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THE LONG-TERM REAL INTEREST RATE FOR SOCIAL SECURITY

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Abstract:

This paper considers the Social Security real interest rate, examining historical interest rates and estimates derived from Treasury inflation-indexed securities. The paper demonstrates that historical experience with nominal rates of return and realized inflation back through 1870 results in a long-term real interest rate just under 3 percent, although in the more recent historical record, rates have been somewhat higher. Forward-looking projections based on inflation-indexed Treasuries for the past three years have averaged about 2.8 percent.

The author is with the U.S. Department of the Treasury. The views expressed here are those of the author and not necessarily those of the Treasury Department. I would like to thank Mark Warshawsky, Karen Hendershot, Ralph Monaco, and James Duggan for their helpful suggestions.

Introduction

Long-range estimates of the unfunded obligation for Social Security include a long-term assumption for the real interest rate. The real interest rate is used to compute future earnings on the Trust Fund assets and the present value of future obligations. This paper examines approaches to developing such a long-term interest rate assumption. The approaches include the analysis of historical interest rate data, as well as the assessment of yield curve estimates of long-term returns embedded in contemporaneous Treasury inflation-indexed securities.

Social Security uses a special concept for the real interest rate. As discussed in greater detail later, the Social Security nominal interest rate that is the source for the real interest rate assumption is the average market yield of outstanding Treasury issues of medium-term and long-term maturity. This nominal rate is computed at the end of each month, and it becomes the coupon rate on new securities for the Social Security Trust Funds, which are issued at par.

To get the Social Security real interest rate, the nominal rate is converted to an annual rate of return, which is the annual increase in funds invested at this rate, and the return is converted to real terms by applying the CPI for Urban Wage Earners and Clerical Workers (CPI-W). The CPI-W is first adjusted for methodological improvements. Methods for estimating the future real interest rate as defined in this fashion are the focus of this paper.

Because the Social Security nominal interest rate is not available before the end of September 1960, a historical study of this rate prior to that date is not possible. Based in part on an analysis of the rate over the last 40 years, the Trustees Report (2005) assumes that the real interest rate will settle on a long-term average of 3.0 percent in the intermediate cost case, with the low cost and high cost assumptions being respectively 3.7 percent and 2.2 percent. The Congressional Budget Office (2004) uses a real interest rate of 3.3 percent for its Social Security projections, which is the real rate on 10-year Treasury notes at the end of their 10-year projection period.

The last 40 years, however, is a relatively short time frame for generating long-term projections. This is especially true in the case of Social Security projections that extend at least 75 years into the future, almost twice as long as the 40 years. Therefore, it may be informative to examine a much longer time span, taking into account the special characteristics of each historical episode, and use the historical data so developed to inform judgments about long-term projections.

Consequently, this paper looks at historical data back through 1870, about twice as long as the Social Security projection time period. The historical long-term average real interest rate is derived from a historical nominal interest rate series that is similar to the Social Security interest rate. The resulting average real interest rate for the 134 years from 1870 to 2003 is near 3 percent. The first three sections of the paper set out this historical real interest rate.

The fourth section of the paper complements the historical evidence with a study of the recent market for Treasury inflation-indexed securities. Using daily yield curves estimated for the last several years, the annual real return implied by this market is calculated for a time span

of 80 years into the future. Currently implied long-term market returns are especially relevant for long-term projections because they are consistent with returns actually available in markets, and thereby indicate what market participants may expect for the future. Even though historical data are critical in understanding long-term trends and form a basis for projections, such data are affected by specific past circumstances, and so history needs to be supplemented by market analysis. Because the inflation-indexed market is relatively new, greater weight is placed on recent years when the market appears to be better developed. Since 2001, the implied annual 80-year real return has averaged about 2.8 percent.

A Government Interest Rate

This section describes the government nominal interest rate which is used to approximate the Social Security nominal rate for historical analysis. Development of a historical interest rate series will enable the analysis to stretch back through 1870, and not be limited by the 40 years for which the Social Security rate is available.

In nominal terms, the Social Security interest rate is defined to be the weighted average of market yields on outstanding Treasury issues with at least four years to maturity or call, with the weights given by the market values of the respective securities. The yield to call is used for any security that is callable and selling above par, while the yield to maturity is used for all other securities. The nominal rate is computed at the end of each month for new issues to the Trust Funds.

Because the Social Security nominal interest rate is based on Treasury securities, the chosen historical rate should also reflect the yields on risk-free Federal government securities. As part of his work on historical returns to various asset classes, Jeremy Siegel has put together a time series on the long-term total return to government securities, and the sources of his data can be used for the present analysis.[1]

Professor Siegel obtains his annual long-term government total return data for 1926 forward from Ibbotson Associates. In this paper, the annual government yield for the years 1926-2004 is also taken from Ibbotson Associates, and it is the average of their monthly yields on long-term Treasury bonds.[2] The Ibbotson series chooses for each month a representative Treasury bond of about 20 years maturity. Ibbotson attempts to select bonds so as to minimize the effects of the special features of certain older bonds, such as flower bonds – bonds whose yields are lower because they can be redeemed by estates at par – and fully or partially tax-exempt bonds.[3] Nevertheless, some bonds with special features are in the Ibbotson series, possibly depressing yields in earlier years relative to what they would be today.

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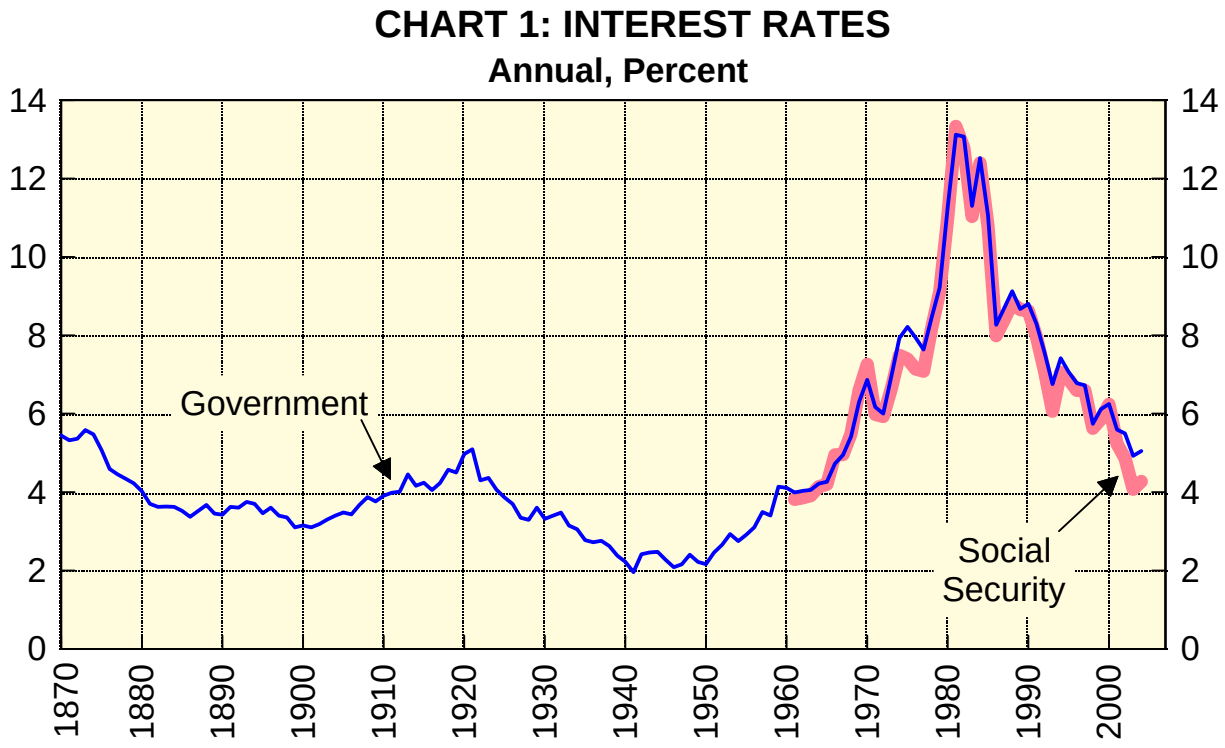
[1] See the long risk-free return series in Siegel (1992), with data sources in his Appendix A.
[2] See Ibbotson Associates (2005).
[3] Flower bonds were issued until the early 1970s, and even though all bonds issued after March 1941 were subject to the income tax, both fully and partially tax-exempt bonds were still traded into the 1960s. See Ibbotson and Sinquefield (1976) for more discussion.

The Ibbotson data are carried back for the years 1921-1925 by the standard series for the Treasury long-term composite interest rate. This is the longest existing Treasury long-term bond interest rate series, and it is still computed by the Treasury Department.[4] For 1921-1925 the bonds included in this series are partially tax exempt, so again their yields may be lower than equivalent bonds today.

Before 1921, Federal government bonds do not appear to be suitable for a general government series. This is because Federal bonds could be held as reserves by banks against bank notes, a feature which made them more desirable and artificially depressed their yields.[5] Therefore, following Professor Siegel, the yields on high-grade municipal bonds are used instead. Municipal yields are taken from the classic study on interest rates by Sidney Homer.[6] For 1901-1920, the yields are the High-Grade Bond Buyer series, and for 1870-1900 the yields are averages on New England municipal bonds.

Chart 1 plots the resulting annual government nominal interest rate series for 1870-2004, and includes annual averages of the Social Security nominal interest rate:



[4] In contrast to the Social Security interest rate, the Treasury long-term composite interest rate series is an unweighted average of yields, but similar to Social Security, yields to call are used for securities trading above par and yields to maturity otherwise. The maturities of the bonds in this series have varied over time; for the years 1921-1925, the series includes all bonds with maturities or first call date of more than 8 years. Monthly values for this series are averages of daily values in the month; in contrast, only end-of-month figures are available for the Social Security series, and such figures are taken to be the succeeding month's value.

[5] See Siegel (1992) for a discussion of this.

[6] See Homer (1963).

Several features of the chart are notable. Nominal interest rates fell in the 1930s during the Great Depression, and were kept low in the 1940s because they were pegged by the Federal Reserve during World War II and its aftermath. However, inflation at the time of the Korean War showed that rates were pegged too low, so Treasury and the Federal Reserve reached an accord in March 1951 which eliminated the constraints of pegging. Nevertheless, rates during the 1950s and 1960s remained relatively low, and any long-term average that includes these decades will be lower in consequence. The accelerating inflation of the late 1960s and 1970s caused interest rates to soar, while the subsequent deceleration and Federal Reserve policy brought rates down.

Various explanations have been given for the low interest rates in the 1950s and 1960s.[7] One reason is that stock market fears from the crash in 1929 were still a vivid memory, inducing many investors to accept low returns on fixed-income securities rather than the uncertainty of stocks. Moreover, Federal Reserve Regulation Q kept interest rates down on savings and time deposits, reducing the competition to bonds from such deposits.

Chart 1 also shows that the government nominal interest rate closely tracks the Social Security nominal interest rate over the period 1961-2004 when the Social Security rate is available. Over that period, the government rate averages about 24 basis points more per year than the Social Security rate. This is to be expected, because the government rate over that period pertains to a 20-year bond, while the Social Security rate includes a range of maturities down as low as 4 years. Therefore, it appears that the government rate can approximate the Social Security rate going back in time, keeping in mind that the government rate may be a bit on the high side relative to Social Security.

[7] See Siegel (1998), pp. 15-16 for more discussion.

The Price Series

The nominal interest rate is converted to real terms with the CPI for Urban Wage Earners and Clerical Workers (CPI-W), and the same price series carried back historically will be used for the government interest rate series.

The official CPI-W published by the Bureau of Labor Statistics introduces improvements in methodology at discrete points in time, but does not carry these changes back historically. Social Security, however, uses an adjusted CPI-W which is modified to reflect these methodological improvements throughout the historical series.[8]

The Social Security adjusted CPI-W series goes back through 1951. The official Bureau of Labor Statistics CPI-W extends back through 1913. For this paper, annual levels of the Social Security adjusted CPI-W are extended back through 1913 with the growth rates of the official series minus the 0.2 percentage point for the geometric formula correction used by Social Security in their series before 1967.

Before 1913, for this paper the adjusted CPI-W series is spliced with the Hoover series for 1851-1890 and the Rees series for 1891-1912.[9]

Levels of the resulting extended and adjusted CPI-W price index from 1870-2004 are depicted on a ratio scale in Chart 2 on the next page. The annual percent change in the index is shown in Chart 3, also on the next page. Chart 3 includes for each year the average annual growth rate of the index back 10 years, computed by trend-line regression.

The charts show that this price index was actually declining until about 1900. After that time it rose, but the level of the index at the beginning of World War II was not much different from its level around 1900 or even 1870. After World War II the index began its steady rise as postwar inflation took off. The implication is that prices were fairly stable across the decades before World War II, with inflationary periods reversed by deflation. So it is possible that the low nominal interest rates during the 1950s and 1960s reflected a deep-seated expectation of price stability, which only gradually changed as postwar inflation was seen as different from history.

[8] The adjusted CPI-W used by Social Security is modified in several ways, including use of the CPI-U-RS – which is a recomputation of the CPI-U with current methodology – and the CPI-U-X1 – which takes account of rental equivalence in housing costs. For years before 1967, the percent change in Social Security's adjusted CPI-W is the published CPI-W percent change minus 0.2 percentage point, which is an estimate of the effect of the geometric weighting formula introduced by the Bureau of Labor Statistics in January 1999. The adjusted CPI-W is unpublished and its source is the Office of the Actuary at the Social Security Administration.

[9] Data are in U.S. Bureau of the Census (1975), Series E 135.

CHART 2: ADJUSTED CPI-W

Annual Level, Ratio Scale

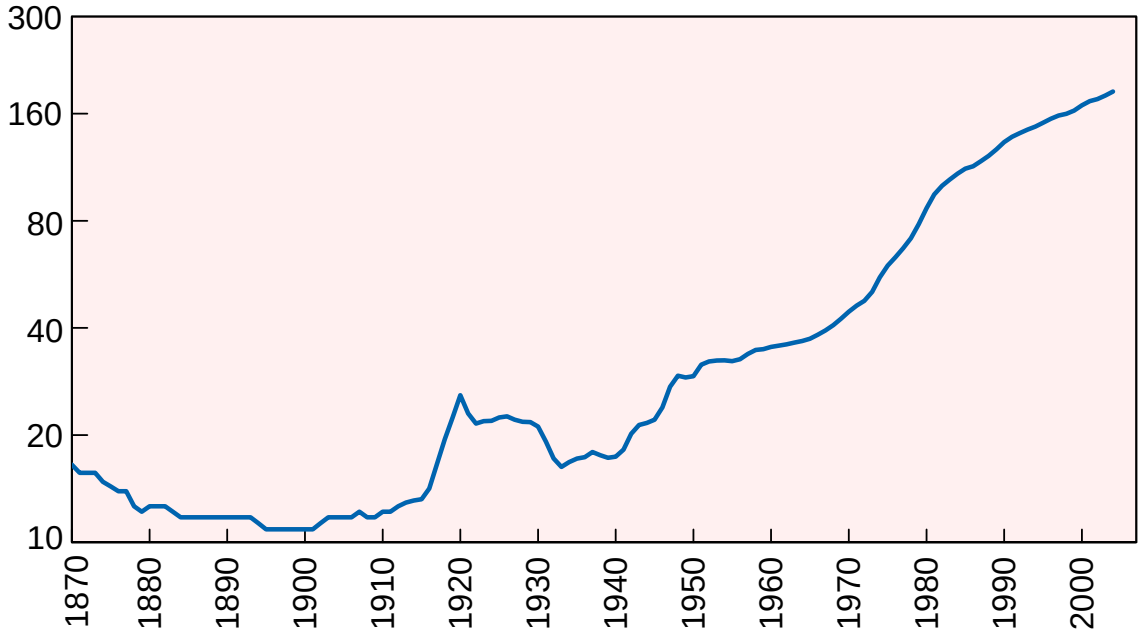
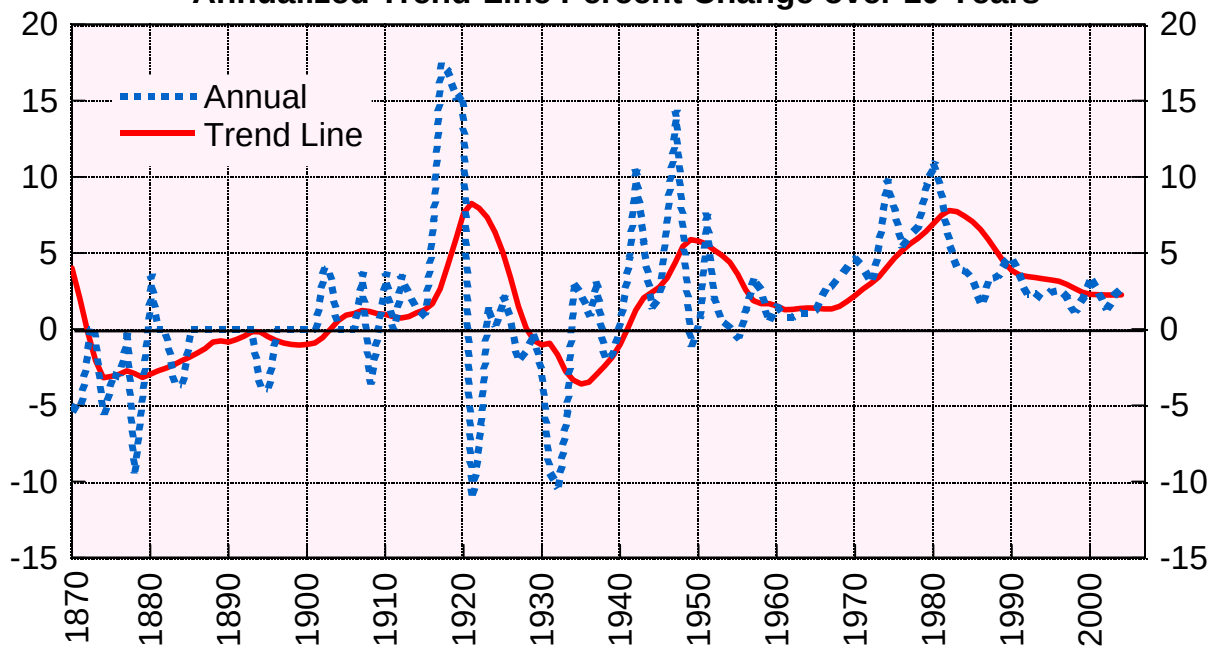


CHART 3: ADJUSTED CPI-W

Annual Percent Change and
Annualized Trend-Line Percent Change over 10 Years



A "Realized" Government Real Interest Rate

In this section, the government nominal interest rate is converted to a real rate using the modified CPI-W series in the previous section.

There are many different ways to convert a nominal interest rate to real. Perhaps the best-known approach is to subtract a distributed lag on inflation from the nominal rate. The lag represents adaptive inflation expectations and the resulting real rate represents the expected real rate. Sometimes survey data on inflation expectations are subtracted instead of actual inflation.

The approach underlying the real rate used in the Trustees Report is to compute for each year the total real return that would have been realized from investing in a bond for that year and selling the bond at the end of the year. The total real return may be different from the real interest rate calculated from inflation lags; in the long run, however, when inflation and interest rates have settled down, these approaches should give the same average. Using the total real return has the advantage over the adaptive expectations approach in that it avoids having to make decisions about the proper lags on inflation. Moreover, the total real return shows the actual real earnings that were realized from holding the bond, while the use of lags is an estimate of the expected real earnings.

In accordance with this "realized" approach, the total return method is used in this paper to convert the government rate to real. However, in most computations of total return, changes in the price of the bond from the beginning of the year to the end, that is, capital gains and losses, are taken into account. Capital gains and losses are ignored in the Trustees' approach because securities in the Trust Funds are bought and redeemed at par with no gains or losses. Thus, capital gains and losses will also be ignored in converting the government interest rate to real, and the Social Security formula will be used exactly.[10]

Chart 4 on the next page plots the total real return calculated in this fashion from the government interest rate and the modified CPI-W for each year 1870-2003. (Note: 2004 cannot be included because the price index for 2005 is not yet available.) The chart also contains 10-year compound averages, which for each year show the annualized average real return from repeatedly investing for that year and 9 previous years.

The chart shows that on balance, real interest rates were higher before 1900 than in the years immediately following. Real rates were low in the decade before 1920, high in the 1920s, but low again in the 1940s with wartime inflation and the Treasury rate pegged down, and they continued to be low in the 1950s through 1970s. Real rates have been higher since 1980, but more recently (thus far in the 2000s) have been lower.

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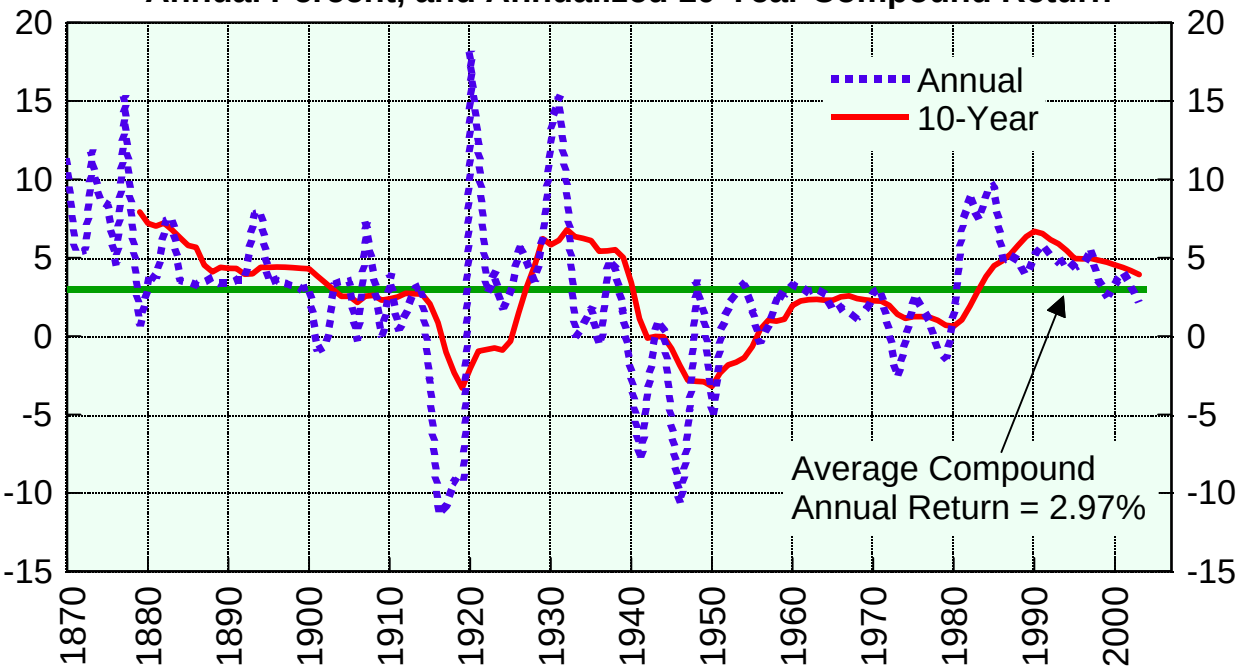
[10] To be specific, for each year the real interest rate is derived from the average nominal interest rate for that year and the price indexes for that year and the following year. The first step is to calculate the semiannually compounded nominal return over the year from buying a bond at par yielding that nominal interest rate. Such a bond will pay a coupon of half the amount of the interest rate at midyear, which will be reinvested at the same rate, and another coupon at the end of the year. The real return is then gotten by dividing the nominal return by the ratio of the following year's price index to the current year's. Because the following year's price is needed for the computation, annual real rates go through 2003.

CHART 4: GOVERNMENT REAL INTEREST RATE

Annual Percent, and Annualized 10-Year Compound Return



The chart also contains a line at 2.97 percent for the long-term average compound real interest rate for the entire period 1870-2003. This average is very close to the 3 percent long-term real interest rate currently assumed by the Social Security Trustees. After allowing for the previous observations that the government interest rate may be biased down in some years of the period because of the types of bonds included and the lingering effects of the Great Depression, and for the fact that this rate has exceeded the Social Security rate by about 24 basis points in recent decades, the 2.97 percent average provides support for the view that the long-term real interest rate for Social Security is in a band around 3 percent.

In addition, the 2.97 percent average is broadly consistent with Professor Siegel's result of an average compound annual real return of 2.8 percent for long-term government securities for the years 1871-1997.[11] Professor Siegel includes capital gains and losses in the total return formula. For the longer period 1802-1997, he gets a significantly higher 3.5 percent.

It is also useful to focus on the period for which the Social Security interest rate is available. The average government real interest rate for the years 1961-2003 is 3.48 percent, which compares with the 3.26 percent average real Social Security rate over this period. As seen earlier, the government nominal rate is a bit above the Social Security rate, so some spread is to be expected.

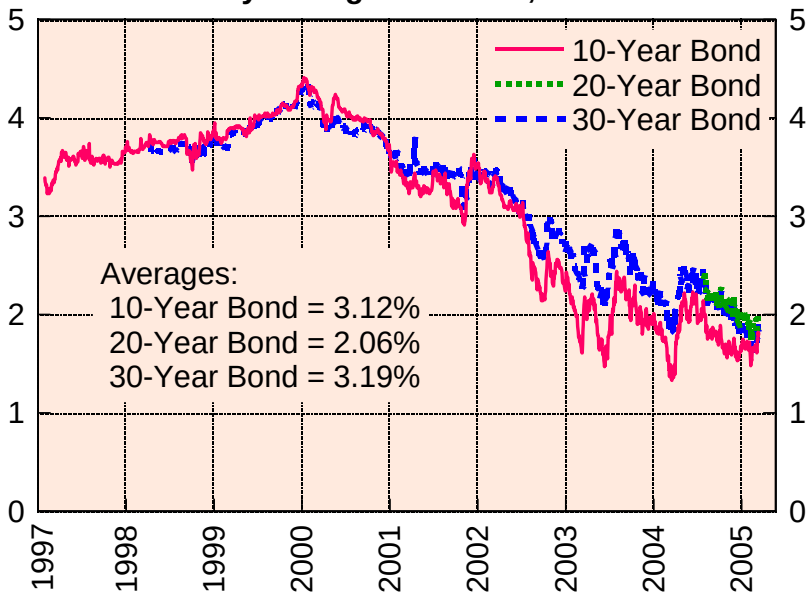
[11] See Siegel (1998), Table 1-2. See also Diamond (2000).

Inflation-Indexed Treasuries

Starting in 1997, Treasury has issued inflation-indexed coupon securities (called Treasury Inflation-Protected Securities or TIPS) whose interest and principal payments are indexed to the CPI for All Urban Consumers (CPI-U). Therefore, the yields on these securities are in real terms, and the yields provide direct relevant evidence on long-term real interest rates presently available in markets, implied by market conditions, and expected for the future.[12]

Chart 5 plots daily values of the real yields for 10-year, 20-year, and 30-year inflation-indexed Treasury bonds. The yield series in the chart were derived by chaining successively the yields on the latest issues for the respective maturities. The 10-year bond was first issued in January 1997, the 30-year bond in April 1998, and the 20-year bond started last July.

CHART 5: REAL YIELDS ON INFLATION-INDEXED TREASURY BONDS
Daily through 3/15/2005, Percent



Of course, one shortcoming with using inflation-indexed Treasuries for long-term projections is that these securities have been issued for such a short time. Moreover, the market for these securities was not developed fully during the first few years of their existence, so it is not clear at what point they became accurate indicators of market conditions and beliefs, and their high yields during the first few years may have stemmed from their novelty. All the same, in contrast to historical interest rate series, there is a mass of market data available for inflation-indexed Treasuries, and these data can be used effectively to develop a different approach for projecting real interest rates.

[12] When inflation-indexed Treasuries were first issued, it was decided that, based on the relevant legislation, they should be excluded from the computation of the Social Security interest rate, both nominal and real.

In this new approach, a yield curve pricing model is fitted to price quotes for the inflation-indexed Treasuries for each day. This model produces a host of data for the inflation-indexed market, but in particular, it provides an estimate of the average annual total real return implied by this market over different investment horizons. Although there may not be any actual set of securities available in the market which can be used to generate this total return, nevertheless, the estimated return is in accord with market conditions in the sense that if appropriate securities were offered, they would provide the estimated total return. In the case of Social Security, the investment horizon chosen is 80 years, to correspond approximately to long-term Social Security projections.

Conceptually, the 80-year inflation-indexed return differs somewhat from the long-term projected Social Security real interest rate. The Social Security rate is the average expected real return from the nominal Treasury securities in the Trust Funds, whereas the 80-year return is the long-term real return implied by the inflation-indexed market right now. Nonetheless, current market implied returns may be a better guide to investors' time preference, and so they are relevant for Social Security projections. Moreover, market returns are forward looking, while historical data are limited by specific circumstances in the past, so market returns provide direct pertinent evidence on investors' present expectations for future interest rates.

The data used for implementing this approach are a set of price quotes on the inflation-indexed securities for 1,476 trading days, spanning the time period April 15, 1999 through March 15, 2005.[13] For each of these days, a yield curve is fitted to the inflation-indexed quotes for that day using the yield curve approach developed in Treasury's Office of Economic Policy. Each curve goes out through 31-1/2 years, which covers the maximum maturity of all the securities, and is then extended out through 80 years.[14]

Chart 6 on the next page is a daily surface chart showing all the fitted yield curves in terms of spot rates. A spot rate curve gives the interest rate that would be earned at each maturity on a zero coupon security. The only difference between a spot rate and annual total return is that the semiannual compounding is carried out for the total return, which makes the total return a bit higher. Nevertheless, the spot rate concept is standard in financial markets, and so it is presented here. The chart shows that short-term real spot rates had been negative for a while, but have recently moved up along with increases in the federal funds rate.

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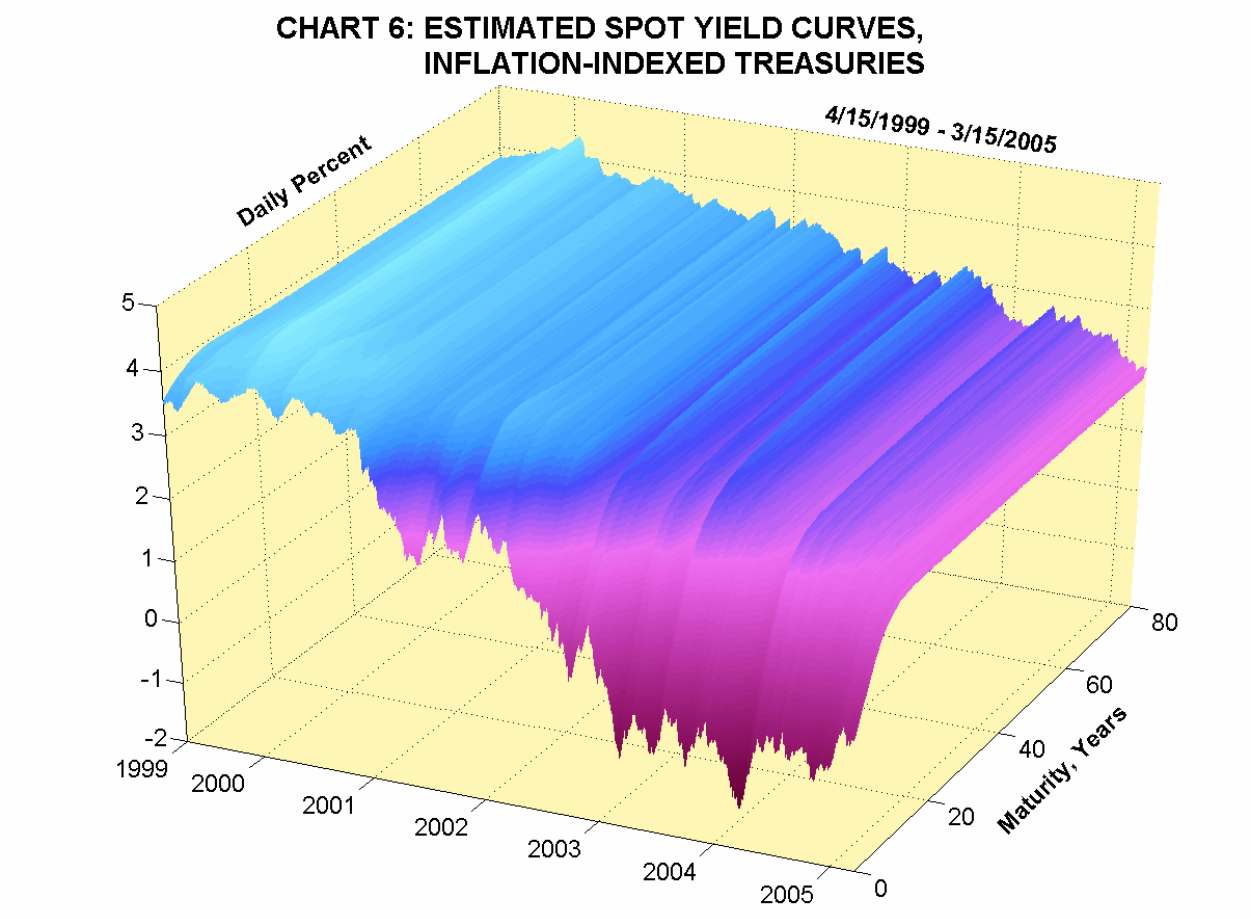
[13] The quotes are Bloomberg Generic Prices, and certain quotes and days were eliminated to get a consistent set. The quote series was started in 1999 to minimize abnormalities in the prices when these securities were new in the market. Only quotes from issue date forward were used, and for each day there had to be at least 6 securities outstanding to have a large enough sample, including at least 1 security within each of the three ranges 0 - 7, 7 - 10, and 10 – 31-1/2. As of March 15, 2005, there had been a total of 17 inflation-indexed securities issued, with 16 still outstanding, and an early 5-year security having matured in 2002.

[14] This approach models the inflation-indexed prices as the sum of their future payments in real terms multiplied by discount factors. Each discount factor is expressed as a function of the forward real interest rate, and the forward rate in turn is modeled as a cubic spline. The parameters of the spline are estimated by least squares with endpoint smoothness constraints, and with no weighting. In addition, the forward rate at 31–1/2 years and beyond is set equal to its mean for 10 through 31–1/2 years, which produces a smooth projection beyond 31–1/2 years and ensures that the yield curve will settle down to a reasonable long-term level. See U.S. Department of the Treasury (2005) for more information and an application of this approach to corporate bond yield curves for pension discounting. The yield curves presented here are separate from those underlying the real rates published in the Federal Reserve Board's H.15 release.

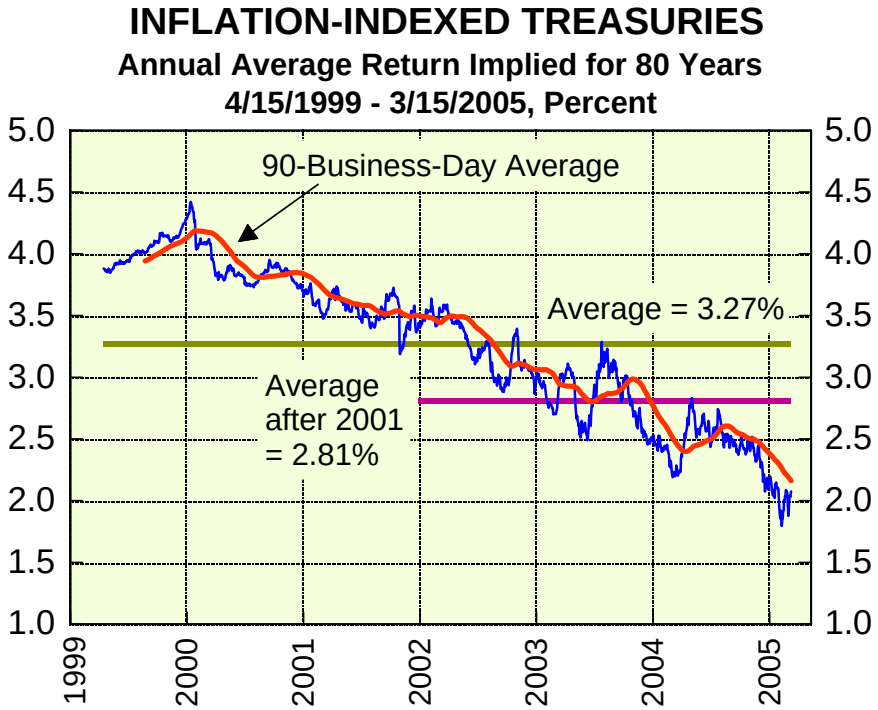


Using these yield curves, the implied total return over 80 years can be computed for each day. This return is the average real rate per year that would be earned in this market over an 80-year horizon, as implied by the structure of prices in the market. It is shown for each of the 1,476 trading days in Chart 7 on the next page. The chart also plots the average value of the 80-year return over the entire period 4/15/99 through 3/15/05 at 3.27 percent, and the average value of the 80-year return since 2001 at 2.81 percent. And the chart includes the 90-day moving average of the 80-year return, which for each day is the average of the return for that day and the 89 previous days. The moving average dampens daily fluctuations.

One feature of Chart 7 to note is the dip on October 31, 2001, which lasted for several weeks before recovering. That was the date on which it was announced that 30-year Treasury securities, both conventional and inflation-indexed, would be discontinued. The announcement caused demand for long-end inflation-indexed Treasuries to increase temporarily.

The chart indicates that the 80-year return has varied over time. There appears to be a breaking point around the middle of 2002, before which the rate was above average, and after which it has been below. Of course, there is still the question of when this market developed sufficiently to capture accurately trading behavior and market expectations. Because the development of this market is questionable in the earlier years, it is useful to look at the 80-year

returns more recently. The average 80-year total return was 2.81 percent after 2001, 2.60 percent after 2002, 2.08 percent on the day 3/15/05, and 2.16 percent over the 90 days ended 3/15/05.



The recent 80-year returns are around 2.8 percent or less. And so, based on the inflation-indexed market at this time, the long-term real return could be assumed to be below 3 percent. The last few years, however, have been a period of cyclically low interest rates and accommodative monetary policy. As monetary policy continues to tighten and the cycle moves into its next phase, interest rates may rise, although the amount of the increase is uncertain.

In translating these results from the inflation-indexed Treasury market into projections for the Social Security real interest rate, the presence of an inflation risk premium must be taken into account, which might push up the Social Security real rate relative to the inflation-indexed rate. In general, yields on nominal Treasury securities are elevated not only by expectations of inflation, but also by a risk premium reflecting the uncertainty of future inflation. Such a risk premium is in principle absent from inflation-indexed Treasuries, since they offer protection against shifting inflation rates.

Because the Social Security real interest rate assumption is based on the nominal Treasury market, it includes the inflation risk premium if there is any. For that reason, projections from the inflation-indexed market may need to be adjusted upward to account for this risk premium. Estimates of the amount of the adjustment vary widely, however, covering a range from no adjustment at all to perhaps 50 basis points. Moreover, the newness of the inflation-indexed market makes a firm estimate difficult.[15]

[15] See Sack and Elsasser (2004) and Hammond (2002) for more discussion.

Conclusions

This paper has developed alternative approaches for projecting the long-term Social Security real interest rate, including an examination of historical data and estimation of yield curves for the Treasury inflation-indexed market. The examination of historical experience back through 1870 implies that the long-term real interest rate is near 3 percent. Forward-looking projections from yield curves for inflation-indexed Treasuries for the past three years have averaged about 2.8 percent.

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