van Oss (1898) does not have a statement indicating awareness of the argument favoring the 2_% over the 3% consols as the representative asset.

Harley's series differs from the other entries in assuming resumption in 1905 for the years 1894-1899, when the price of "Goschen" Consols rose above par—see section d.

d. Compilations that address existence of temporary annuity and redemption possibility in 1889-1902 (Table 19)

Harley (1976, p. 103) describes the issue of the temporary annuity well: "The easiest way to think of the Goschen Consols, and the way informed contemporary investors looked at them, was a 2_% Consol plus an annuity of 5s. [_ %] per year to 1903." He computes "the yield of Consols allowing for the decline in interest in 1905" [a clerical error—the correct year is, of course, 1903]. The computational method allows "for the quarterly payment of dividend [and] the value of the 'annuity' is calculated at the same rate as the yield" (1976, pp. 103-104, n. 5). Restating the last point, "the value of a 5s. annuity to 1903 [is] calculated at the interest rate implied by the [current] Consol price" (1976, p. 105). This means use of a varying interest rate instead of a fixed 2_% for computation of the current (present) value of the annuity. Harley (1976, p. 104, n. 5) notes that allowing for a variable interest rate and explicitly incorporating the effect of quarterly payments "have almost no effects on the calculated yield."

However, a third computational decision of Harley does substantially affect the adjusted Goschen-Consol yield. In calculating the present value of the annuity, Harley (1976, p. 105, n. 4) assumes "redemption in 1923 when relevant." Harley assumes, in effect, that when the observed consol price exceeds 100 (par)—which in fact occurred for the years 1894-1899—investors had a 100% subjective probability of redemption when the Treasury had the right to do so (that is, in 1923 and on demand). Harley justifies the assumption of a 1923 redemption by reference to the yields on 2_% consols and trustee-grade perpetual railway securities relative to the yield on Goschen Consols.

As Harley (1976, p. 105, n. 5) further writes: "In all cases when Consol prices exceed par the yield has been calculated assuming redemption at the earliest possible date." So his computation of the corrected yield for 1894-1899 assumes that the Goschen Consols would be paid off at par in 1923 and the 2_% consols similarly in 1905. The final step in Harley's computation is to subtract the present value of the annuity from the Goschen-Consol observed market price. The assumption of redemption in 1923 makes the calculated yield lower than otherwise.

Capie and Webber (1985, pp. 317-318) support Harley's methodology" "In 1894 the 'Goschen' Consols went above par and the threat of redemption, albeit not until 1923, again became an issue. The price movements clearly indicate an appreciation of the possibility of redemption; hence the yields at this time should be calculated assuming redemption of the 2_ per cent Consols in 1905 and the '2_' per cent Consols in 1923, again making them invalid as indicators of long-term interest rates." Mitchell (1988, p. 678) adopts the same position" [Harley's] substitute figures [for 1889-1902]...using the yield on Goschen's Consols less its annuity element...are to be preferred to the conventional yield on Consols for most purposes."

The only entry other than Harley in Table 19 is Hawtrey (1938). Harley (1976, p. 103, n. 2) observes: "Hawtrey's discussion of the price and yield on Consols is the only work encountered that shows an awareness of all the problems in calculating the long-run interest rate in the period 1880-1903." Hawtrey makes a Harley-like adjustment to the price of Goschen Consols—but for one day only. He allows for the fall in interest to 2_% in 1903 and for the government's option to redeem at par in 1923. The extra _% interest up to Aprl 1903 is discounted at 2% (the corrected yield is "barely 2 per cent"). So Hawtrey anticipates Harley even in using the current yield rather than the fixed 2_% to compute the value of the annuity.

Table 19
Compilations of Consols Price or Yield, 1753-1923
Series That Address Both Existence of Temporary Annuity in 1889-1902 and Option to Redeem at Par in 1923

Author	Description[a]	Period	Frequency	Observation	Form[b]	Source
Hawtrey (1938, p. 158)	price, yield; interest rate at yield for annuity adjustment	1896	day	July 1	fract.	unstated
Harley (1976, p. 105)[c]	price, yield; interest rate at yield for annuity adjustment[d]	1889-1902	annual	average of monthly figures[e], yield at average price	1, 2	*Annual Abstract of Statistics*[f]

[a]Annuity of _ % to 1903 deducted from price of "Goschen Consol."

[b]Number of decimal places, or "fract." = fractional part.

[c]Yield reprinted in Capie and Webber (1985, p. 318) and in Mitchell (1988, p. 678).

[d]Listed in addition to "consol yield usually calculated." Yield also presented in Harley (1977, p. 87) in lieu of "the yield usually reported" [that is, the yield on 3 % consols], with the latter yield provided for 1903-1914.

[e]Themselves average price for month.

[f]Formerly *Statistical Abstract for the United Kingdom*.

e. Compilations that address existence of temporary annuity in 1889-1902 (Table 20)

Table 20 lists compilations that allow for the temporary annuity of _% to 1903 but not for the redemption option in 1923. The authors in this table, unlike those in Table 19, do not assume that in 1894-1899 (when the price of Goschen Consols was above par), the consols would be paid off at par in 1923. Homer and Sylla (1991, pp. 194, 197) make their position clear, in implicit reference to the work of Harley (though they do not mention Harley by name):

> The new consols sold at substantial premiums after 1893. As they were redeemable at the option of Parliament after 1923, some have calculated their yield by amortizing a 2_% bond downward to par in 1923, and adding the current value of the extra _%. This calculation, resulting in yields below 2% at the market highs of 1896-1898, is probably an understatement. The possibility of redemption of 2_s twenty-seven years hence may have had little weight with investors interested in current income.

Table 20
Compilations of Annuities/Consols Price or Yield, 1729-1923
Series that Address Existence of Temporary Annuity in 1889-1902[a]

Author	Description[b]	Period	Frequency	Observation	Form[c]	Source
Williams (1912, p. 400)	price, yield; interest rate of 2_ % for annuity adjustment	1888-1902	annual	average of monthly series[d]	2	AAS
Paish (1966, p. 52)	yield; interest rate at yield for annuity adjustment	1875-1913, with annuity adjustment for 1888-1902	annual	average of monthly figures[e]	2	Tinbergen (1966), *The Economist*

Table 20
Compilations of Annuities/Consols Price or Yield, 1729-1923
Series that Address Existence of Temporary Annuity in 1889-1902[a]

Author	Description[b]	Period	Frequency	Observation	Form[c]	Source
Homer and Sylla (1991, pp. 161-162, 195-197, 444)[f]	price, yield; interest rate at yield for annuity adjustment	1727, 1729-1923, with annuity adjustment for 1889-1902	annual	average of monthly figures[e,g]; high, low (from 1789)	fract., 2	Fenn (1883, 1889), Warren and Pearson (1933), Ashton (1955), BA, AAS, FS

[a]But not possibility of redemption in 1890s.

[b]Annuity of _ % to 1903 deducted from price of "Goschen Consol."

[c]Number of decimal places, or "fract." = fractional part.

[d]Monthly series in source is "average" for month.

[e]Themselves average price for month.

[f]Reprinted 1869-1923 in Friedman and Schwartz (1982, pp. 130-132).

[g]Except: September figures for 1727, 1729-1752 (unstated by authors).

Abbreviations: AAS = *Annual Abstract of Statistics* (formerly *Statistical Abstract for the United Kingdom*), BA = *Bankers' Almanac*, FS = *Financial Statistics*

Homer and Sylla (1991, p. 197) justify their stance empirically by reference to their series of the yield on the old 2_% consols. They describe their own technique as follows: "yields on the 2_-2_% consols during this interim period of fourteen years [1889-1902, are] calculated by reducing the market price of the 2_s by an amount approximately equal to the discounted value of the extra _%. From this lower price the yield of a perpetual 2_ is derived." Further justifying their method, they note that "the resulting yields were very close to the market yields on the 2_% annuities."

The main difference between the techniques of Harley and Homer-Sylla, therefore, is that, for the years 1894-1899, Harley assumes redemption in 1923 whereas Homer and Sylla (1991, p. 197) calculate the yield "as a perpetual 2_." Both techniques allow for payment of "an extra _% until 1903." Also, it appears that Homer and Sylla follow Harley by applying the current yield rather than using the fixed 2_% rate to compute the present value of the annuity. However, the computational procedure of Homer-Sylla (1991, p. 197) may be less accurate than that of Harley, as Homer-Sylla

reduce the consols price "by an amount approximately equal to the discounted value of the extra _%."

There are only two other entries in Table 20. Williams' (1912) technique differs from that of Homer-Sylla (and also that of Harley) in (1) using the fixed 2_% interest rate to calculate the value of the annuity in all years, and (2) assuming (for ease of computation) that the annuity ends on July 1 instead of April 1, 1903. Williams deserves credit as the only author of the entries in Tables 19-20—that is, the only author who provides an adjusted consols price or yield in 1889-1902—to show his method of computation in explicit mathematical form. Regarding Paish (1966), Harley (1976, p. 103, n. 2) states that Paish's method is identical to is own, except for the failure to allow for conversion in 1923. However, the precision of the computations might differ, which is confirmed in Table 23.

Returning to the Homer-Sylla series and for the 18th century, Homer and Sylla use Ashton's (1955) figures for 1727 and 1729-1752 (that is, for old 3% annuities), even though (1) there is no basis for Ashton's 1727 figure, and (2) the data are for September rather than annual averages of monthly values.

3. Gild-Edged Securities

Table 21 lists compilations of broad-based British-government-securities interest-rate series for the time period 1919-2001. Homer and Sylla (1991) provide year-end series of high and low yields over all such securities with maturity of at least 30 years. The first *Annual Abstract of Statistics* (AAS) series is the average redemption yield of representative long- or medium-dated gilts.[50]

Table 21
Compilations of British-Government-Securities Yield, 1919-2001

Author	Description[a]	Period	Frequency	Observation	Source
Homer and Sylla (1991, pp. 444-445)	all with maturity 30 years or more	1900-1989	annual	low, high; Dec. 31	AAS, FS, Pember and Boyle, Kitcat and Aitken
AAS	representative long-dated[b]; redemption yield	1935-1951; 1938, 1942-1945	quarterly; annual	average of daily figures	Bank of England

Table 21
Compilations of British-Government-Securities Yield, 1919-2001

Author	Description[a]	Period	Frequency	Observation	Source
AAS	Long-dated (20 years), derived from yield curve; par yield	1957-1993	annual	average of: month-end 1957-1977, Weds. 1969-1979, all observations[c] 1980-1981, days 1982-1993	Bank of England
AAS	20-year maturity, derived from yield curve; zero-coupon yield	1985-1998	monthly	average of daily figures	Bank of England
Bank-of-England website[d]	same[e]	1979-2001[f]	daily	day	Bank of England
Bank of England	same	1985-2001[g]	monthly	average of daily figures	Bank of England[h]
National-Statistics website[i]	same	1985-2001	monthly	month-end	Bank of England

[a]Of British government securities; type of yield.

[b]Formerly called medium-dated.

[c]Usually three per week.

[d]bankofengland.co.uk

[e]Also, for various subperiods, maturities of 20.5, 21.0, 21.5,...,24.0, 24.5, 25.0 years.

[f]Missing May 24, 1979 – June 24, 1980; July 18, 1980 – January 14, 1985; September 25, 1985 – June 6, 1986; July 17, 1991 – February 10, 1992.

[g]Missing October 1985 - May 1986, August 1991 - January 1992.

[h]Provided directly to author.

[i]statistics.gov.uk

Abbreviation: AAS = *Annual Abstract of Statistics* (formerly *Statistical Abstract for the United Kingdom*)

The remaining series in Table 21 are derived from yield curves, as estimated by the Bank of England.[51] The Bank-of-England and National-Statistics-website series (the latter three entries in the table) emanate from the Bank's computation of the yield curve current in 2002.[52] The two preceding AAS series are from the preceding methodology and thus former computations of the Bank.

Not included in Table 21 is the "Government Bond Yield: Long-Term" series of the International Monetary Fund, available annually 1956-2001 and monthly 1957-2001 in the *International Financial Statistics* CD-ROM. It is unclear which series is reproduced and also what is the extent to which revisions are incorporated.

C. Contemporary Series: Selection of Data

1. Pre-Consol Annuities (1729-1752)

Table 22, columns 1-2, summarizes the selection of series for the U.K. long-term interest rate, contemporary standpoint. Considering first pre-consol 3% annuities, the compilations of Ashton (1955, 1959) are unsatisfactory, with Ashton (1959) showing yield to only one decimal place and Ashton (1955) providing price for September only. For an annual average with sufficient precision, one must go to Ashton's sources. Rogers (1902) contains the annuities price for four specific dates (July 25, September 8, November 8, December 14) in 1729, and the September price is taken by Ashton. For greater representativeness in **What Was the Interest Rate Then?** the four figures for 1729 are averaged.

Table 22
Components of U.K. Long-Term Interest Rate, 1729-2001

		Overlap for Consistent Series		
Component	Period	Period	Annual Divergences[a] (basis points)	Linking Ratio[b]
I. Annuities Yield[c]				
Rogers (1902)[d]	1729-1730	1731	5[e]	_____
Sinclair (1803)[d]	1731-1752	1753-1757	-1, 0, 1, -1, 2[f]	_____
II. Consols Yield[g]				
Warren and Pearson (1935)	1753-1785, 1787, 1789-1880			
Sinclair (1803)[d]	1786, 1788	1781-1793	-2, 3, 16, 0, -16, _, -5, _, -1, -1, -1, 1, -1[f]	_____
Harley (1976)	1881-1893			
Homer and Sylla (1991)	1894-1899			

Table 22 Components of U.K. Long-Term Interest Rate, 1729-2001				
		Overlap for Consistent Series		
Component	Period	Period	Annual Divergences[a] (basis points)	Linking Ratio[b]
Harley (1976)	1900-1902			
Warren and Pearson (1935)	1903-1918	1919-1923	16, 15, 27, 47, 29	1.0571
III. British-Government-Securities Yield: Representative Long-Term Yield[h]				
Homer and Sylla (1991)[i]	1919-1934	1935-1939	9, -4, 9, -23, 1[j]	_____
AAS[k]	1935-1956	1957-1961	3, -7, -4, 0, 2[l]	_____
IV. British-Government-Securities Yield: Derived from Yield Curve				
AAS[d]	1957-1984	1985-1989	-122, -83, -65, -84, -119	0.9035
Bank of England[d]	1985-2001			

[a]Subsequent series minus current series. See section I.B.3 of text.

[b]Average of annual ratios of subsequent series to current series. See section I.B.3 of text.

[c]Component series described in Table 16 and in section B.1 of text.

[d]Annualized by author, see text.

[e]Average *monthly* divergence for 1731, see text.

[f]Averaging less than one-half basis point.

[g]Component series described in Tables 16-20 and in section B.2 of text.

[h]Component series described in Table 21 and in section B.3 of text.

[i]Average of current and previous year-end, performed by author.

[j]Averaging 1_ basis points.

[k]Quarterly figures for 1935-1941 annualized by author. Results compatible with annual figures for 1938 and 1942 onward.

[l]Averaging one basis point.

Abbreviations: AAS = *Annual Abstract of Statistics*

For 1730, Ashton (1955) has a price of 91—which must be an error, as Rogers' price for his one September date is 97 and his minimum price for the year is 94_. Again it behooves one to average Rogers' figures for the year. He has one observation for each

month, except none for February and May, and two for June (separated by 16 days). It is reasonable to take the unweighted ten-observation average to obtain the 1730 price. For 1731-1752, the Sinclair (1803) monthly price series is averaged annually to produce an annual series.

The resulting annual price (P) of annuities for 1729-1752 is converted to yield (Y) via the formula $Y = 100 \cdot (3/P)$.

2. Consols (1753-1918)

For the consols yield over 1753-1918, except for the problem period 1881-1902, Homer and Sylla (1991) are followed in adopting the Warren and Pearson (1933, 1935) series. This series is an annual average, as headed by Homer and Sylla in their tables. An alternative is Mitchell and Deane (1962) or Mitchell (1988), who use the Warren-Pearson series for 1831-1851 and the primary source, *Annual Abstract of Statistics* (AAS, formerly *Statistical Abstract for the United Kingdom*) thereafter. However, inexplicably, the Mitchell-Deane series has only one decimal place, while the series in Warren and Pearson is precise to two decimal places. Although Mitchell and Deane go directly to AAS for their source data from 1852 onward, Warren and Pearson provide the same data via secondary sources.[53]

For 1786 and 1788, Warren and Pearson have missing data. Homer and Sylla use Ashton's (1955) figures for these years, but these are only September observations. For **What Was the Interest Rate Then?** the Sinclair (1803) monthly series is averaged annually to obtain figures for 1786 and 1788.

The problem years 1881-1902 are now considered. For 1881-1888, it is reasonable to adopt the yield on the 1853 2_% consols, with Harley (1976) as the source. For the Goschen Consols in 1889-1902, there can be no dispute that allowing for a temporary annuity of _% to 1903 is appropriate. However, whether possible redemption in 1923 was an element in the market determination of the Goschen-Consols price is not clear. As discussed in sections B.2.d and B.2.e, there are two opposing positions in the literature. Harley, supported explicitly by Capie-Webber and implicitly by Hawtrey and by Mitchell, in effect asserts a 100-percent subjective probability of market participants than redemption would occur in 1923 during the years when the Goschen-Consols price exceeded par (1894-1899) and a zero probability in other years (1889-1893, 1900-1902). Homer and Sylla, supported implicitly by Williams and by Paish, see 1923 as too far in the future to affect measurably the behavior of investors even when the current price of consols was above par. In effect, these authors assume a zero probability of redemption in all years 1889-1902.

Ideally, a time-varying subjective probability of redemption in 1923 could be modeled, dependent on the current price of consols, the time remaining to 1923, and other elements. A model to incorporate that ideal does not exist and its construction is beyond the purview of **What Was the Interest Rate Then?** Therefore a choice must be made between the Harley and Homer-Sylla dichotomous positions. The present author

acknowledges that the choice is a matter of judgment, but he is persuaded more by the Homer-Sylla than the Harley argument.

Therefore, for 1894-1899, the Homer-Sylla series is selected. For 1889-1893 and 1900-1902, the Harley series is adopted, because his compilation apparently has greater precision. It is instructive to examine the Harley, Homer-Sylla, and Paish series for 1889-1902. These series are listed in Table 23.

Table 23
Adjusted Goschen-Consols Yield, 1889-1902
(percent per year)

Year	Harley (H)	Homer-Sylla (HS)	Paish (P)	Difference (basis points) HS – H	P – H	P - HS
1889	2.63	2.81	2.69	18	6	-12
1890	2.67	2.67	2.67	0	0	0
1891	2.68	2.70	2.68	2	0	-2
1892	2.65	2.65	2.65	0	0	0
1893	2.60	2.61	2.60	1	0	-1
1894	2.55	2.52	2.52	-3	-3	0
1895	2.29	2.39	2.40	10	11	1
1896	2.06	2.28	2.30	22	24	2
1897	1.96	2.25	2.26	29	30	1
1898	2.00	2.28	2.28	28	28	0
1899	2.18	2.36	2.35	18	17	-1
1900	2.53	2.54	2.52	1	-1	-2
1901	2.67	2.67	2.66	0	-1	-1
1902	2.66	2.66	2.65	0	-1	-1

Sources: Harley (1976, p. 105), Homer and Sylla (1991, pp. 197, 444), Paish (1966, p. 52).

The Homer-Sylla figure for 1889 is clearly a clerical error This figure is the *unadjusted* yield on consols—as found in Williams (1912, p. 399), Warren and Pearson (1933, p. 273; 1935, p. 403), and Harley (1976, p. 105). For 1895-1899 Homer-Sylla and Paish are greater than Harley—the expected result, given that allowing for redemption reduces the computed yield. The lower value of Homer-Sylla and Paish in 1894 compared to Harley is anomalous. However, Homer-Sylla and Paish agree on the figure of 2.52, which is also the adjusted value of Williams (1912, p. 400). It may be that Harley's figure for 1894 reflects a computational or clerical error.

For 1890-1893 the Harley and Paish series are identical, and they differ by only one basis point in 1900-1902. The divergence of Paish from Homer-Sylla is slightly greater for three of these years and the same for the four remaining years. It is reasonable to select the Harley series for 1890-1893 and 1900-1902 over Homer-Sylla. The six-

basis-point divergence of Harley from Paish in 1889 is a puzzle, as it is the only Harley-Paish divergence explainable neither by differential treatment of redemption possibility nor by rounding error. However, the Williams adjusted figure, at 2.63, agrees with that of Harley, suggesting that Harley's value for 1889 is correct.

3. Gild-Edged Securities (1919-2001)

For 1985-2001, the Bank-of-England monthly series of the 20-year zero-coupon yield (the penultimate entry in Table 21, denoted as "LNZC" in the source) is used, as reflecting the current methodology of the Bank's yield curve.[54] The missing observations of October 1985 - May 1986 and August 1991 - January 1902 emanate from the fact that the Bank's current yield-curve model does not compute yields for a 20-year maturity for periods when there was no outstanding bond longer than that maturity.

Fortunately, the missing observations can be estimated via the 20-year yield series derived from the Bank's *previous* yield-curve model. This series (denoted as "KORR" in the source) is found in AAS (the fourth entry in Table 21). The value of LNZC for a given missing month is estimated as the product of the observed KORR and the 12-month average LNZC/KORR ratio, six months before and six months after the missing range.[55]

The average redemption yield of "representative" long-dated (described both as "about 18-25 years" and "15-25 years") or medium-dated British government securities is available in AAS back to 1935. These data, which were compiled prior to the Bank's yield-curve modeling, extend the contemporary long-term interest-rate series to 1935. For 1935-1941 the data are quarterly, and are averaged via four-quarter averaging.

Prior to 1935, there is no official series of the representative average yield of gilt-edged securities . For 1919-1934, resort is had to the Homer and Sylla (1991) year-end low-yield and high-yield series of gilts with maturity of at least 30 years. The two series are averaged, and the current and previous year-end values of the resulting series are themselves averaged to represent the yield over the current year.

D. Consistent Series: Linking of Component Series

Information on the linking overlap between component series is provided in columns 3-5 of Table 22. Consider first the transition from the Rogers to Sinclair components. These are monthly series, and the Rogers series is used for only the two years 1729-1730. Therefore an appropriate overlap is the *months* of 1731. The series are identical for four of the ten months of commonly available data (including September, which is Ashton's (1955) month of choice). It follows that, notwithstanding the average monthly divergence of five basis points, the Rogers and Sinclair series may be viewed as consistent.

The shift from the Sinclair to Warren-Pearson series is also a switch from the old 3% annuities to the newly created 3% consols. The overlap averages less than one-half a basis point, indicating no break in the series. It is prudent to determine whether the 1786

and 1788 figures (derived from Sinclair) are consistent with the Warren-Pearson series. Considering five-year overlaps before 1786 and after 1788 as well as the overlap for 1787, the eleven years of overlap again average less than one-half a basis point. So the 1786 and 1788 figures are taken to be consistent with the Warren-Pearson series.

It is not appropriate to consider links between the yield on 2_% consols (1881-1888) and the adjusted Goschen-Consols yield (1889-1902). As the discussions in sections A.2.b and B.2.c show, a nominally "consistent" Consols yield (achieved, say, by adopting the Warren-Pearson series throughout 1889-1919) would lead to a series *unrepresentative* of the long-term interest rate.

In contrast, it is legitimate to link the consols yield with the Homer-Sylla gilt yield, via the 1919-1923 overlap. Also, overlaps from the Homer-Sylla to AAS (average-yield) components, and from the AAS (average-yield) to the AAS (yield-curve-derived) series must be examined. These overlaps are insignificant; so the linking ratio remains at the unity default. Finally, the AAS former-yield-curve-derived component series is linked to the Bank of England's current-yield-curve-derived component via the 1985-1989 overlap.

VII. Long-Term Interest Rate: United States

A. Market Instruments

1. Representative Market Instruments and Applicable Subperiods

The representative instruments for the long-run interest rate are quite different for the United States from those for Britain. In the case of the United Kingdom, central-government securities constituted the instrument throughout the 18th to 21st centuries. Further, for most of that period—indeed, until after World War I—essentially one such security (consols and their predecessor annuities) fulfilled the role. The contrasting situation for the United States is described well by Homer and Sylla (1991, pp. 285, 334):

> No single security or group of securities provides a continuously satisfactory index of the going rate for best American long-term bonds throughout the nineteenth century. At times, United States government bond yields offer a good indication of the level and trends of market rates. At other times only choice municipal and state bonds provide a usable index of the level and trends of the market. Late in the century the best long-term railroad bonds achieved such high quality and respect as to provide a good index of prime market yields....Long-term trends of the yields of best-quality long-term American bonds in the twentieth century can best be described in terms of the history of prime long-term corporate bond yields.

> The reason why no one securities group can serve the role of representative security over the full 19th and 20th centuries is also stated by Homer and Sylla (1991, p. 290): "Several important distortions and inadequacies render certain of the series misleading at specific periods."

To fulfill the role of long-term interest rate, it is logical to begin with the market yield on federal-government bonds. In principle, should appropriate data be available, that yield applies from the creation of *domestic* debt by the Continental Congress in 1776.[56] In practice, suitable data are not available until 1798 (see section B.1). The date when the representativeness of the federal-securities market yield ceases and, more generally, the periods when there is a lack of such representativeness, are well-recognized in the literature:

1. "During and directly after the Civil War, United States government bond yields were distorted by gold premiums because they were quoted in greenbacks and might be paid in specie." While the matter is complex, it is reasonable to infer that "all [federal bond issues] were helped after 1862 by the hope for a gold profit " (Homer and Sylla, 1991, pp. 290, 306, n.). In other words, the gold premium associated with the greenback period (which began at the end of 1861) biased U.S.-government bond yields downward as a measure of the long-term interest rate.

Homer and Sylla (1991, p. 306, n.) conclude: "Therefore, the tables of bond yields for the years 1863 to 1870 do not provide a reliable picture of long-term interest rates." It is better to say "the years 1862-1876" (associated with maximum gold premiums of at least 10 percent) or even "the years 1862-1878" (all years of some positive and no negative premiums). So, for the purpose of **What Was the Interest Rate Then?** the representativeness of U.S. government bonds ends in 1861.

2. From 1863 to 1935, national banks could issue notes by depositing with the Treasury government bonds equal in face value to 111 percent (reduced in 1900 to 100 percent) of the value of the notes issued. This backing of national-bank notes by government bonds again enhanced the price, and reduced the yield, of such bonds. Several researchers of interest-rate history have made this point. Mitchell (1911, p. 269; 1913a, pp. 140-141) writes: "National bonds, while quoted every month, are prevented from reflecting accurately general market conditions by the requirements of the National Banking Act." Friedman and Schwartz (1982, p. 120, n. 23) observe: "Before 1917, many United States government securities bore the circulation privilege, which affected their yield."

Macaulay (1938, p. 74) states: "we did not use United States government bonds. The sufficient reason is that, during most of the period covered by this study, their yields were seriously affected by their circulation privileges. The bonds were intimately tied up with the whole structure of the national banking system. American 'National Banks' were allowed to issue 'National Bank Notes' based on United States government bonds that they had deposited with the Comptroller of the Currency. Consequently, the bonds were bought for two reasons: first, because of the interest they paid; second because they could

be used as collateral for the issuance of currency. The yields were naturally much lower than if the bonds had been valued for their interest payments alone."

Homer and Sylla (1991, pp. 290, 306, n.) declare that "from the late 1860's on, the national banks bought government bonds at low yields to secure circulation, and this was later supplemented by Treasury purchases at large premiums....The national banking system eventually created a demand for "government bonds which by the mid-1870's put government bond prices up to levels where their yields were far below acceptable rates of long-term interest." They conclude: "Therefore, market yields on governments must be disregarded altogether from 1863 until 1918 as a guide to American long-term interest rates." They omit consideration of such yields as "representative of prevailing interest rates" between 1880 and 1920 "because of the distortions affecting U.S. governments between the 1870's and the 1920's, mainly their use by national banks as backing for bank note currency" (1991, p. 339).

3. As noted by Friedman and Schwartz (1982, p. 120, n. 23), "from 1917 to 1941, many United States government bonds were partially tax exempt." Homer and Sylla (1991, pp. 334-335, 443, 447) state that "in the twentieth century...tax advantages and other privileges often distorted the yields of both government and municipal bonds," and they refer to the "partial tax exemption [of U.S. government bond yields] from 1917 to 1941." Tax advantage not only provides a third reason why the market yield on federal government bonds underestimates the long-term interest rate but also extends the non-representativeness of that yield from 1862 to 1941.[57]

4. A fourth problem—which needs to be considered here only for the pre-1862 time period and which fortunately is solvable (see section B.1), is that "from 1825 to 1842 there were few government bond issues outstanding and occasionally there were none....From 1835 to 1841 there were no government bonds outstanding and hence no government bond yields for history to record" (Homer and Sylla, 1991, pp. 290, 302).

It is useful to ignore the period 1862-1899 temporarily and move discontinuously to the 20th century. Homer and Sylla (1991, p. 334) write: "Long-term trends of the yields of best-quality long-term American bonds in the twentieth century can best be described in terms of the history of prime long-term corporate bond yields." This position is accepted here, if only for want of an acceptable alternative. The option of returning to the market yields of U.S.-government bonds is unsatisfactory. Homer and Sylla (1991, pp. 334-335) state: "Long-term government bonds were often not outstanding. Tax advantages and other privileges often distorted the yields of both government and municipal bonds." Macaulay (1938, p. 74), writing before Homer and Sylla, also rejects federal bonds as the representative instrument for the twentieth century:

> It might be thought that, since the formation of the Federal Reserve system, the yields of Liberty and Treasury Bonds could be considered an adequate index of long time interest rates in the United States. However, it must not be forgotten that they also carry special banking privileges, such as eligibility for use as collateral with the Federal Reserve banks at par.

> Finally, the investigator who might consider using them is faced with the practical difficulty that the yields of most of them are ambiguous. The maturity dates are not fixed. They are callable bonds.

Another alternative is the yield on municipal bonds. This option is rejected by both Macaulay and Homer-Sylla. "The fact that the holder of municipal bonds has always had certain tax exemptions, which were sometimes more and sometimes less valuable, made such bonds poor material for our purposes. We dropped them entirely as soon as the Federal Income Tax Law began to function [1914]."—Macaulay (1938, pp. 74-75). "The progressive income tax created a special demand for tax-exempt state and municipal bonds, which rendered them no longer a good index of prevailing yields....Municipals have been omitted for years after 1900 [actually 1910, for decennial averages] because of the distortion of tax exemption."—Homer and Sylla (1991, pp. 333, 339).

There remains determination of the representative long-term interest rate for 1862-1898.[58] There exist two candidates:

1. Extend the prime corporate-bond yield back into the 19th century.

2. Adopt a prime "municipal" (always meaning "state and municipal") bond yield.

Alternative 1, extension of the prime corporate-bond yield, can be performed by using the yield on railroad bonds, for which the best series are developed by Macaulay (1938, pp. A141-A170). He writes (1938, p. 75):

> We were faced with the necessity of using bonds from one or more *industries*. We discovered that if bonds are to be used from more than one industry, each industry should be used by itself for a reasonably long period. Switching back and forth or using even the best bonds of two or more industries at the same time may easily lead to undesirable statistical results....When the decision to use only one industry had finally been made, the railroad industry was the inevitable choice. There was no other industry whose securities were of comparable importance in January 1857, the date we knew we could reach by using railroad bonds.

The two advantages of railroad bonds as the long-term instrument for 1862-1898, then are (i) retention of corporate bonds as the instrument as one moves from the 20th century to the 19th century, and (ii) selection of the sector with the highest credit rating of all industries in the second half of the 19th century.

A potential disadvantage of the railroad-bond yield is changes in the quality of the bonds over time or, as Macaulay (1938, p. 83) writes, "secular and cyclical changes in the grades of the bonds," which causes "economic drifts" in his chained index-number series. In particular, "the very best railroad bonds in the early period were inferior to the best bonds in the later period."—Macaulay (1938, p. 121). Macaulay develops a procedure to correct for "economic drift," and presents both the adjusted and unadjusted series.

Alternative 2, adoption of a prime municipal bond-yield series, is justified by the fact that "from 1857 to 1930, municipal bonds of the highest grade were 'prime' investments for the ultra conservative" (Macaulay, 1938, p. 121). As only the 19th century is under consideration, the tax advantages of municipals associated with the income tax instituted in 1913 are irrelevant.

The best municipal-bond-yield series for the period is again generated by Macaulay (1938, pp. A174-A176): the index of New-England municipal-bond yields. This series does not have the "secular-drift" problem of his railroad bond yield: "an examination of the levels and movements of the highest grade New-England municipal bonds in the period before 1914 can hardly fail to suggest that the best railroad bonds of the earlier years were not relatively so high in grade as were those of the later years....The credit standing of the leading New-England municipalities underwent, during the period 1857-1914, no such radical changes as did the credit standing of many American railroads. Indeed, the best of the New-England municipal bonds seem to have deserved about the same rating in 1857 as they did in 1914."—Macaulay (1938, pp. 117-118, 120). So Macaulay presents only one municipal-bond-yield series.

Which alternative should be chosen for **What Was the Interest Rate Then?** Macaulay (1938, pp. 73, 74) is emphatic that the railroad-bond series is preferred:

> For the study of long term...rates, primary reliance has been...placed on the yields of American railroad bonds....We have used index numbers based on the yield of New England bonds as a check on the results obtained from the railroad bonds. We did not consider using such indexes as a substitute for the railroad indexes. The market for municipal bonds has never been such a highly developed market as that for railroad bonds. The accuracy and adequacy of the quotations on which our index of the yields of New England municipals is based are not to be compared with the accuracy and adequacy of the railroad quotations. Available quotations were neither very good nor very numerous.

Homer and Sylla, in contrast, judge that Macaulay's municipal-bond yield can represent long-term interest rates for the full 1857-1900 period, whereas his railroad-bond-yield series is applicable only from about 1885 onward:

> ...starting in 1857. Macaulay's New England municipal bond index is probably a good guide to the level and trend of American long-term high-grade bond yields at that time; tax exemption did not distort their yields as it does today. His adjusted railroad bond yield is a rough but serviceable guide to prime corporate bond yields after 1885....After 1865, for two decades, the municipal average alone must be relied upon. After 1885, prime railroad bond yields were about the same as the municipal average yields and provide a usable index....There is a good history of high-grade municipal bond yields covering the last half of the century and of high-

> grade corporate bond yields covering the last two or three decades. With their help the level and trends of high-grade long-term interest rates can be traced....The railroad average...in 1879 still well above municipal yields...by 1889 [was] now close to municipal yields and hence thoroughly respectable.

Macaulay's railroad-bond-yield series (in one or other form) has been reproduced in eight studies of which I am aware.[59] In contrast, his municipal-bond-yield series has been tabulated in only two studies.[60] Nevertheless, the judgment of Homer and Sylla—based, as it is, on the actual yields of the two alternative series—is difficult to refute. Therefore the New-England municipal-bond yield is taken here to represent the U.S. long-term interest rate from 1862 to 1898.

2. Histories of Market Yields

a. U.S.-Government Bonds

A history of federal bond yields, 1798-1861, is provided by Homer and Sylla (1991, pp. 294-307). A "pre-history" of government yields (that is, prior to 1798) is also in Homer and Sylla (1991, pp. 277-279, 293-294).

b. New-England Municipal Bonds

A history of the New-England municipal-bond yield from 1857 to 1898, intertwined with the history of Treasury-bond and railroad-bond yields, is in Homer and Sylla (1991, pp. 305-317).

c. Corporate Bonds

Homer and Sylla (1991, pp. 334-357, 366-387, 409-416) also provide a general history of U.S. long-term bond yields, with special attention to prime-corporate-bond yields.

B. Compilations of Series

1. U.S.-Government Bonds

Compilations of interest-rate series that correspond to the selection of the federal-government-bond yield to represent the long-term interest rate for 1798-1861 are shown in section I of Table 24. Homer and Sylla (1991, p. 290) generate "a highly abbreviated estimate of market yields. This series is derived from average annual prices of those longer-term issues with the least discount or premium. Yields are selected to reflect what appears to be a realistic going average for the year. This attempt at selection, liable as it is to error, has resulted in a series that was usually close to new-issue yields until 1865....From 1798 until 1863, the United States yields for issues selling close to par provide the best available guide to market trends." Therefore the Homer-Sylla series is

adopted, at least in principle, as the long-term interest rate until 1862. No market yields are available prior to 1798, with the exception of 1791.[61]

Table 24
Compilations of U.S. Long-Term Interest Rate, 1798-2001

Author	Description	Period	Frequency	Observation	Source
I. U.S.-Government-Bond Yield, 1798-1861					
Homer and Sylla (1991, pp. 286-288)[a]	long-term issues selling close to par	1798-1832, 1842-1861	annual	derived from average annual prices	Martin (1886), *Financial Review*
Sushka (1978, p. 145)	same	1832-1859	annual	1833-1841 estimated[b]	Homer (1963)
II. New-England-Municipal-Bond[c] Yield, 1857-1904					
Macaulay (1938, pp. A174-A175)	all bonds	1857-1904	quarterly	average of yields in Boston market	publications of Joseph G. Martin
Homer and Sylla (1991, pp. 287-288)[a]	same	1857-1900	annual	average of quarterly series	Macaulay (1938)
III. Corporate-Bond Yield, from Yield Curve, Twenty or More Years to Maturity, 1899-1923					
Durand (1942, pp. 5-6)[d]	highest-grade bonds (20, 25, 30, 40, 50, 60 years to maturity)	1900-1923	annual	first quarter	Corporate Bond Project
Homer and Sylla (1991, pp. 342, 350)	prime corporate bonds	1899-1923	annual; monthly	average of monthly series; Feb. (1900-1923) from Durand (30 years to maturity), other months via interpolation[e]	Durand (1942), Macaulay (1938)
IV. Corporate-Bond Yield, Moody's Aaa Series, 1919-2001					
A. Federal-Reserve Publications and Website					
BMS, *1914-1941* (pp. 468-474)	prime corporate bonds	1919-1941	annual	average of monthly series	Moody's Investors Service
same	same	1919-1941	monthly	average of yields of individual bonds; Nov. 1931 onward: based on daily closing quotations[f]	same

Table 24
Compilations of U.S. Long-Term Interest Rate, 1798-2001

Author	Description	Period	Frequency	Observation	Source
same	same	1934-1941	weekly	based on daily closing quotations	same
BMS, *1941-1970* (pp. 720-757)	same	1941-1970	annual, monthly, weekly	same as for BMS, *1914-1941*	Moody's publications
ASD, *1970-1979* (pp. 162-172)	same	1970-1979	annual, monthly	average of daily figures	Moody's Investors Service
ASD, *1980-1989* (pp. 141-150)	same	1980-1989	same	same	same
ASD, *1990-1995* (pp. 92-97)	same	1990-1995	same	same	same
FRB, various issues	same	1996-2001	same	same	same
BGFRS website[g]	same	1976-2001	annual	same[h]	same
same	same	1919-2001	monthly	same[i]	same
B. Historical-Statistics Publications					
HSUS, *Colonial Times to 1957* (p. 656)	prime corporate bonds	1919-1957	annual	same as BMS, *1914-1941*	Moody's publication
HSUS, *Colonial Times to 1970* (p. 1003)	same	1919-1970	annual	same as BMS, *1914-1941*	Moody's publication
HSUS, *Millenial Edition*	same	1919-1997	annual	1919-1970: same as BMS, *1914-1941*; 1971-1997: average of daily figures[j]	Moody's publication, FRB
C. Other Publication					
Homer and Sylla (1991, pp. 370-371)	same	1946-1989	annual, monthly	same	Federal Reserve publications

[a]Reprinted in HSUS, *Millenial Edition*.

[b]See text.

[c]Including state bonds.

[d]Reprinted in BMS, *1914-1941* (p. 477); HSUS: *1789-1945* (p. 279) (20, 50 years to maturity), *Colonial Times to 1957 (*p. 657) (20, 50 years to maturity), *Colonial Times to 1970* (p. 1004) (20, 30 years to maturity); Friedman and Schwartz (1982, pp. 123-124) (30 years to maturity); Homer and Sylla (1991, p. 395) (20, 25, 30 years to maturity).

[e]Using Macaulay's (1938, pp. A152-A158) adjusted series of the yield on railroad bonds.

[f]1919-1927: based on average of month's high and low sale prices for each bond; 1928-1929: based on bi-weekly closing quotations; 1930 - Oct. 1931: based on weekly closing quotations.

[g]federalreserve.gov

[h]Statement "average of monthly averages" is incorrect.

[i]Statement "average of daily data" is correct only from November 1931. See note f.

[j]Statement "averages of monthly data" is correct only to 1970.

Abbreviations: BMS = *Banking and Monetary Statistics*, ASD = *Annual Statistical Digest*, FRB = *Federal Reserve Bulletin*, BGFRS = Board of Governors of the Federal Reserve System, HSUS = *Historical Statistics of the United States*

Ingenious as Homer-Sylla are in construction of this series, they *cannot* provide figures when there are no government issues outstanding, that is, for 1835-1841. Further, they *choose* not to present data for 1833-1835, when "the low redemption yields on premium governments reflected merely the possibility that they might not be redeemed promptly" (Homer and Sylla, 1991, p. 302).

For insight into "the true level of market yields," Homer and Sylla (1991, p. 302) note that "[as] issues of the City of Boston and the State of Massachusetts were quoted regularly...these yields may be taken as a help in judging market levels and trends." However, they warn that "the possibility of special privileges and the effects of local financial preferences make it impossible to draw firm conclusions on national market trends from the prices of one or two local issues." Sushka (1978, p. 136) summarizes: "Homer suggests that for this period [1833-1841] the New England municipal rate best approximates market interest rate levels and trends."

Sushka (1978) re-addresses the issue of the missing observations in 1833-1841, and generates two alternative estimates. She shows that using the New-England municipal-bond rate is inappropriate, because its level differs from that of the federal-bond yield. She uses a regression equation to estimate the missing figures, with the sample period 1805-1859, excluding 1812-1815 (war years) and, of course, 1833-1841 (to be estimated). Her preferred estimate emanates from the Homer-Sylla government-bond-yield regressed on the New-England municipal-bond yield (also from Homer and

Sylla) and the "long term British rate" (certainly the consols yield and presumably also from Homer and Sylla).[62] An alternative estimate includes the Prussian interest rate as an additional regressor.

In that way Sushka provides two alternative sets of figures for 1833-1841, thus eliminating the discontinuity in the Homer-Sylla data. She writes: "These [two] series can be interpreted as an estimate of the yield on federal government bonds that would have prevailed if government bonds were issued during the period 1811-1841" (Sushka, 1978, p. 142).

2. New-England Municipal Bonds

Section II of Table 24 summarizes compilations of Macaulay's New-England municipal-bond-yield series. Homer and Sylla's annualization of the Macaulay, quarterly, series has incorrect averages. While the divergences from correct averaging are small, they are more than normal rounding errors. It appears that Homer and Sylla (i) took only two decimal places of Macaulay's figures instead of the three decimal places shown, and (ii) truncated rather than rounded to the second decimal place.

3. Corporate Bonds

The ideal corporate-bond yield is that of the Aaa group of Moody's Investors Services.[63] Compilations of this series (section IV of Table 24) fall into three groups: Federal-Reserve publications and website, historical-statistics publications, and Homer-Sylla. Unfortunately, Moody's Aaa corporate-bond-yield series is available only from 1919 onward. So the first part of the 20th century remains.

Durand (1942) generated interest rates of prime corporate bonds by number of years to maturity, making use of a yield-curve technique.[64] His estimates are annual, but pertain only to the first quarter of the year, and extend back to 1900. Homer and Sylla (1991, p. 433) state that: "From 1900...the best index of prime corporate bond yields classified by years to maturity is provided by David Durand's *Basic Yields of Corporate Bonds*."

Homer and Sylla use the Durand series for 30-year bonds, along with Macaulay's adjusted railroad-bond-yield series, to construct a monthly prime-corporate-bond-yield series and, via averaging the monthly figures, a representative annual series. The Durand series is allocated to the month of February, with the remaining months interpolated via Macaulay's series.[65] They use an (unstated) interpolative technique to carry the series back to January 1899, though Durand's series begins in 1900.

C. Contemporary Series: Selection of Data

1. U.S.-Government Bonds (1798-1861)

Selection of the component series of the U.S. long-term interest rate is obvious from the discussion in section A.1 and is summarized in Table 25, columns 1-2. The Homer-Sylla series of federal-bond yield is combined with Sushka's preferred estimate of their missing years to provide a continuous series for 1798-1861.

Table 25
Components of U.S. Long-Term Interest Rate, 1798-2001

		Overlap for Consistent Series		
Component[a]	Period	Period	Annual Divergences[b] (basis points)	Linking Ratio[c]
I. U.S.-Government-Bond Yield				
Homer and Sylla (1991)	1798-1832			
Sushka (1978)	1833-1841			
Homer and Sylla (1991)	1842-1861	1857-1861	90, 72, 10, -78, -141	1.0078
II. New-England-Municipal-Bond Yield				
Macaulay (1938)[d]	1862-1898	1899-1903	13, 16, 16, 12, 18	1.0464
III. Corporate-Bond Yield, from Yield Curve				
Homer and Sylla (1991)	1899-1918	1919-1923	65, 85, 81, 61, 61	1.1447
IV. Corporate-Bond Yield, Moody's Aaa Series				
BMS, *1914-1941*	1919-1941			
BMS, *1941-1970*	1941-1970			
ASD, *1970-1979*	1970-1979			
ASD, *1980-1989*	1980-1989			
ASD, *1990-1995*	1990-1995			
FRB, various issues	1996-2001			

[a]Component series described in Table 24 and in section B of text.

[b]Subsequent series minus current series. See section I.B.3 of text.

[c]Average of annual ratios of subsequent series to current series. See section I.B.3 of text.

[d]Annualized by author, see text.
Abbreviations: BMS = *Banking and Monetary Statistics*, ASD = *Annual Statistical Digest*, FRB = *Federal Reserve Bulletin*

2. New-England Municipal Bonds (1862-1898)

The Macaulay series is converted to annual form here by averaging the quarterly observations, thus providing the long-term interest rate for 1862-1898.

3. Corporate Bonds (1899-2001)

Homer and Sylla's extension of Durand's series is used for 1899-1918, followed by Moody's Aaa yield, taken from Federal Reserve publications, for 1919-2001.

D. Consistent Series: Linking of Component Series

Overlaps for linking of component series are shown in columns 3-5 of Table 25. Sushka's completion of Homer and Sylla's federal-bond-yield series is consistent by construction, and Moody's Aaa series is consistent over all Federal-Reserve publications. Therefore the only linkages are from the U.S.-government-bond yield (Homer-Sylla) to the New-England municipal-bond yield (Macaulay), thence to the yield-curve-derived corporate-bond yield (Homer-Sylla, extending Durand), thence to Moody's Aaa corporate-bond yield.

Notes

1. An exceptional author, who devotes explicit attention to computation of a representative temporal average, is Mitchell (1911, p. 275, n. 5; 1913a, p. 149, n. 53).

2. See Anderson and others (1996).

3. A change in the selected series may occur under either of two circumstances: a change in the asset or market instrument underlying the interest-rate concept, or a change in the data source or series that measures the return of the given asset.

4. A basis point is 1/100th of a percent, or one percent = 100 basis points.

5. As stated above, for reason of data unavailability or peculiarity, the linking ratio may be computed from less than a five-year overlap.

6. An early author who ratio-links interest-rate series is Mitchell (1911, pp. 269-270; 1913a, pp. 140-141). He links two U.S.-government-bond-yield series, using a one-year (1896) overlap. He warns: "this shift is more simple than accurate, and the composite series which it gives cannot be highly commended" (1911, p. 270; 1913a, p. 141). In contrast, the current essay takes a sanguine view of ratio-linking, for two reasons. First, the linked series are carefully selected to be representative of the interest-rate concept under consideration. Second, the overlapping period is generally five years, rather than the one year employed by Mitchell.

An apparent later example of such ratio linking is Balke and Gordon` (1986, pp. 789, 809)—apparent because the linking technique is not specified, whereas Mitchell is explicit about his ratio-linking. Balke and Gordon conjoin two corporate-bond-yield series, and are similar to Mitchell in using only a one-year overlap (1919), probably too short.

Friedman and Schwartz (1982, pp. 110, 129) adopt a linking process for two corporate-bond-yield series that is additive rather than multiplicative. They add to the earlier series its average difference from the later series over a three-year overlap (1900-1902). The ratio technique is superior, because it accommodates changing levels in the series over time.

7. This argument does not apply to the ordering of instruments, because the period to which each instrument applies has been predetermined.

8. Although Balogh's (1947, p. 202) table, from which the figures are taken, is headed "commercial bills," the text (p. 174) is explicit that the data pertain to all bills.

9. Excellent descriptions of the bill of exchange are King (1936, pp. xv-xviii), Ashton (1959, pp. 106-109), Capie and Webber (1985, pp. 310-313), Fletcher (1992, p.

5), and Nishimura (1992, pp. 206-208). For the history of the London discount market to 1919, see King (1936).

10. See Capie and Webber (1985, p. 310).

11. Sayers (1957, p. 139) notes that London banks buy, but do not sell, Treasury bills. The Bank of England observes: "The secondary market in Treasury bills has in recent years become illiquid and representative rates are no longer obtainable other than those for the most recently issued 91 day bills."—*Annual Statistical Abstract*, Part 1 (2001), Explanatory Notes, p. 195.

For descriptions and histories of the Treasury bill, see King (1936, pp. 275-278), Anonymous (1964), Wadsworth (1973, pp. 141-152), Capie and Webber (1985, pp. 307-308), Llwellyn (1992), and Wilson (1992, p. 799; 1993, pp. 27-30).

12. On all this, see Officer (1996, pp. 71-72; 298, n. 32).

13. In contrast, the 1824-1854 segment of the Homer and Sylla (1991) series diverges from the annual average of the Overend-Gurney series—for some years beyond rounding.

14. The ceiling had been reduced from six percent in 1714.

15. "Until about 1824, there was not in England anything in the nature of a regularly published market rate of bank discount"—Silberling (1923, p. 241).

16. In fact, the Mitchell and Homer-Sylla series for 1824-1828 differ only in 1828—and by only one basis point.

17. Alternatively, one can say that the linking ratio is unity.

18. See LaRoche (1993, pp. 132-133) and Beckhart (1932, pp. 253-408). The latter author provides a detailed history of the acceptance market.

19. As James (1995, p. 224) writes: "But it [commercial paper] was not exactly liquid….in general there was no secondary market before the Federal Reserve—it had to be held to maturity, in contrast with the ready rediscounting of bankers' acceptances by European banks."

20. Descriptions of commercial paper are in Woodlock (1908, p. 21), Foulke (1931, p. 3), Macaulay (1938, p. A337), James (1978, p. 178; 1995, pp. 219, 225), and Hahn (1993, p. 107). Histories are in Foulke (1931, pp. 216-256), Myers (1931, pp. 46-47, 200-201, 315-337), Greef (1938), Beckhart (1932), Selden (1963), Goodhart (1969, pp. 22-24), and James (1978, pp. 174-198; 1995).

21. For descriptions of the U.S. Treasury bill, see *Banking and Monetary Statistics, 1941-1970*, p. 641, and Cook (1992, 1993).

22. Crum noticed that if the maximum and minimum figures differ for a given week, then Mitchell assigns a double weight for that week compared to a week in which extreme figures coincide. This interpretation seems correct; for Mitchell (1913a, p. 149) writes: "Both the high and the low [weekly] figures were included in making the averages." Crum's method involves equal weights for all the weeks in a time period, and his figures for 1890-1915 differ from those of Mitchell (as reprinted in Persons, 1919).

23. Also, the logical alternative to the "official" series for 1890-1918 would be to continue the Macaulay series to 1918. It is a matter of judgment that the official series is given priority for **What Was the Interest Rate Then?**

24. The maturity and interest-rate data are in *Banking and Monetary Statistics, 1914-1941*, pp. 426, 460.

25. See *Banking and Monetary Statistics, 1914-1941*, p. 426.

26. The reasons for the demise of the call-loan market were primarily legislative. Member banks of the Federal Reserve System were no longer allowed to make call loans on the account of nonbanks, severe margin requirements were instituted, and interest on demand deposits was prohibited. Also playing a role were the rise of the Treasury bill and the onset of, and the stagnation associated with, the Great Depression.

27. The data source is Balles and others (1959, p. 31).

28. The data source is Willis (1970, p. 53).

29. Interestingly, Sayers (1957, p. 139) observes that "the tighter monetary conditions of 1954-5 have drawn into its [the federal-funds market's] vortex temporarily surplus bank-cash from all over the country."

30. For descriptions of the call-loan market, see Woodlock (1908, pp. 27-40), James (1978, pp. 63-66), and Friedman and Schwartz (1982, p. 109). For a history of the market, see Myers (1931, pp. 126-148, 265-287).

31. On the determination of the new and renewal rates, see Woodlock (1908, pp. 30-32), Beckhart (1932, pp. 53-63), Macaulay (1938, pp. A338-A339), and Goodhart (1969, p. 197).

32. For descriptions and histories of the federal-funds market, see Balles and others (1959), Nichols (1965), Willis (1970), Beckhart (1972, pp. 71-76), Lewis (1992, p. 271), Meulendyke (1992), Poole (1992), Goodfriend and Whelpley (1993), and Wilson (1993, pp. 118-123).

33. “The ‘effective’ rate on Federal funds...is not a statistical calculation, such as an average, of the rates paid on all transactions in Federal funds. Rather, it represents a consensus of major market participants in New York City as to the rate at which most transactions in these funds were executed during the day, after taking into account reports from active participants in the market.”---*Banking and Monetary Statistics, 1941-1970*, p. 640. “The daily [federal-funds] rate is the average of the rates on a given day weighted by the volume of transactions at these rates.”—*Annual Statistical Digest, 1980-1989*, p. 689.

34. Neither the Friedman-Schwartz nor the Homer-Sylla annual version of the Macaulay series is used, because spot checking shows that both pairs of authors provide incorrect averages.

35. Just as for the Treasury-bill secondary-market yield, there is an inconsistency in the Federal Reserve federal-funds-rate data, with website and published figures differing over 1955-1979; but the divergence is only one basis point for all years except 1962, for which the divergence is three basis points (see note b of Table 11). Again it is reasonable to assume that the cause is transcription or rounding errors on the website; so Federal Reserve publications (rather than the website) are taken for the source series.

36. For descriptions of the U.K. call-loan market, see Capie and Webber (1985, pp. 313-314), Lewis and Davis (1987, p. 84), Homer and Sylla (1991, p. 206). Glimpses into the prehistory and early history of the call-loan market are provided by King (1936, pp. 67-68), Cope (1942, pp. 200-201), Ashton (1955, p. 179), Pressnell (1956, pp. 89, 92-94, 104), and Hawtrey (1938, pp. 10-11).

37. For descriptions of the interbank market, see Wadsworth (1973, pp. 165, 168-169, 196), Lewis and Davis (1987, p. 85), and Wilson (1993, pp. 12-13).

38. Series for overnight, seven-day, one-month, six-month, and annual maturities are available. Interesting is the “sterling overnight banking average” (SONIA), the weighted average of all brokered unsecured deals (all maturities) between money-market institutions and their overseas branches. However, this series is available only since 1997.

39. For 1935-1937, this AAS version is identical to the Capie-Webber (*The Economist*) series, at 0.5 percent per year. In 1938, the AAS series is 0.51 versus 0.5 for Capie-Webber. For 1940-1944, the AAS series is at 1 versus only 0.5 for Capie-Webber (except 0.60 for 1943). For 1945, the Capie-Webber figure (now from BESA) is 0.995, compared to 0.91 for AAS and again 0.5 for *The Economist*. For 1946, Capie-Webber is 0.625, compared to 0.5 for both AAS and *The Economist*.

40. In his successor historical-statistics volume, Mitchell (1988, p. 649) moderates the statement to the following: “As a measure of the long-run rate of interest it perhaps comes as close as we can to that theoretical abstraction.”

41. For a description and history of the pre-consol annuities, see Homer and Sylla (1991, pp. 155-159).

42. The perpetual nature of the consols is discussed by Harley (1976, p. 101) and Solomou (1996, p. 168).

43. On the nominal interest rate and market yield of consols, one may consult Gibson (1908, p. 54), Andrew (1910, p. 281), Warren and Pearson (1933, p. 272; 1935, p. 404), Mitchell and Deane (1962, p. 455), Sheppard (1971, p. 190), Capie and Webber (1985, p. 319), and Mitchell (1988, p. 678). For histories of these aspects of the consols, see Capie and Webber (1985, pp. 316-317), Homer and Sylla (1991, pp. 159-163, 184-185, 192-200, 211-215, 441-449), and Shepperd (1992, p. 240).

44. Homer and Sylla (1991, p. 160) are alone in making a symmetrical argument for the price of consols far below par: "When the price was very low, their yield was apt to fall below other long-term rates partly because of their almost total immunity to early redemption and partly because of their expectation of large price recovery." This contention does not seem correct, because (1) low or zero probability of redemption enhances the representativeness of consols, and (2) market expectations of the future price of an asset are fully reflected in the current price, given an efficient market.

45. For the outstanding amounts of each issue, see Harley (1976, p. 102, n. 1).

46. Following Harley, a similar statement is made by Capie and Webber (1985, p. 317): "Threats of conversion eliminated the 3 per cent Consols as long-run securities and indicators of long-run interest rates."

47. For discussions of the Goschen conversion and the temporary-interest phenomenon of the resulting consols, see Harley (1976, pp. 101-103; 1977, p. 83, n. 18), Capie and Webber (1985, p. 317), Homer and Sylla (1991, pp. 192, 194), Mills and Wood (1992, p. 205), Taylor and Wood (1996, p. 287).

48. A comparison of gilt-edged yields with the yield on consols from 1750 to 1990, and also with the U.S. long-term interest rate in the 20th century, is in Homer and Sylla (1991, pp. 441-455).

49. This solution is not obvious. Only about £3 million (increased to £10 million in 1884) of this 2_% consol was held by the public, compared to £500 million of the various 3% consols in 1888. See Harley (1976, pp. 102-103).

50. A bond's redemption yield is its internal rate of return: the interest rate that equates the present value of all cash flows to the price.

51. The Bank's model and its estimation, and changes in them over time, are described in Anonymous (1967, 1982, 1990), Burman and White (1972), Burman (1973), Page and Burman (1976), Deacon and Derry (1994), Anderson and Sleath (1999, 2001).

52. This Bank monthly series was obtained by the author directly from the Bank.

53. Mitchell and Deane (1962, p. 455) and Mitchell (1988, p. 678) note that Warren and Pearson (1935) "also contains the figures up to 1934."

54. This series is the nominal rather than real yield, resulting from the Bank's estimation of the nominal (rather than real) yield curve. See Anderson and Sleath (1999).

55. Thus the linking ratio is computed for (1) April-September 1985 and June-November 1986, to estimate LNZC for October 1985 - May 1986, (2) February-July 1991 and February-July 1992, to estimate LNZC for August 1991 - January 1992.

56. Terms on *foreign* debts incurred, successively, by the (i) Continental Congress, (ii) Confederation, and (iii) U.S. Treasury under the Constitution, in the last quarter of the 18th century, play no role in representing the U.S. long-term interest rate, for two reasons. First, such loans made by friendly governments during the Revolution were generally at subsidized rates, as aid to the Americans and against the British. Second, the interest rates on foreign loans "were a part of the interest rate history of the creditor countries and do not indicate market rates of interest in America" (Homer and Sylla, 1991, p. 278).

57. The interest earned on three-month Treasury bills was tax exempt until March 1941 (*Banking and Monetary Statistics, 1941-1970*, pp. 693, 707). However, this element is not deemed to affect the representativeness of the Treasury bill for the short-term ordinary-funds interest rate (see section III.A.1.b).

58. The series of prime corporate-bond yield begins in 1899 rather than 1900; see section B.3.

59. *Banking and Monetary Statistics, 1914-1941*, p. 478. *Historical Statistics of the United States*: *1789-1945*, p. 280; *Colonial Times to 1957*, p. 656; *Colonial Times to 1970*, p. 1003; *Millenial Edition*. Friedman and Schwartz (1982, pp. 122-123), Balke and Gordon (1986, pp. 781-782, 789-793), Homer and Sylla (1991, pp. 287-288).

60. Homer and Sylla (1991, pp. 287-288, 342); *Historical Statistics of the United States, Millenial Edition*.

61. See Homer and Sylla (1991, pp. 293-294).

62. Although Sushka states Homer (1963) as her source data, these data are simply replicated in Homer and Sylla (1991).

63. Aaa is Moody's highest-quality rating. For discussion of bond ratings, see Ederington (1992) and Blitzer (1992). For descriptions of Moody's corporate-bond-yield series, see *Banking and Monetary Statistics: 1914-1941*, pp. 429-430; *1941-1970*, pp. 647-649.

64. For discussion of Durand's technique, see Friedman and Schwartz (1982, pp. 109-110, 294); Homer and Sylla (1991, pp. 433-435); Anderson, Breedon, Deacon, Derry, and Murphy (1996, pp. 21-22).

65. See Homer and Sylla (1991, pp. 342, n; 434) for a description of their constructed series. The method of interpolation is not stated.

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