

Research Department
Federal Reserve
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Are Interest Rates Comparable?

Many of us forget—if we ever knew—that market traders don't always quote interest rates on comparable bases. By convention, they may quote rates on the basis of a discount or investment yield; a 360- or 365-day year; or simple or compound interest. In the special case of money-market funds, quoted rates may even represent a past-realized return rather than an expected future yield. Such discrepancies are significant indeed, especially when rates approach lofty levels. For example, a 3-month commercial paper rate of 16.0 percent and a bank CD rate of 16.7 percent, when calculated on a comparable basis, both produce an 18.0-percent compound yield.

Obviously we need directly comparable rates when considering alternative investments. But there are other reasons as well. In term-structure studies, for example, economists typically use a money-market instrument for the shortest maturity instrument and a bond for the longest maturity instrument, even though the two typically are not quoted in directly comparable terms. (In this regard, stated maturity is not normally a good measure of effective maturity, or duration, and may lead to large term-structure biases, as shown by Joseph Bisignano in the April 3, 1981 *Weekly Letter*.) Economists also use the differential between the T-bill and commercial-paper rates as a measure of default risk, or the differential between the bank-CD and commercial-paper rates as a measure of bank aggressiveness. While the T-bill/commercial-paper comparison is valid, the bank-CD/commercial-paper comparison is not, again because CD and commercial-paper rates are not calculated the same way.

First step: annual compound interest

To examine how quoted rates differ, we must first establish a single method of expressing all yields. Next, we must ferret out the different conventions on which rates actually are quoted, and finally, adjust the quoted rates to a directly comparable basis.

Instruments may vary in maturity from one-day Federal funds to perpetual British consols. Thus, to compare rates of return, one must first put yields on a single time basis—the year being the universally accepted denominator. But one must also decide on a comparable treatment of interest received during the life of the instrument. One sensible rule, especially for shorter-term money-market instruments, is to presume that all cash payments (either coupon- or face-value redemption) can be reinvested at the same rate of return as the initial instrument. This rule-of-thumb enables the yields from instruments with different maturities and payment streams to be compared on the basis of annual compound interest.

Accepted conventions

Financial-market participants quote rates on the basis of a number of conventions that puzzle the purist. Although accepted practice seems crude and often inconsistent, it resulted from the need to make quick decisions when sophisticated calculators were unavailable and when historically low interest rates made fancy calculations less critical. The year thus took on 360 days in the money market because of its computational ease, while simple-interest calculations became the industry norm for short-term instruments.

In the money market, which deals in securities with initial maturities of up to one year, discount securities are treated differently from interest-bearing securities. Discount securities are redeemable at face value as of a stated date; the yield is calculated as the difference between face value and purchase price as a *percentage of face value* (redemption price). In contrast, for single-payment interest-bearing securities, the yield is calculated on the basis of interest paid at maturity as a *percentage of principal* (purchase price). The latter method properly reflects return on investment, while discounting understates the true investment yield. Moreover, the de-

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gree of understatement rises nonlinearly with the rate of interest.

Equally important, market participants use simple rather than compound interest when annualizing money-market rates. This convention is particularly puzzling because it creates difficulties for comparing instruments with different maturities. Dealers defend simple-interest calculations on the grounds that compound-interest comparisons would imply reinvestment of accrued interest at the initial rate. But simple-interest comparisons are even worse, since reinvestment of accrued interest presumably occurs at a zero rate of interest. However weak the justification, dealers still annualize all money-market instruments on the basis of simple interest. This practice, like discounting, results in an understatement of annual yield—again, nonlinearly related to the level of rates.

The choice of a 360-day year for most money-market instruments is indefensible in today's world of \$10 calculators. It also leads to an understatement of annual yield, as it presumes that no interest is earned during five (or six) days of the year. This practice results in a small bias compared with those of the other conventions cited, however.

For notes and bonds (coupon-bearing instruments with initial maturities beyond a year), the accepted conventions for yield calculations come closer to a true approximation of annual compound yield. The standard "bond yield" avoids most of the bias present in money-market quotes; i.e., it is based on investment (not discount) yield, compound interest, and a 365-day year. However, it compounds the annual coupon payment as if it were paid in a single lump at the end of the year. Most bonds actually pay interest twice a year (half at midyear), so that the "bond yield" results in an understatement of the true annual compound-interest yield. Nonetheless, dealers customarily express money-market rates in terms of "bond-equivalent yields" for comparative purposes, although not even this rate is an effective compound yield.

Money-market funds (MMF's) do not pay an *ex ante* promised yield as debt instruments do. Instead, they pay an *ex post* realized portfolio return—the result of accrued interest plus capital gains and losses. In their computations, most consumer-oriented MMF's first mark assets to market daily (i.e., estimate unrealized capital gains/losses). Next they quote a weekly yield on the basis of the average return (including realized interest and both realized and unrealized capital gains/losses) over a seven-day period. Finally they annualize this yield using the money-market norm of simple interest.

Yield comparisons

In the money market, many of the widely traded instruments, such as T-bills, commercial paper, finance-company paper, and bankers acceptances, are quoted on a discount—simple interest—360-day basis. At the high interest rates prevalent today, rate quotes fall well below effective yields. For example, a 90-day T-bill quoted at 16.0 percent actually yields 18.0 percent (see table), while the bias is even larger for a 180-day T-bill. One can easily decompose the bias into its sources (see chart). For the 90-day instrument, the assumption of simple interest is the greatest source of error, followed by the effect of quoting on a discount basis. For the 180-day instrument the roles of these two factors are reversed, which is understandable given that discounting would have a greater effect—and interest compounding a smaller effect—on the instrument of longer maturity. Finally, the 360-day-year convention imparts a small but measurable bias in both cases.

For interest-at-maturity instruments, such as bank CD's and Eurodollar deposits, the lack of discounting results in a somewhat smaller bias. For notes and bonds, the error in quote yields is even smaller because of the use of a 365-day year. But the error still is substantial because of the failure to recognize that half of each year's interest is received at mid-year. Thus, the common practice of adjusting money-market rates to the "bond equivalent yield" still results in a sizable underestimate of effective yield.

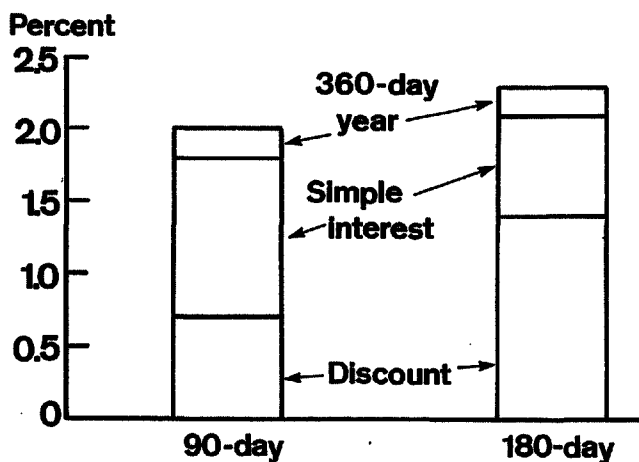
Does all of this really matter? As the table indicates, the difference is small at low levels of interest rates—except, of course, to traders who eke out their living on basis points. At higher rates, such computations matter even to the casual observer. Money-market traders know the problems well, and thus apply both rule-of-thumb and exact correction factors when comparing yields. But the rest of us would do well to remember that interest rates are more complex than we generally give them credit for being.

Jack Beebe and Elaine Foppiano

Equivalency of Quoted Rates

| Type of Security | Effective Yield | |
|----------------------|-----------------|-------|
| | 6% | 18% |
| Discount | | |
| 90-day | 5.7% | 16.0% |
| 180-day | 5.8 | 15.7 |
| Interest-at-Maturity | | |
| 90-day | 5.8 | 16.7 |
| 180-day | 5.8 | 17.0 |
| Bond | 5.9 | 17.2 |
| MMF Weekly Return | 5.8 | 16.6 |

Yield Bias in Discount Securities at an 18-Percent Yield



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BANKING DATA—TWELFTH FEDERAL RESERVE DISTRICT
 (Dollar amounts in millions)

| Selected Assets and Liabilities Large Commercial Banks | Amount Outstanding | Change from | Change from year ago | |
|---|------------------------------|-------------------------------|---------------------------------------|---------|
| | 4/7/82 | 3/31/82 | Dollar | Percent |
| Loans (gross, adjusted) and investments* | 158,027 | - 94 | 11,486 | 7.8 |
| Loans (gross, adjusted) — total # | 136,952 | - 43 | 12,822 | 10.3 |
| Commercial and industrial | 42,846 | - 177 | 6,393 | 17.5 |
| Real estate | 56,574 | 45 | 4,897 | 9.5 |
| Loans to individuals | 23,261 | 31 | 527 | 2.3 |
| Securities loans | 1,992 | 326 | 501 | 33.6 |
| U.S. Treasury securities* | 6,279 | 94 | 346 | 5.2 |
| Other securities* | 14,796 | - 145 | 969 | 6.1 |
| Demand deposits — total# | 41,502 | 983 | 1,497 | 3.5 |
| Demand deposits — adjusted | 29,033 | 1,017 | 1,713 | 5.6 |
| Savings deposits — total | 31,824 | 731 | 192 | 0.6 |
| Time deposits — total# | 90,020 | -1,117 | 14,511 | 19.2 |
| Individuals, part. & corp. | 80,793 | -1,180 | 14,032 | 21.0 |
| (Large negotiable CD's) | 33,100 | -1,036 | 4,105 | 14.2 |
| Weekly Averages of Daily Figures | Week ended 4/7/82 | Week ended 3/31/82 | Comparable year-ago period | |
| Member Bank Reserve Position | | | | |
| Excess Reserves (+)/Deficiency (-) | 40 | 95 | 46 | |
| Borrowings | 95 | 103 | 2 | |
| Net free reserves (+)/Net borrowed(-) | - 56 | - 7 | 44 | |

* Excludes trading account securities.

Includes items not shown separately.

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