



C A M B R I D G E   A S S O C I A T E S   L L C

## U.S. MARKET COMMENT: THE FALLACY OF THE FED MODEL

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## The Fallacy of the Fed Model

According to the formula dubbed, "the Fed Model" by Ed Yardeni, the S&P 500 was 29% undervalued as of November 25, 2002. A logical question is how this measurement could be possible as it stands so starkly in contrast to the overvalued readings suggested by most other valuation measures. For example, at 28.1, the P/E ratio of the S&P 500 is in the fourth percentile of historical valuations since 1926 and the eighth percentile since 1960. Similarly, most other valuation ratios are in the top decile of historical valuations.

While there are circumstances under which the Fed Model provides a useful back-of-the-envelope assessment of market valuations, it suffers from significant limitations that stem primarily from the following implicit assumptions:

- all earnings are distributed to equity holders;
- the nominal level of earnings is constant in perpetuity;
- forward earnings estimates accurately reflect future earnings growth;
- the risk of stocks and bonds is comparable, or that the equity risk premium (ERP) over bonds is equal to the long-term earnings growth rate;
- the duration of equities is equal to that of ten-year bonds; and
- the relationship between bond yields and the implied fair value P/E ratio is not linear.

The Fed Model is a simplified version of a dividend discount model, which discounts future expected cash flows to equity holders by the cost of capital, or the opportunity cost for holding equities rather than another asset of comparable risk. The formula for the Fed Model is as follows:

$$\text{Fair Value} = 12\text{-Month Forward Earnings Per Share} \div (\text{Ten-Year Treasury Bond Yield} \div 100).$$

The model forces stocks into a bond construct by assuming that equity earnings per share (EPS) are like bond coupon payments in that they are paid out for the life of the stock at the same nominal amount each year. However, in reality only a fraction of earnings are paid out to equity holders in dividends, with a dividend payout ratio averaging 50% since 1960. In addition, earnings do not stay constant in nominal terms, and actually have grown even after adjusting for inflation by about 1% compounded per year since 1926. Given that the model assumes nominal earnings are constant each year, it would be more logical to discount the earnings by the real interest rate, rather than the nominal interest rate, since earnings historically have at least kept pace with inflation. The assumption that all

earnings are paid out to equity holders tends to overstate valuations, while the assumption that nominal earnings stay constant tends to understate valuations.

While the model assumes earnings are constant in each year, it likely overstates the 12-month forward earnings, as consensus earnings estimates, as published by Thomson Financial, fairly consistently overestimate actual earnings. Since 1979, consensus estimates have been greater than actual earnings in all but two years, and according to a Federal Reserve study exceeded actuals by an average of 900 basis points (bps) between 1979 and 1996. Therefore, the Fed Model's version of a fair value market price will tend to be higher than that of the market because the market expects analysts to be overoptimistic, while the Fed Model does not. This should lead to a tendency for the Fed Model to provide undervalued readings.

The model's failure to incorporate an ERP is tantamount to assuming that equities and Treasury bonds have equal risk when in fact bonds are less risky than equities. While Treasury bond coupons are backed by the full faith and credit of the government, the return to equity holders is based solely on the ability of corporations to continue to pay dividends and increase shareholder value. In addition to the absence of a government guarantee on stock dividends or capital gains, stocks have tended to be more volatile than bonds. For example, between 1973 and third quarter 2002, the standard deviation of the S&P 500 was 17.2 compared to a standard deviation of only 5.3 for the Lehman Brothers Intermediate Government Bond Index. The formula is most sensitive to changes in the discount rate assumptions, so the absence of an ERP tends to make equities appear much less expensive than they would be otherwise. However, Ed Yardeni suggests that one of the reasons the Fed Model worked reasonably well in the 1980s and 1990s is that it is equivalent to a perpetuity calculation if the ERP is equal to the long-term EPS growth rate, which was the case in his view over this period. However, as Yardeni himself points out, there is no reason to assume that the ERP and the long-term EPS growth rate will be equivalent, making the absence of the ERP a significant limitation of the model.

The use of the ten-year Treasury yield as the discount rate, rather than a longer duration bond yield will tend to understate valuations, given that the yield curve is positively sloped most of the time. Since equities are assumed to be perpetual, the longest maturity Treasury yield should be used to come as close as possible to the duration of equities. When the yield curve is relatively flat, this assumption is not particularly limiting; however, today, the yield curve is positively sloped, with a spread of 103 bps between the ten-year and the 30-year Treasury.

While all of these assumptions dilute the usefulness of the Fed Model, the most critical factor as to why the model provides a false reading today is the low level of interest rates. The model assumes that the relationship between bond yields and the fair value P/E ratio is not linear (see Table B). Therefore,

when bond yields are very low, the formula suggests the fair value P/E ratio of the S&P 500 is very high. For example, the model suggests a fair value P/E of 33.3 with a bond yield of 3%, and 100 with a bond yield of 1%—clearly too high to be considered reasonable.

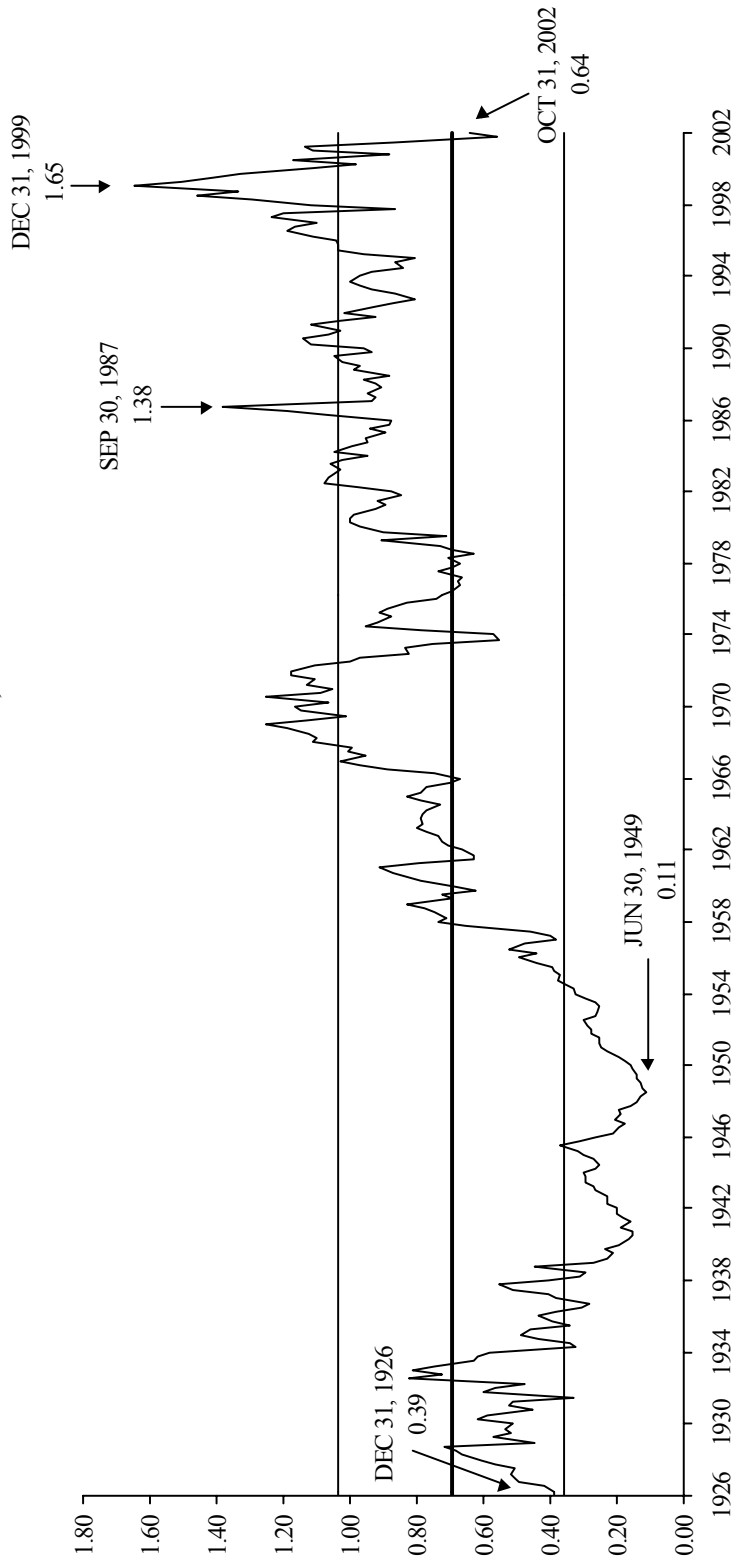
This phenomenon can also be seen empirically by examining the relationship between these yields since 1926. Given that Thomson Financial's forward earnings estimates are not available prior to 1978, we used trailing reported earnings yields prior to that date as a proxy for forward earnings yields.<sup>1</sup> An examination of Table B indicates that the relationship between bond yields and implied fair value P/E ratios is close to linear for bond yields above 5%. Table C shows that bond yields and earnings yields exhibited negative correlations between 1926 and the late 1960s when interest rates were generally below 5%, and positive correlations through 2001 when interest rates were generally above 5%. In fact, between January 1, 1926 and March 31, 1967, the correlation between ten-year Treasury bond yields and earnings yields was -0.56, compared to +0.86 from April 1, 1967 to March 31, 2002. Most recently, bond yields have fallen below 5% and bond yields and earnings yields have moved in opposite directions, implying that yields are too low for the model to provide meaningful results.

In short, although the Fed Model can sometimes provide useful insights into equity valuations, it is a relatively crude construct impaired by significant limitations that are very much in evidence in an environment of relatively low interest rates. As a result, the model currently misleads unwary investors into regarding the U.S. market as substantially undervalued when more robust indicators suggest that equities are either fairly valued or still overvalued.

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<sup>1</sup> The common convention is to assume that forecasters had perfect foresight and to use actual earnings over the next 12 months as a proxy for the forward estimate. However, between 1978 and 2001, earnings yields based on trailing earnings had a higher correlation to Thomson Financial's 12-month forward earnings yield than did the conventional calculation.

**Table A**  
**FEDERAL RESERVE S&P 500 VALUATION MODEL**  
**10-Year Treasury Bond Yield Divided by 12-Month Trailing S&P 500 Earnings Yield**  
**As of October 31, 2002**



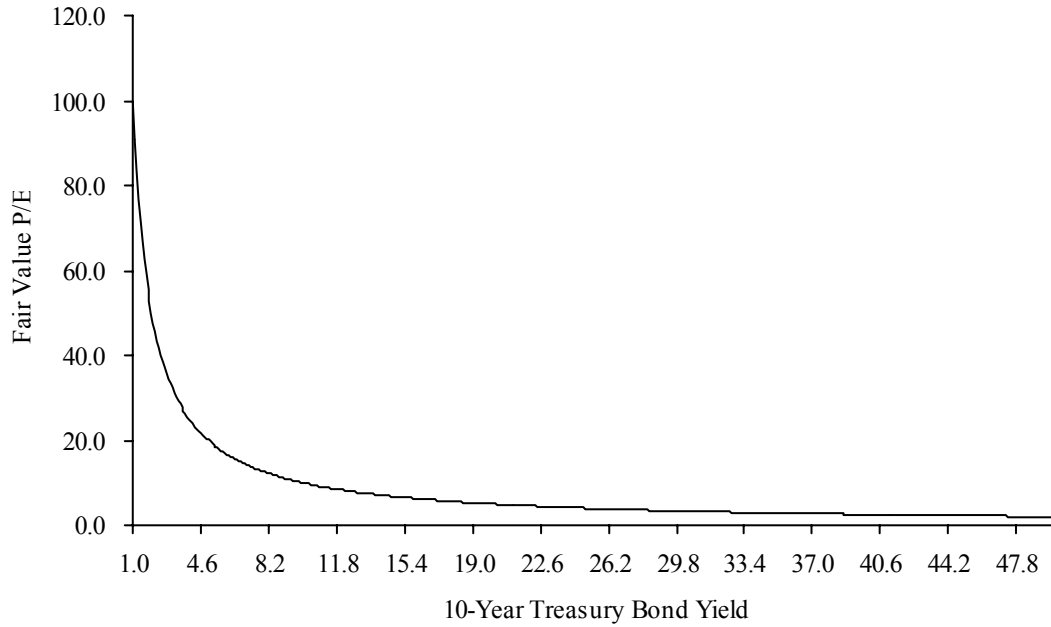
Sources: Global Financial Data, Standard & Poor's, Thomson Datastream, Thomson Financial, and *The Wall Street Journal*.

Notes: The model compares the yield investors expect to receive on intermediate Treasuries to the expected earnings yield on the S&P 500. Given that Thomson Financial's forward earnings estimates are not available prior to 1978, we used trailing reported earnings yields prior to that date as a proxy for forward earnings yields. The common convention is to assume that forecasters had perfect foresight and to use actual earnings over the next 12 months as a proxy for the forward estimate. However, between 1978 and 2001, earnings yields based on trailing earnings had a higher correlation to Thomson Financial's 12-month forward earnings yield than did the conventional calculation. I/B/E/S earnings estimates have historically been twice as high as actual earnings.

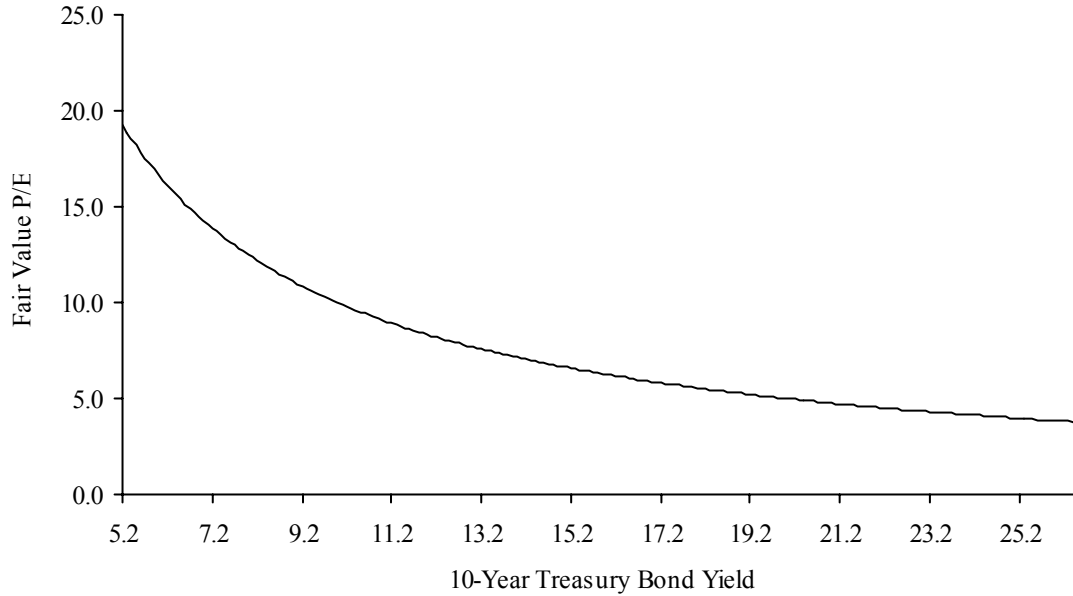
**Table B**

**FED MODEL IMPLIED FAIR VALUE PRICE-EARNINGS RATIOS AT DIFFERENT INTEREST RATE LEVELS**

**Relationship is Non-Linear**

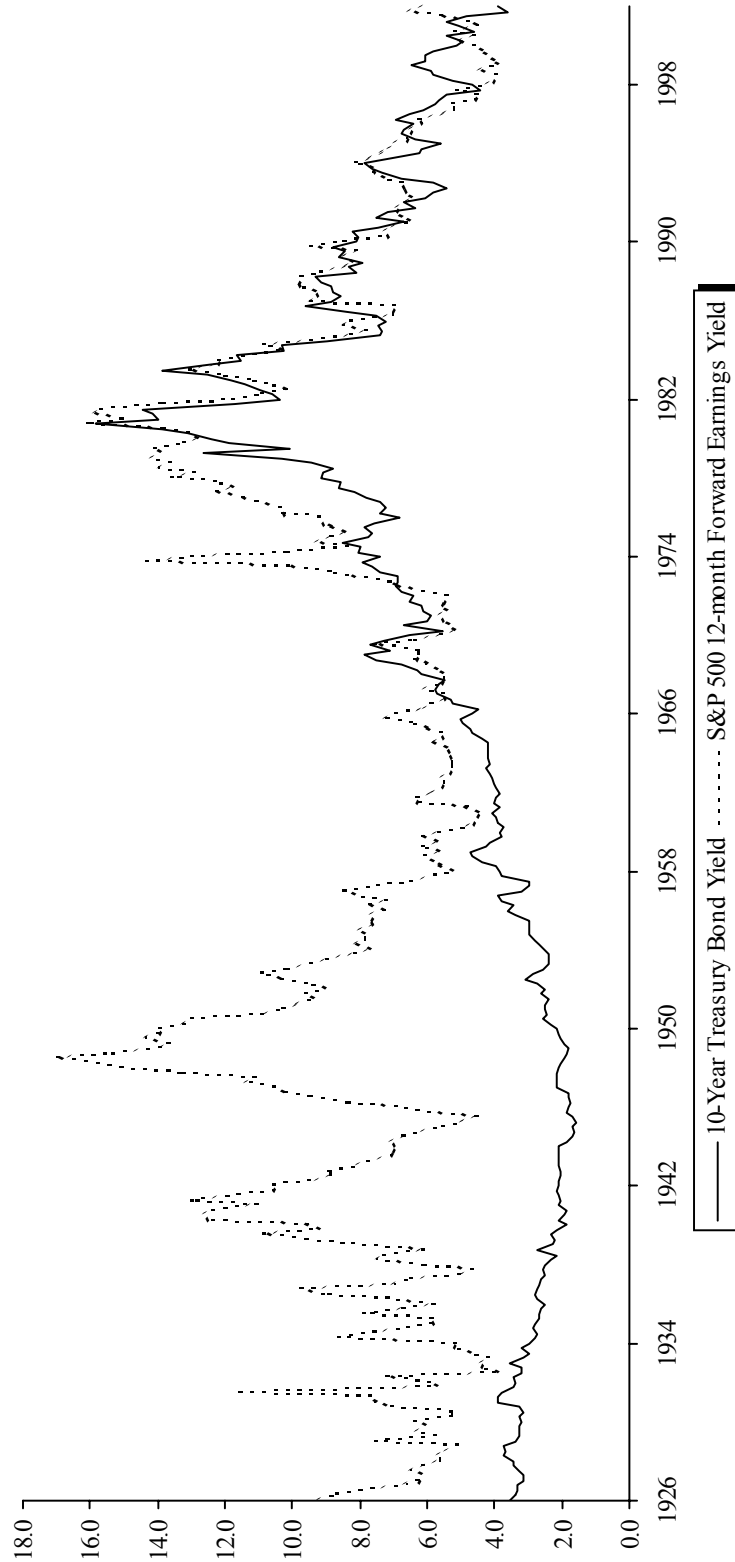


**But Approximate Linearity Over a Range of Interest Rates**



Source: Federal Reserve.

**Table C**  
**HISTORICAL RELATIONSHIP BETWEEN BOND YIELDS AND FORWARD EARNINGS YIELDS**  
 As of October 31, 2002



Sources: Global Financial Data, Standard & Poor's Compustat, Thomson Financial, and *The Wall Street Journal*.  
 Notes: Given that Thomson Financial forward earnings estimates are not available prior to 1978, we used trailing reported earnings yields prior to that date as a proxy for forward earnings yields. The common convention is to assume that forecasters had perfect foresight and to use actual earnings over the next 12 months as a proxy for the forward estimate. However, between 1978 and 2001, earnings yields based on trailing earnings had a higher correlation to Thomson Financial's 12-month forward earnings yield than did the conventional calculation. I/B/E/S earnings estimates have historically been twice as high as actual earnings.