Price equals forward earnings scaled by the risk-free rate: the implications of this remarkable empirical regularity

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Abstract

In many markets around the world, aggregate market capitalization is close to the ratio of earnings forecast for the next year to the long-term risk-free rate. This remarkable relation between prices and earnings, known popularly as the Fed Model, has a number of implications for market efficiency (stock prices are affected by inflation illusion and are too volatile), and the level of and time variation in the equity risk premium. This paper explores some of those implications.

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1. Introduction

The popular financial press and television refer often to an empirical regularity known as the "Fed Model", which appears to have first been mentioned in a July 1997 Federal Reserve Monetary Policy Report to Congress (see pp. 23-24 of the full report, available as a pdf file at http://www.federalreserve.gov/boarddocs/hh/1997/july/fullreport.htm). The model suggests that aggregate stock market valuations equal the ratio of forward earnings to long-term risk-free rates. Stated differently, forward earnings yields for stocks (the ratio of forecast earnings to current valuations) should equal long-term government bond yields. This relation is not a normative one derived from first principles; rather it is an approximate description of the behavior of the US stock market, similar to physical laws that describe patterns observed in nature.

This empirical regularity is remarkable for a variety of reasons, some of which are summarized below. First, despite the considerable amount of time and energy invested by stock market participants and financial intermediaries to understand the determinants of stock prices, this relation was not known commonly until the late 1990's and appears to be a serendipitous discovery. Second, this relation is not observed at the individual analyst level, where forecasts are made; stock prices deviate substantially from the ratio of forward earnings to risk-free rates across specific analysts' forecasts. And yet aggregating those forecasts across analysts following the same stock to build a consensus forecast, and then aggregating those consensus numbers across all stocks results in aggregate forecasted earnings that are related to aggregate market valuations as described by the Fed model. Third, the model appears to work over a variety of economic conditions, such as recessions and boom periods, even though it does not incorporate two important ingredients necessary for valuation: forecasted long-term growth in

earnings/dividends and the premium over the risk-free rate required for investing in risky equities (the Fed model is based on risk-free rates, not on required rates of return for equity).

Mulling over this empirical regularity raises a number of interesting questions. First, is this relation a representative, albeit heuristic, summary of an underlying pricing mechanism or a meaningless statistical quirk that is observed randomly? Relatedly, is this relation documented for the US since 1982 also observed in other markets and periods? Second, if it is representative of market pricing, does the relation imply that market prices are generally efficient, as derived from a prescriptive model, or does it reveal a systematic inefficiency because relevant parameters are ignored? Third, if it represents efficient pricing on average, do temporary deviations of market prices from the ratio of forward earnings to risk-free rates predict subsequent stock price movements back toward that ratio, as implied by the Fed model?

Preliminary conclusions from the exploratory investigation described in this paper are as follows. First, the Fed model is a reasonable way to obtain quick valuations at the aggregate level. In particular the criticism leveled against it by financial economists (e.g., Asness, 2003) that the model suffers from inflation illusion (e.g., Modigliani and Cohn, 1979) is misguided. The model does, however, imply an unusual condition: the valuation effects of the two omitted fundamental parameters—the equity premium and anticipated long-term earnings growth—cancel each other out. Second, the Fed model describes stock market valuations for other periods and markets with available earnings forecast data, including the US going back to the 1960's as well as many large markets other than the US, such as Australia, Canada, France, Germany, Hong Kong, and the UK. Third, there is evidence, however, of departures from the Fed model for earlier periods in the US (before the 1960's) and also in Japan, implying that the risk premium effect does not always cancel out the long-term earnings growth rate effect. I consider

the potential role played by accounting practices, which impact forward earnings yields and long-tem earnings growth rates, in explaining some of these deviations from the Fed model. Fourth, stock market valuations are in general reasonably justified by forecasts of fundamentals and therefore do not exhibit the extent of excess volatility implied by studies that calibrate current valuations with dividends observed subsequently (e.g., Shiller, 1981). Fifth, the Fed model appears to identify temporary mispricing: when prices are substantially higher (lower) than the ratio of forward earnings to risk-free rates, subsequent 12-month returns are lower (higher) than average.

The next section provides the descriptive evidence that underlies the Fed model, for the US as well as nine other markets. Section 3 discusses the implications of that evidence, and Section 4 concludes.

2. The evidence underlying the Fed model.

To construct the time-series for aggregate earnings yields (forward earnings scaled by market value), I scanned the IBES summary files for countries with sufficient firms with available data to construct an aggregate that was reasonably representative of the overall market. The summary files provide consensus (mean) earnings per share forecasts, based on all analysts with active forecasts for that stock, and share prices as of the middle of each month (the Thursday before the third Friday). I require non-missing data for price per share, number of shares outstanding, and earnings per share (eps) forecasts for the next full fiscal year.[1] The ten countries selected are Australia, Canada, France, Germany, Hong Kong, Japan, South Africa, Taiwan, UK, and US. I picked a start date of January 1987 for my main sample, since most countries had sufficient aggregate data available by that date.

[1] If, for example, the month is June 1990, then for a calendar year firm (which would have reported its 1989 earnings some time earlier in 1990), the forecast I use will be for the year 1991.

The aggregation process is straightforward. Each month, I multiply both the price per share and the forecast eps by the number of shares to get the market capitalization and forecast earnings for each firm and then add across all firms with available data that month to calculate aggregate market capitalization and aggregate forecast earnings. For a country-month to be included, I require a minimum of 100 firms with available data, except for Hong Kong, South Africa, and Taiwan, for which I require a minimum of 50 firms. For firms with data in a different currency than that used typically in each country, I convert earnings and prices using the foreign exchange rate as of the IBES pricing day.[2] I then calculate the ratio of forecast earnings to market capitalization to get the forward earnings yield for that country-month. The number of firms used to calculate these aggregates varies across time, though the ratio is relatively insensitive to the inclusion or exclusion of the smaller firms that are likely to drop in and out of the sample from month to month.

For the long-term risk-free rate, I searched for a monthly Government bond series for each country that was closest in maturity to 10 years.[3] For each month between January 1987 and June 2003, I take the yields as of the end of each month.

The plots for the bond yields and the forward earnings yields for the aggregate stock portfolios for the 10 countries are provided in Figure 1, Panels A through J, in alphabetical order. The breaks in the earnings yield series observed for some countries, especially in the earlier part of the sample period are due to there being fewer than the minimum number required to construct representative aggregates.

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[2] The other currency most likely to be converted to the local currency is the US dollar. Also, toward the end of the 1990's most European firms switched to the Euro.

[3] Government bonds with maturities longer than 10 years are relatively uncommon for countries other than the US.

Note that analysts' forecasts for next year (e_1) are biased upward, and the 10-year rate likely understates the true long-term rate. While the extent of bias in forecasted aggregate earnings has not been documented, at the firm level the median level of optimism is about one percent of price (Table VI in Claus and Thomas, 2001, for forecasts made between 1985 and 1997).[4] And to the extent that 30-year rates represent a more plausible estimate of long-term rates than 10-year rates, those rates have exceeded 10-year rates by about 30 basis points in the US. In effect, adjusting for these two biases suggests that the equivalence between forward earnings yields based on optimistic analyst forecasts and 10-year bond yields implies that unbiased estimates of long-term bond yields exceed unbiased estimates of earnings yields by about 1.3 percent. For the remainder of this discussion, I will ignore any bias in the estimates of earnings and bond yields.

The US data reported in Panel J of Figure 1 illustrates the extent to which earnings yields track bond yields. Both series begin with the yields as of January, 1987, and end on June, 2003. The markers on the bottom axis refer to the beginning of each of the years noted; i.e., the marker for 1979 refers to data as of December, 1978 (the earnings yields are based on forecasts and prices as of the middle of December, and the bond yields are as of the end of December). The proximity of the two series is particularly evident in the period before 1997, which is the period considered in the Fed report that first referenced the model. Subsequently, there is evidence of temporary (three to four-year) swings away from each other: earnings yields fall below bond yields during the so-called "internet bubble" of the late 1990's, followed by a brief period when earnings yields exceed bond yields during the early part of this decade, and the two series appear

[4] Since the extent of optimism in earnings forecasts declines as the forecasts approach the year being forecast, and since a majority of US firms have calendar year-ends, forward earnings yields calculated just after annual earnings are announced early in the year (e.g., in March) will contain more optimism bias than earnings yields calculated jus prior to annual earnings announcements (e.g., in January).

to trend toward each other after that. Some proponents of the Fed model point to these temporary swings as evidence supporting their view that stocks were temporarily overpriced during the late 1990's and temporarily underpriced during the early 2000's.

Focusing on the magnitudes of the deviations can be misleading during periods of low yields: small differences between the two yields can imply large deviations in pricing from the Fed model. For example, in 2000, the bond yields were in the neighborhood of 6 percent, which implies a forward P/E of about 16, whereas the stock yields were approximately 4 percent, which implies a forward P/E of about 25, which is considerably larger than a P/E of 16. A similar 2 percent difference between stock and bond yields would imply a much smaller pricing deviation during the late 1980's when yields were much higher. In essence, differences between the two yields should be deflated by the level of the bond yield to obtain pricing deviations from the Fed model that can be compared across time.

Turning to the data for other countries in Panels A through I, bond yields are approximately equal to earnings yields for Australia, Canada, France, Germany, Hong Kong, and UK (in Panels A, B, C, D, E, and I, respectively). Less weight should be placed on apparently large deviations between the two yields noted for some countries during the earlier part of the sample period, as there are considerably fewer firms with available data in these cases. The most apparent departures from the Fed model appear in Japan (Panel F). A discussion of possible reasons for those departures is deferred until Section 3. The patterns observed in South Africa (Panel G) and Taiwan (Panel H) are mixed: while there is some evidence of comovement, earnings yields lie below bond yields in the early years (1993 through 1998) for South Africa and they are well above bond yields in the later years (after 2000) for Taiwan.

For the seven countries where the earnings and bond yields generally track each other, there are similarities across countries in the timing and extent to which the two yields deviate temporarily from each other. For example, earnings yields are higher than 10-year rates for all seven countries during 2003. However, other temporary deviations are not as universal. For example, the apparent overpricing noticed during the Internet bubble of the late 1990's for the US is observed in Canada, France, Hong Kong, and Germany, but is not evident for Australia and the UK.

There is a suggestion in some of the prior literature (e.g., Campbell and Vuolteenaho, 2004) that the US evidence noted over the more recent years, such as the sample period in Figure 1, Panel J, is not representative of earlier periods. The results for those earlier periods reported in the literature are not derived from analysts' estimates. Instead, they are based on actual earnings, which are typically adjusted for observed inflation and then averaged over prior multi-year windows. Given that the Fed model relates only to anticipated earnings yields, there is a potential for these studies to show deviations from the Fed model even if it held in those earlier years.

To provide evidence based on anticipated earnings yields for earlier periods, I went as far back as possible using IBES data for the US. The results of that investigation are reported as Panel A in Figure 2 and cover the period from October, 1978 to the end of 1986. I require that at least 100 firms with available data be included in the aggregate for a particular month's earnings yield to be included in the plot. There are many breaks in the series because of this data requirement, and the number of firms in the aggregate for the included months runs between 100 and 200 until October, 1984, at which point it jumps up to over a thousand. The results after

October, 1984 are clearly consistent with the Fed model. Before that, the degree of consistency decreases somewhat, especially for the few months included in 1979 and 1980.[5]

I also derived earnings yields for a sample of 174 firms described in Cragg and Malkiel (1982). The data allowed a calculation of one earnings yield per year, not monthly as in the prior plots. Those results are plotted in Panel B of Figure 2. While the sample of firms is relatively small, it consists primarily of large firms and these earnings yields may be quite representative of the prevailing aggregate earnings yields. Once again, the results suggest a remarkable consistency with the Fed model.

My final analysis of US earnings and bond yields considers trailing earnings yields for the S&P 500, taken from http://aida.econ.yale.edu/~shiller/data.htm. The 10-year risk-free rates from 1925 on are taken from the FRB H15 Report of the U.S. Federal Reserve. These data have been discussed elsewhere in great detail, and my objective here is to revisit it to see if any new insights can be gained regarding the validity of the Fed Model.

Since these earnings yields are based on trailing earnings rather than forward earnings, two differences are expected relative to the plots in Figures 1 and 2. First, trailing earnings yields are generally lower, because a) next year's earnings per share are on average expected to exceed last year's earnings per share because of normal growth, and b) forecasts are known to be optimistic. As a result, if the Fed Model predicts that the levels of forward earnings yields are approximately equal to risk-free rates, levels of trailing earnings yields should then be predicted to be lower than risk-free rates. The focus in Figure 3 should therefore be on comovements between trailing earnings yields and risk-free rates rather than on equivalence of the levels. Second, trailing earnings yields are considerably more volatile because of transitory shocks. As a

[5] I am currently investigating ways to increase the yield of IBES firms with available data. It appears that many firms are excluded because of missing data on the number of shares outstanding. That data should be available from other sources.

result, the comovements between trailing earnings yields and risk-free rates are likely to be less evident than the corresponding comovements between forward earnings yields and risk-free rates.

The results reported in Figure 3 show marked deviations from the Fed model in the period before 1960, whereas the results after 1960 are comparable to those reported in Figures 1 and 2 for forward earnings yields in the US (while the level of trailing earnings yields is lower than that for forward earnings, the comovement with risk-free rates is clearly evident after 1960). In essence, the condition implied by the Fed Model, that the risk premium effect approximately cancels out the earnings growth effect, is not satisfied in the pre-1960 period. Specifically, that period which encompasses the Depression of the 1930's and World War II and its aftereffects during the 1950's is associated with relatively high risk premia and/or relatively low expectations of long-term earnings growth. Subsequently, risk premia fell and/or expectations of earnings growth rose and the two effects tend to approximately cancel each other for the next 4 decades.

3. Discussion and implications

While many view the equivalence between earnings and bond yields observed in recent years as suggesting that the Fed model is a parsimonious description of how stock prices are set at the aggregate level, others question whether the stock market should follow the Fed model. This section discusses the conditions under which the Fed model could represent a summary description of how stock prices are set in an efficient market, and then considers some of the implications.

3.1 The Fed model suffers from inflation illusion

The main criticism of the Fed model raised by some financial economists (e.g., Siegel, 2002) can be stated as follows: it requires the forward P/E ratio (inverse of the earnings yield) to be more responsive to expected inflation (as reflected in bond yields) than it should be. Asness (2003), which contains perhaps the most forceful and articulate defense of this position, offers two main reasons why market prices should not follow the Fed model. A summary of each objection along with my discussion of those objections is provided next.

The first objection relates to how prices (and also trailing P/E ratios, since trailing earnings remain unchanged) should respond to unexpected changes in expected inflation. Trailing P/E ratios should vary one to one with expected inflation if expected cash flows to stocks are fixed in nominal terms, similar to fixed coupon bonds, but trailing P/E ratios should remain relatively constant if stocks are perfect inflation hedges. Since the evidence suggests that stocks are somewhere in between these two polar positions, trailing P/E ratios should also be less than perfectly responsive to changes in expected inflation, which contradicts the Fed model.

The Fed model is an "ex-ante" model, in the sense that it refers to expectations alone, and is therefore agnostic about how changes in expected inflation affect stock prices. Consider the case where the long-term risk free rate rises from 5 percent to 10 percent (due entirely to a change in expected inflation). While it is true that the Fed model would predict that the forward P/E should fall from 20 to 10, it is flexible in terms of how prices would respond to this news, based on how expected earnings change in response to changes in expected inflation. Therefore, historical evidence on how stock prices respond to changes in inflation is not directly relevant to reject or accept the Fed model.

The second objection to the Fed model, which is appropriately based on expectations rather than observed outcomes, is that the anticipated long-term nominal growth in

earnings/dividends should vary positively with expected inflation. If so, the Gordon (1962) dividend growth model, suitably adapted to consider earnings rather than dividends, suggests that earnings yields should not comove exactly with bond yields. To illustrate, consider the traditional Gordon dividend growth model described in equation (1), which is a special case of the general Williams (1938) dividend discount model, detailed in equation (2), where dividend growth is constrained to equal a constant rate *g* each year.

$$p_0 = \frac{d_1}{r-g} \Rightarrow \frac{py * e_1}{r-g} \tag{1}$$

$$p_0 = \frac{d_1}{(1+r)} + \frac{d_2}{(1+r)^2} + \frac{d_3}{(1+r)^3} + \ldots \tag{2}$$

where
p_0 = current price, at the end of year 0,
d_t = dividends expected at the end of future year t,
e_t= earnings expected at the end of future year t,
py = expected payout ratio,
r = expected rate of return for the equity market, and
g = expected dividend growth rate, in perpetuity.

Rearranging the terms in equation (1), the earnings yield can be stated as follows.

$$\frac{e_1}{p_0} = (r-g) * \frac{1}{py} = (r_f + r_p - g) * \frac{1}{py} \tag{3}$$

where
r_f = long-term risk-free rate,
r_p = long-term risk premium,

Since the Fed model requires that the earnings yield be equal to r_f, it must be that r_p–g remains unchanged at different levels of expected inflation, which implies that g is unaffected by inflation (as r_p is unlikely to vary with expected inflation). The second objection to the Fed model is that such a requirement is unreasonable, since one would expect g, the anticipated

growth in nominal dividends, to vary positively with expected inflation. Stated differently, the Fed model implies a "capitalization rate error" caused by inflation illusion, because it requires the same expected growth in nominal dividends for different levels of expected inflation.[6]

Given that equations (1) and (3) are based on intuitive links among earnings, dividends, and an expected dividend growth rate that can be maintained in perpetuity, this second objection is better evaluated by deriving a general relation for earnings yields that begins with the discounted dividends relation in equation (2). Such relations have been derived recently (e.g., Fairfield, 1996 and Ohlson and Juettner-Nauroth, 2003). For purposes of illustration, I will adapt the trailing P/E relation derived in Fairfield (1996) to provide the following formal relation for forward earnings yields.

$$\frac{p_0}{e_1} = \frac{1}{r}\left[1 + \frac{\Delta ri_2}{e_1(1+r)} + \frac{\Delta ri_3}{e_1(1+r)^2} + ...\right] = \frac{1}{r}\left[1+G\right] \qquad (4)$$

where

ri_t= residual income in year t, = $e_t - r*bv_{t-1}$

bv_t = book value of equity in year t,

Δri_t = first difference in residual income = $ri_t - ri_{t-1}$

G = the present value of growth in residual income, scaled by e_1.

In essence, the forward P/E ratio is equal to the inverse of the long-term expected return on stocks multiplied by a growth term. That growth term measures the growth in residual income or rents, which is anticipated earnings less a charge for the cost of equity capital, in each future year discounted back at the expected rate of return on equity (r). While it appears conceptually

[6] In addition to the capitalization rate error discussed here, inflation illusion is also alleged to cause the stock market to make a debt capital gain error, because the entire nominal interest is subtracted as an expense when calculating earnings but the fact that the liability has declined in real terms is not reflected in the income statement. According to this hypothesis (e.g., Ritter and Warr, 2002), accounting earnings is understated and that causes the stock market to undervalue equity. I do not follow why such an error exists , and am currently corresponding with Jay Ritter to better understand this type of inflation illusion. See also O'Hanlon and Peasnell (2004) for a discussion of the inflation adjustments proposed by Ritter and Warr (2002).

similar to the adaptation of the Gordon dividend growth model in equation (3), note how the discount rate affects the growth term in square brackets by discounting each future year's growth in rents at the prevailing rate, *r*. While nominal earnings and nominal residual income grow at higher rates when expected inflation is higher, discounting those higher nominal amounts by a higher nominal expected rate of return reduces the comovement between expected inflation and the growth term. In sum, the intuitive relation in equation (3) is potentially misleading when used to infer how nominal earnings growth rates (*g*) should vary with expected inflation; relations such as equation (4) that are better suited to address this question do not suggest that the nominal growth term (*G*) varies much with expected inflation. If so, it is reasonable to expect forward earnings yields to vary with expected inflation (as captured in bond yields).

To better understand why equation (3) provides a misleading representation of growth rates in perpetuity consider a hypothetical stock market, where firms follow a full payout policy. Assuming that dividend policy is irrelevant, and any capital needs for profitable new projects are financed by issuing new shares, market capitalization and forecast earnings for next year for this hypothetical market should equal the corresponding amounts for the actual markets for each year in the IBES sample. Since firms in the hypothetical market pay out all earnings as dividends, the investment base relevant to the shares currently outstanding will be held constant *in nominal terms*. That is, the higher the expected inflation in this hypothetical market the greater the attrition in the real value of the investment base available to generate future earnings. The relevant growth rate *g* then is the nominal growth in earnings (also nominal growth in dividends, because of full payout) that this investment base can sustain in perpetuity. Recall that the investment base is held constant in nominal dollars. And to return to the original question: how will this rate *g* vary with levels of expected inflation? Unlike the case of the actual market where

it seems reasonable to assume that earnings might grow at a higher nominal rate when expected inflation is higher, nominal earnings growth in the hypothetical full payout market will be far less sensitive to variation in expected inflation.

The sensitivity of earnings growth under full payout to expected inflation is a function of the assets and liabilities held as well as accounting practices.[7] Assets such as land and mineral reserves that are expected to generate profits that are maintained in real terms would generate growth in full payout nominal earnings under historical cost accounting that increases with expected inflation. Recognizing the market values of such assets, either by marking them to market or periodically engaging in market transactions, would however cause growth in full payout earnings to be insensitive to expected inflation Most other assets and liabilities, including depreciable assets and financial assets and liabilities that are denominated in nominal terms, would also generate growth in full payout earnings that does not vary with expected inflation. Given that assets generating "real" earnings, such as land and mineral reserves, represent a small fraction of the aggregate holdings of firms in most markets, it seems reasonable to expect full payout earnings to grow at a nominal rate that is relatively insensitive to expected inflation.

Overall, I find the criticisms of the Fed model based on inflation illusion are less valid when the effects of variation in inflation on earnings yields are properly considered. Also, the formal relations derived for forward earnings yields (such as equation (4)) suggest that the properly specified growth term may not be as sensitive to variation in inflation as growth in nominal earnings might suggest, which in turn implies that forward earnings yields and bond yields should exhibit substantial comovement.

[7] I have constructed spreadsheet examples to illustrate the general observations made in this paragraph, and will share them with interested readers.

3.2 Implications of the Fed model for the equity premium

While considerable attention has been paid to the high comovement between earnings and bond yields implied by the Fed model, there is less focus on what I believe is an even stronger requirement of the model: that the two yields equal each other. I consider next the implications of this equivalence feature of the Fed model for the equity premium.

Consider again the hypothetical full payout market. Since *py*=1 under full payout, equation (3) can be rewritten as follows.

$$\frac{e_1}{p_0} = (r_f + r_p - g_{fp}) \qquad (5)$$

And under the Fed model, where the earnings yield equals the risk-free rate, equation (5) implies that the risk premium for equity should equal g_{fp}, the growth rate in perpetuity that can be sustained by a hypothetical market following a full payout dividend policy.

$$\frac{e_1}{p_0} = r_f \Rightarrow r_p = g_{fp} \qquad (6)$$

This equivalence between g_{fp} and r_p resolves one of the features I mentioned was remarkable about the Fed model: the absence of any adjustments for risk and growth in the model. Apparently, the Fed model implicitly requires that the risk effect cancel out the growth effect.

The equivalence between g_{fp} and r_p also provides some evidence on the level of and variation over time in the equity premium. As described in section 3.1, g_{fp} relates to the growth in nominal earnings that a constant (nominal) investment base can provide in perpetuity. I claim that this growth must be a very low number, which supports estimates of the risk premium that are more in line with the lower estimates that have been proposed recently in the literature (e.g. Claus and Thomas, 2001, and Fama and French, 2002). While it may be possible for high growth

firms to generate higher growth rates in perpetuity, even under full payout, I believe it is not possible for an aggregate of all firms to generate values of g_{fp} under full payout that are much higher than 2 or 3 percent.

Turning to time-variation in the equity premium, the equivalence between r_p and g_{fp} required by the Fed model suggests that both g_{fp} and r_p are relatively constant through time. If the risk premium varied much over time, it must then be the case that g_{fp} would also vary in the same way. I believe this scenario is less likely as I do not see why the earnings growth for a full payout economy would vary exactly with the equity premium.

To be sure, these statements about the level and variation in the equity premium do not apply to the US stock market for the pre-1960 period. As described in Figure 3, earnings yields exceeded bond yields by a substantial amount in that period, suggesting the equity premium was much higher than full payout growth. Since the lower limit for full payout growth is unlikely to be a large negative value (more likely to be zero or a small negative value), those results suggest that the equity premium for the US stock market between 1925 and 1960 was quite high, relative to what it has been in the post-1960 period. A large equity premium may indeed be appropriate when equities are fundamentally more risky due to the depression and world war that dominated this subperiod.

3.3 Implications of the Fed model for market inefficiency

Although the evidence in Section 2 suggests that market valuations are reasonably consistent with the Fed model, it also indicates temporary departures. While proponents of the Fed model might point to these departures as evidence of market inefficiency, there are a number of reasons why those departures are consistent with efficient market pricing. For example, anticipated earnings for next year could be temporarily depressed as the economy moves out from under a recession.

To provide some exploratory evidence on whether the deviations represent periods where the market had mispriced stocks on average, I examine whether the excess of earnings yields over bond yields predict returns over the next 12 months. To calculate those future returns I rely on the S&P 500 index (including distributions), since the next 12 months' returns for the IBES firms in each month are not easily calculated.

Panel A of Figure 4 contains a plot of the time series of the excess of earnings yields over bond yields and the next 12 months' return on the S&P 500. The excess yield series should be read off the left axis, and the return series off the right axis. Since the average for the excess yield series is approximately zero and the average for the return series is approximately 10 percent, I lined up the left and right axes such that the means for both series are aligned. The results in Panel A confirm the view that deviations from the Fed model indicate market mispricing. Specifically, investing long (short) in stocks when earnings yields are higher than (below) bond yields would return above average returns over the next 12 months.

Panel B of Figure 3 provides a scatter plot of the two monthly series plotted in Panel A. Again, the results suggest a strong positive correlation between excess yields and the return earned over the next 12 months, consistent with the view that deviations from the Fed model indicate market mispricing. The correlation between the two series is 0.47 and estimating a regression of the return series on excess yields results in a slope coefficient of 6.96 with a t-statistic of 7.42.[8]

These patterns are, however, consistent with market efficiency if they represent deviations of expected returns from the average, either due to changes in the risk-free rate or changes in the risk premium. To consider the first possibility, I recalculated the returns series by

[8] Both statistics should be viewed with caution as they have not been adjusted for overlapping 12-month holding periods.

subtracting the risk-free rate as of the beginning of the 12-month holding period. The results (not reported) are essentially similar to those in Figure 4. The second possibility would require that a positive excess yield (earnings yields higher than the bond yields) are periods when the long-term risk premium is higher than the prevailing g_{fp} and also higher than the average long-term risk premium that was relevant for the sample period. While there is no reason to doubt that these two conditions might occur for periods with positive excess yield (and the opposite conditions would hold for period with negative excess yields), I do not know of an economic model that is consistent with the long-term equity premium following such a mean-reverting process. Also, the mean negative returns observed towards the left side of Figure 3, Panel B, for 12-month holding periods following dates when earnings yields were 2 or 3 percent lower than bond yields appear inconsistent with market efficiency.

This analysis of market mispricing appears to differ substantially from those reported in Lee, Myers, and Swaminathan (1999) and Ritter and Warr (2002), since the models for fundamental value used in those papers appear far more complex than the ratio of forward earnings to risk-free rates used here. However, a more careful identification of the important ingredients of those more complex models suggests that those models are in essence driven by forward earnings and prevailing long-term rates. Given this similarity among the measures of fundamental value from the Fed model and those other more complex models, the pattern of potential over and underpricing reported here is similar to that reported in those other papers.

3.4 Implications of the Fed model for excess volatility

Attempts to relate market valuations with dividends, both contemporaneous and paid in the future, have typically met with little success. A number of prior papers have concluded that this weak relation between stock prices and fundamentals (level of dividends and expected returns) is evidence in support of the view that stock prices are too volatile, in the sense that they

deviate often from fundamentals. Figure 1 from Grossman and Shiller (1981) is included as Figure 5 to illustrate the potential magnitude of excess volatility in stock prices.

The comovement between earnings and bond yields noted in Section 2 suggests that there is less excess volatility than that indicated by analyses such as those reported in Figure 5. To be sure, while price movements may be consistent with movements in expected earnings and interest rates, it is quite possible that they are not consistent with movements with other fundamentals, such as expected dividends.[9] To partially address this question, I included dividend yields (D/P) for the same 1987 to 2003 period to the plot in Panel J of Figure 1, where D/P is the ratio of aggregate indicated dividends to aggregate market capitalization.[10] While the comovement between dividend and bond yields is not as strong as that noted between earnings and bond yields, there is clear evidence of a general pattern of comovement. This similarity between the two sets of comovements is to be expected given that the correlation between changes in earnings yields and changes in dividends yields for the data in Figure 1, Panel J, is 0.82.[11]

Overall, this evidence suggests that aggregate stock prices exhibit far less excess volatility than that suggested by plots such as Figure 5. There is also growing evidence at the firm level (e.g. Liu and Thomas, 2000) that a substantial amount of variation in stock returns can be explained by revisions in expectations of future earnings and changes in interest rates, the two fundamental variables underlying the Fed model.

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9 That is, it may be the case that earnings measure fundamentals with error, and prices respond to earnings rather than the fundamentals that they should correctly follow.

10 IBES defines indicated dividends as four times the most recent quarterly dividend.

11 Since the level of dividend yields is considerably lower than that for earnings yields, movements in the dividend yield series are harder to discern in this plot.

3.4 Why are deviations from the Fed model observed in some markets and periods?

The two pieces of evidence documented that are clearly inconsistent with the Fed model are the results for the US before 1960 (Figure 3) and the results for Japan (Figure 1, Panel H). I do not interpret this contradictory evidence as suggesting that the Fed Model is patently false. Rather I believe it suggests that the conditions necessary for the Fed model to hold existed during the post-1960 period for the US and for most other countries in recent years, but those conditions do not hold for these two subsamples where earnings yields deviate substantially from bond yields. Listed below is a partial list of potential reasons for why those conditions may not hold.

First, these subsamples may be associated with characteristics that cause the equity risk premium to deviate substantially from g_{fp}, the growth in full payout earnings that can be sustained in perpetuity. As mentioned earlier, the Depression and the World War that dominated the pre-1960 US data may have caused an environment where the equity risk premium was unusually high and long-term growth expectations were unusually low. Large differences between the prevailing equity premium and growth in full payout earnings could also explain the results in Japan: long-term growth expectations may have substantially exceeded the risk premium during the 1980's and subsequently long-term growth expectations declined and/or the risk premium increased such that growth expectations are now substantially less than the risk premium.

Second, the relation between earnings yields and bond yields may be affected by accounting rules, investor-level taxation and ownership practices that are unique to these two subsamples. This explanation applies more to Japan than the pre-1960 period in the US. Reported earnings would need to be understated (overstated) in periods when earnings yields were lower (higher) than bond yields. Similarly, to the extent that cross-holdings are common in Japan, the incentives for corporate owners to have investees under or overstate reported earnings

may have changed over time. Also, since the earnings and bond yields reported here are before investor-level taxation, changes in investor taxation for stocks or bonds could alter the relation between the two before-tax yields observed.

Reported earnings yields are biased downward by conservative accounting rules in combination with high rates of investment growth. In particular, if accounting tends to be conservative in Japan, possibly due to the conformity required between financial accounting and tax accounting, the lower earnings yields observed between the mid 1980's and mid 1990's (Figure 1, Panel F) could simply be due to the higher investment growth associated with that period. As growth declined subsequently, the downward bias on earnings yields abated.

Third, stock markets may be grossly inefficient for long periods. Specifically, it is possible that stock prices in the US were too low during the pre 1960 period and they were too high in Japan before the mid 1990's when bond yields exceeded earnings yields, and subsequently they are too low in Japan when the opposite situation holds. While it is difficult to provide evidence in support of this hypothesis for the US data, there is some evidence consistent with stocks being overpriced during the 1980's in Japan (as evidenced by the extended decline of the stock indexes observed subsequently). Observing substantial appreciation in stock prices over the next few years would add further credence to this view, since that is the prediction of the Fed model for the current position in Japan where earnings yields substantially exceed bond yields.

4. Conclusion

The Fed model offers a fascinating window into how stock prices are set at the aggregate level. There is disagreement about whether the model describes how prices are set, and even more disagreement about whether it should be descriptive of how prices are set. Those who subscribe to the model value its simplicity, and those expressing concerns believe it is too

simplistic. The evidence presented here and elsewhere suggests that the Fed model is indeed a parsimonious description of how prices are set in the US since the 1960's, and it also appears to be descriptive of how prices have been set over the last decade for many other markets.

The next step is to understand better whether the Fed model should describe how prices are set in an efficient market. While logical arguments and empirical tests of implications of the Fed model are a natural way to advance this process, investigation of markets and periods where the Fed model does not hold should offer important insights. Since the Fed Model ignores growth and risk, it would hold if the two effects cancel each other out. At one level, the interesting question is whether such a cancellation is to be expected normally or whether it is a rare occurrence.

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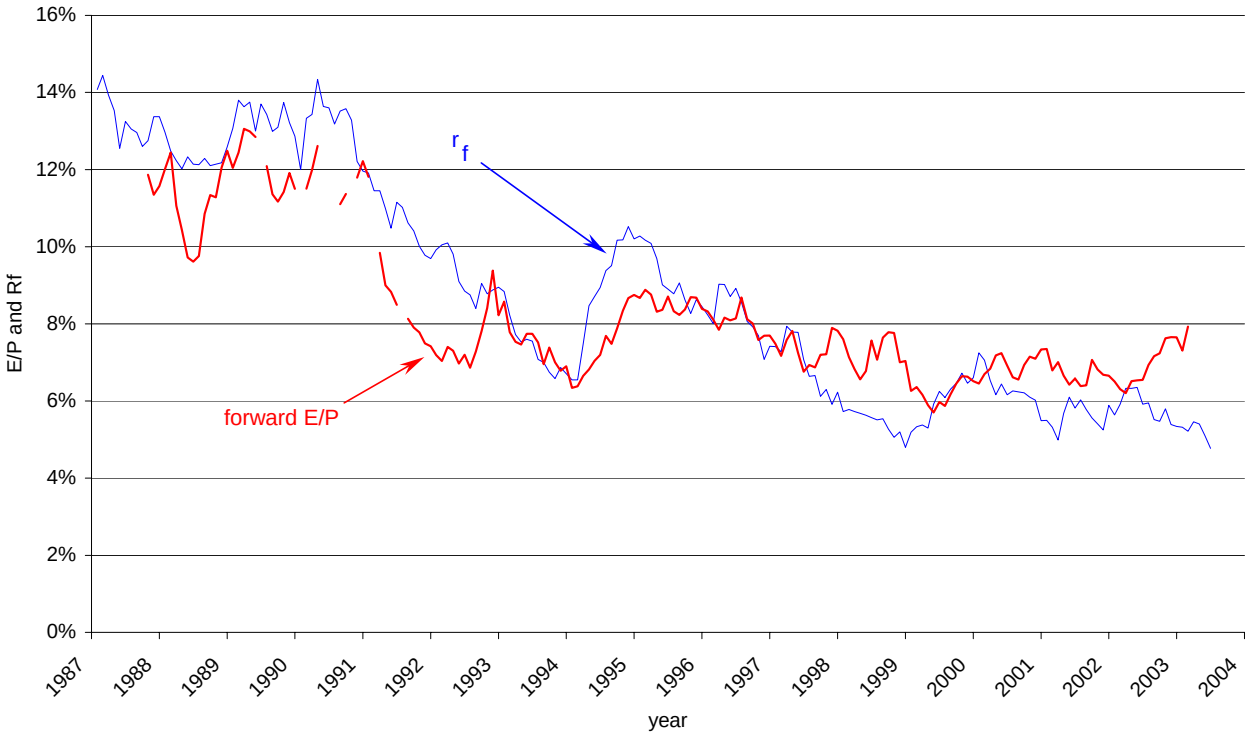
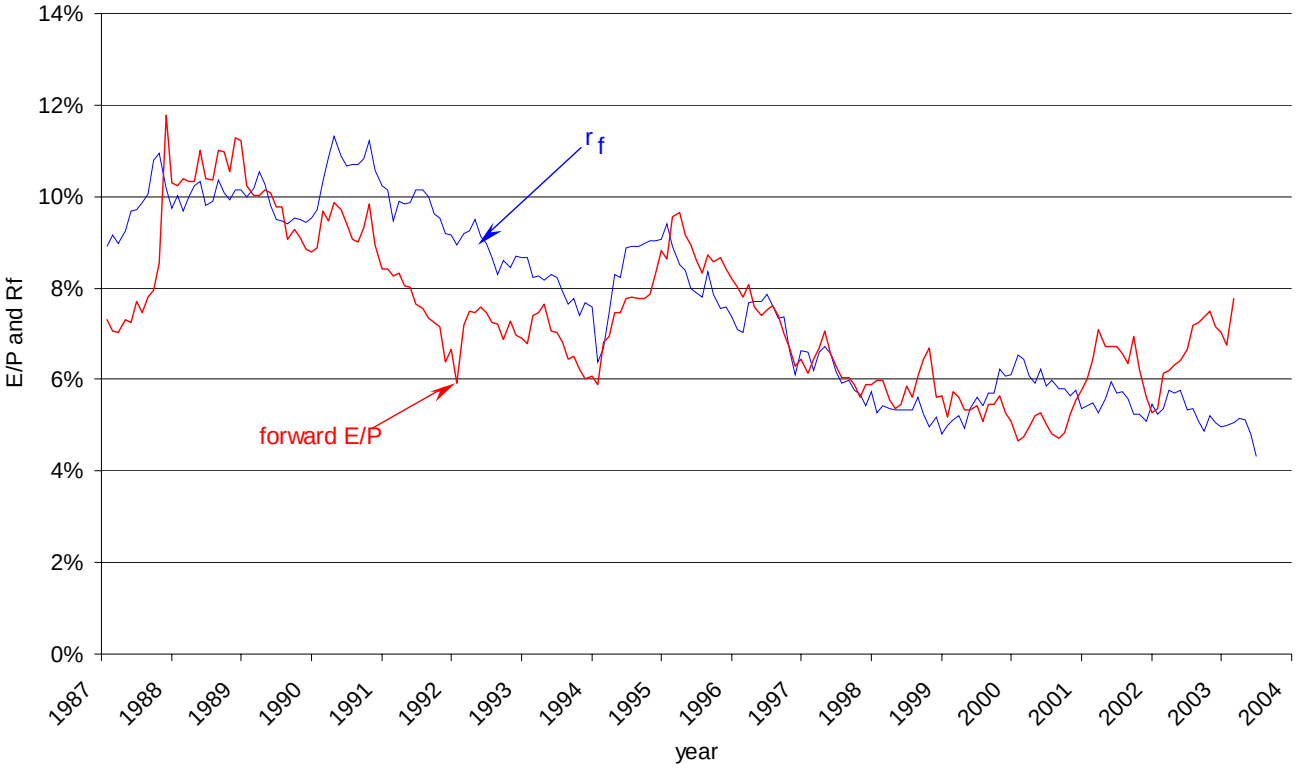
Figure 1
Time series of aggregate forward earnings to price (E/P) ratios and 10-year risk-free rates

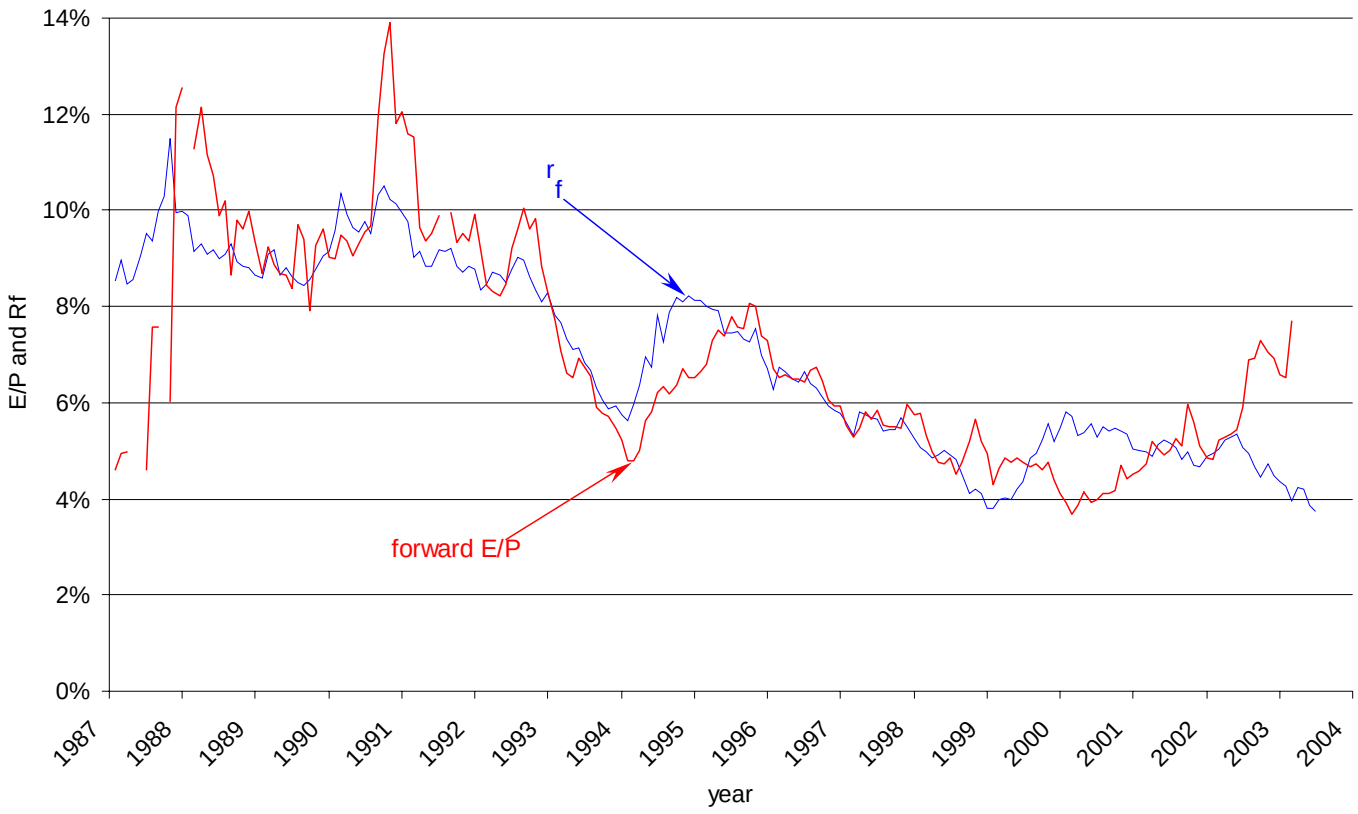
Panel A: Australia



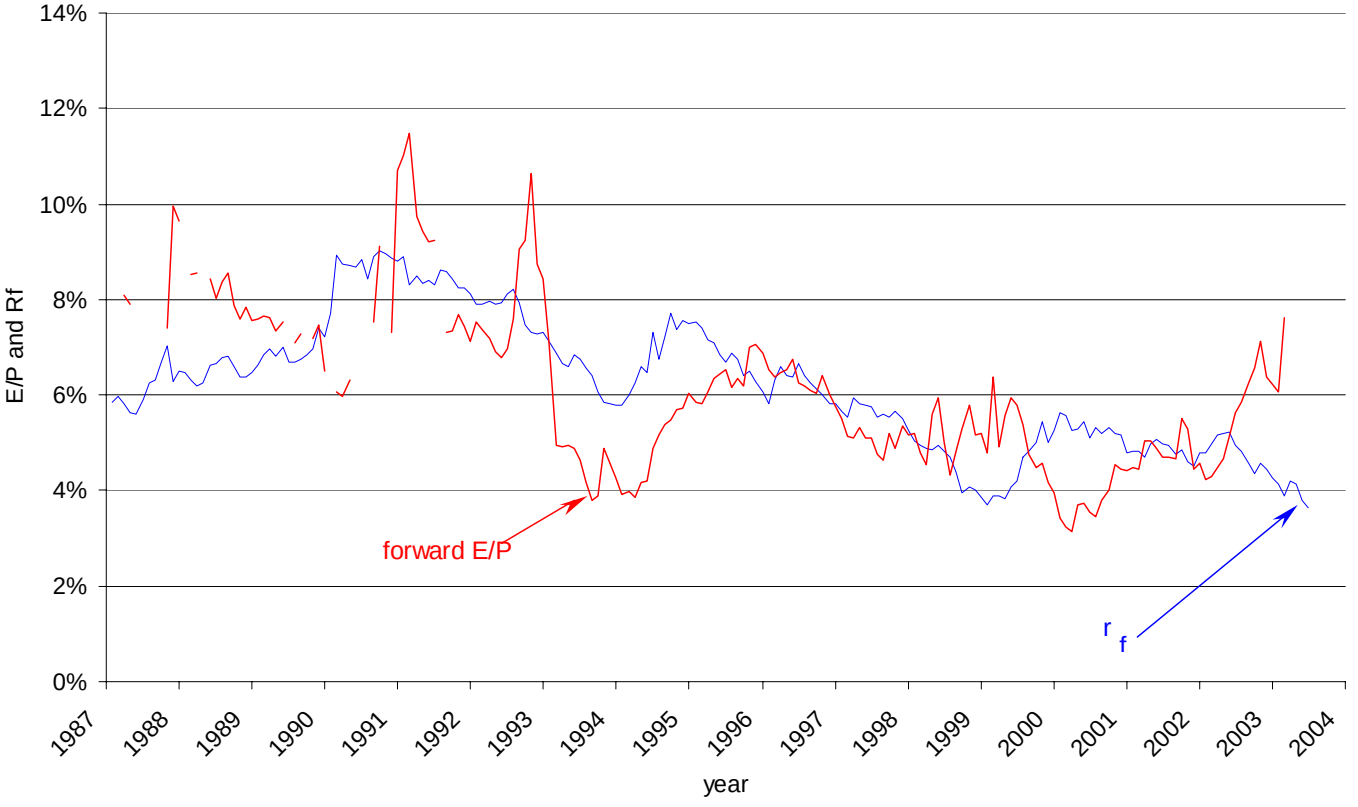
Panel B: Canada



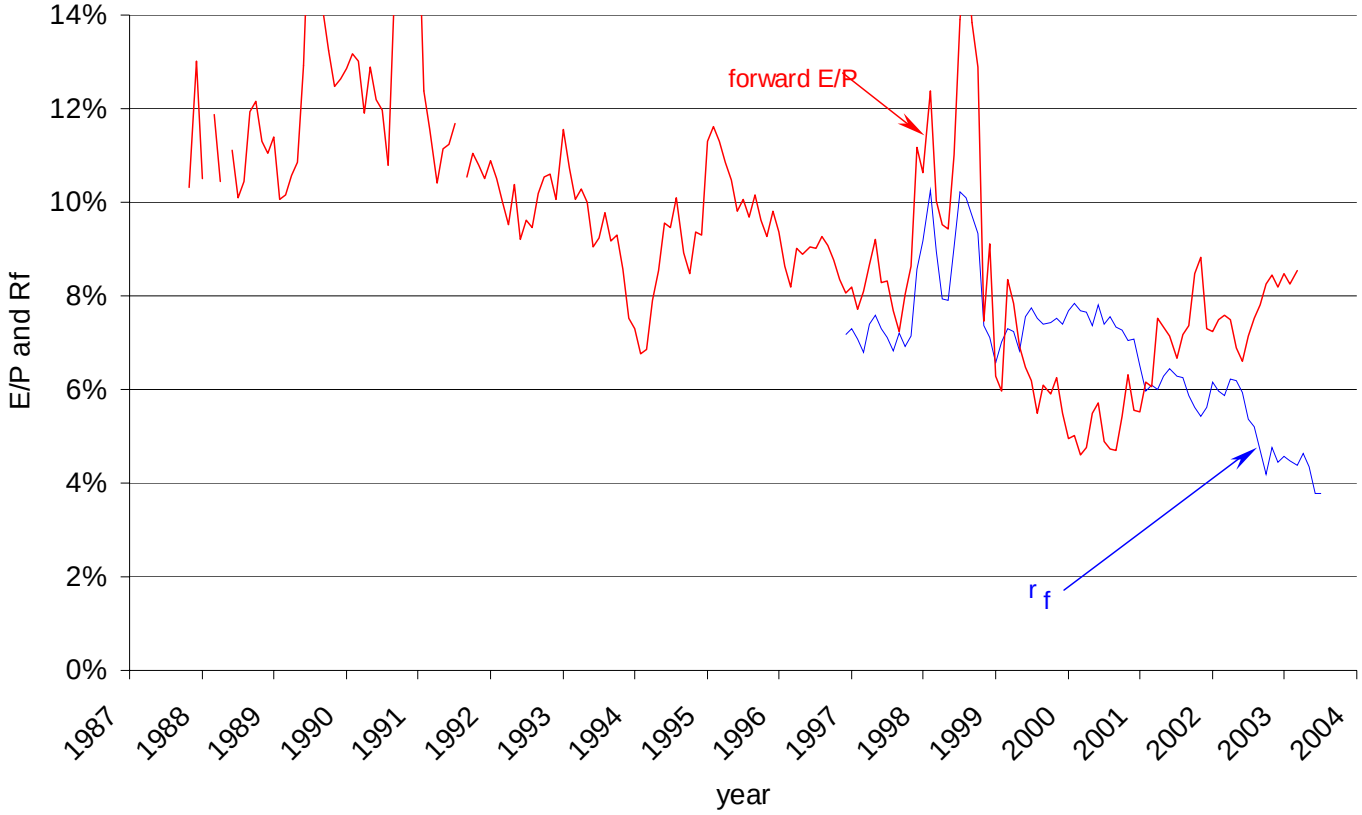
Panel C: France



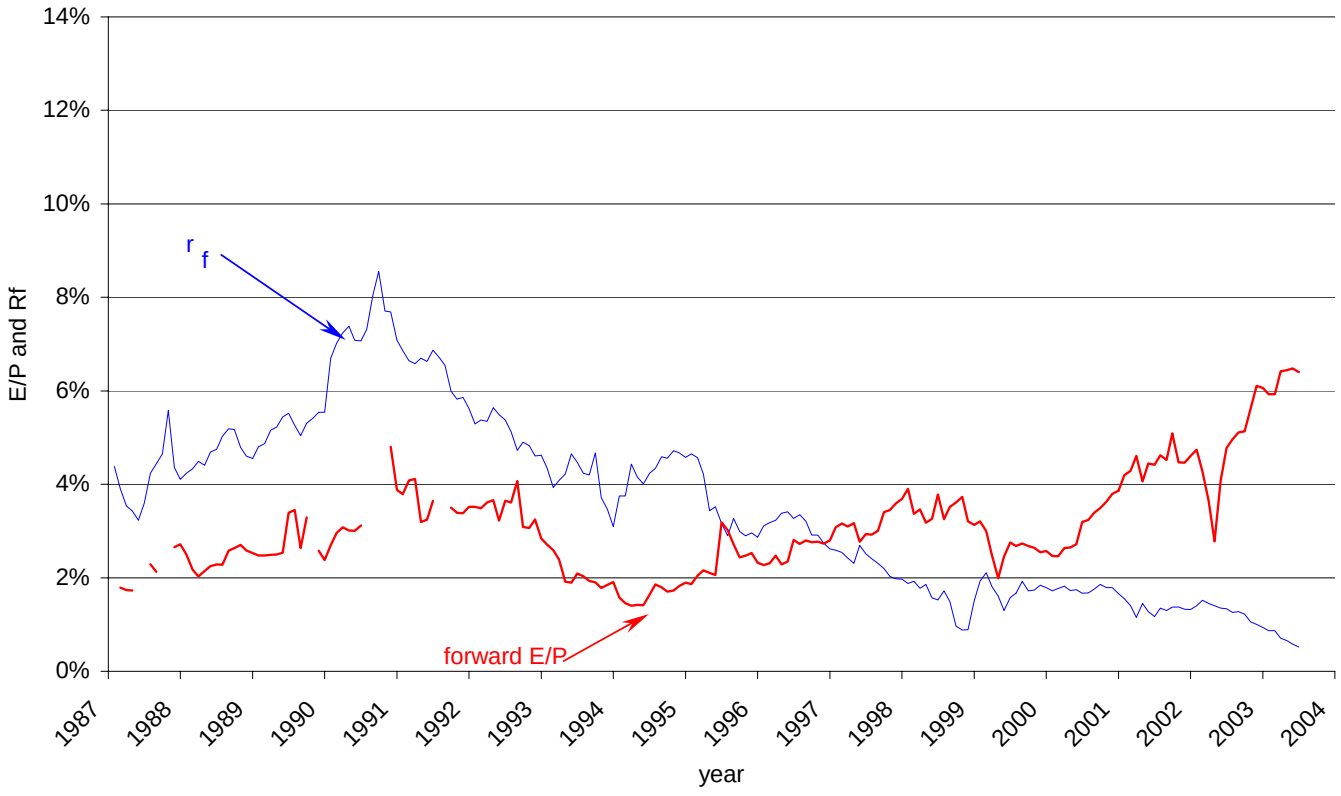
Panel D: Germany



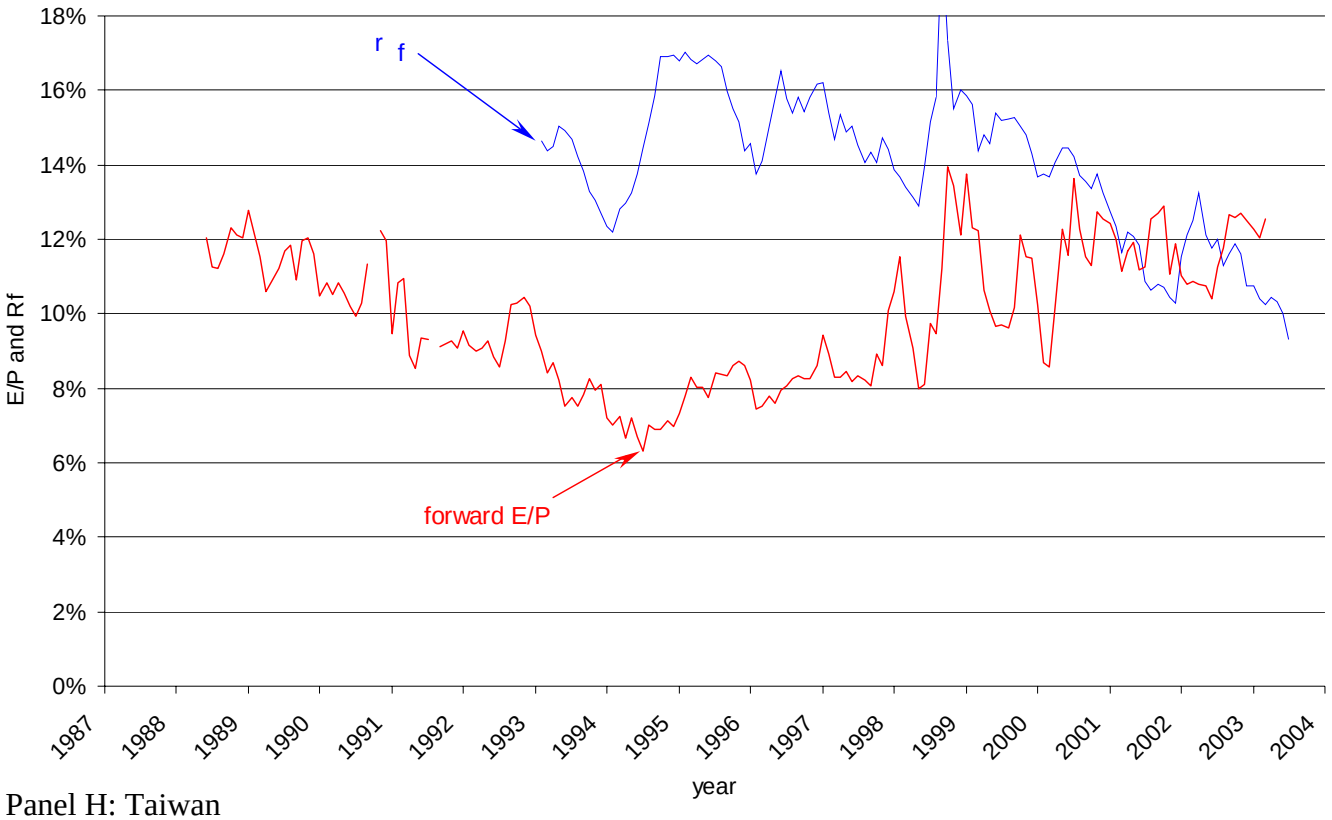
Panel E: Hong Kong



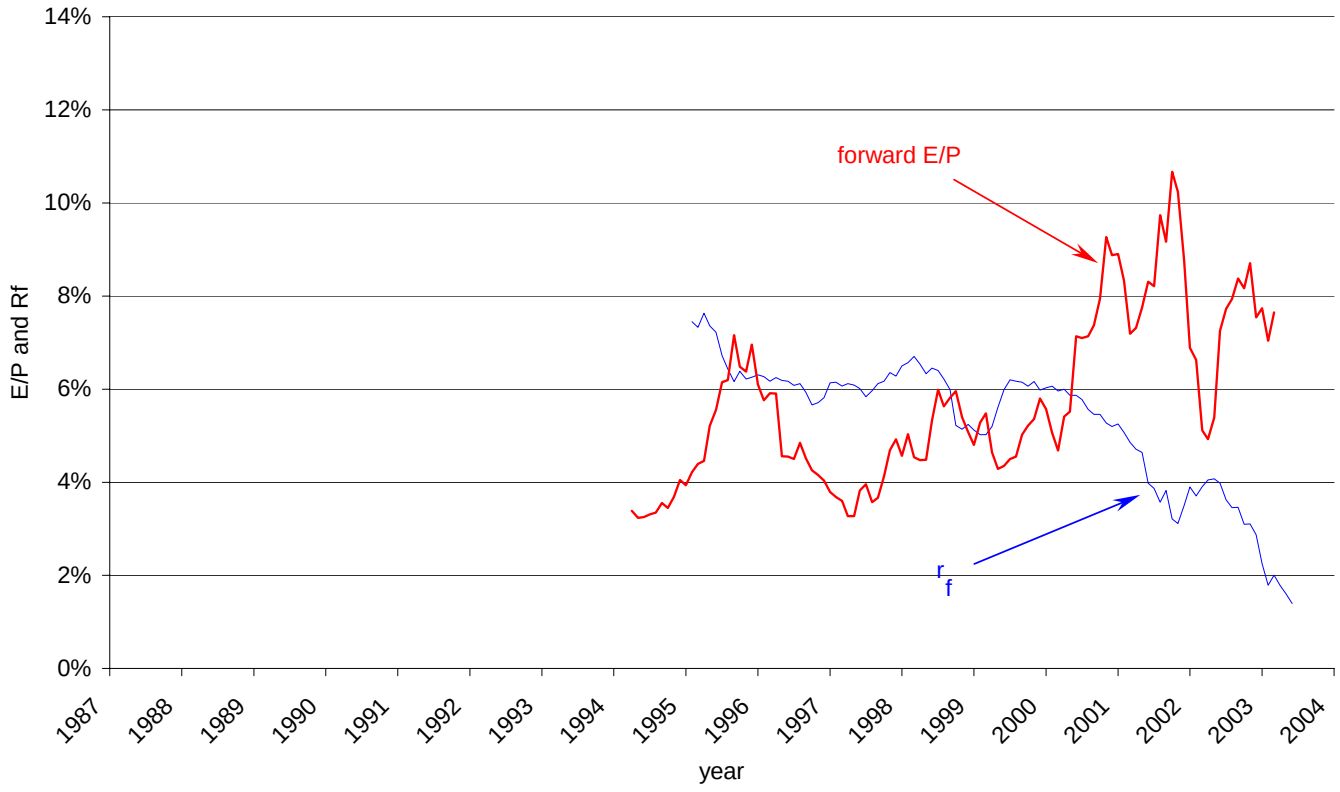
Panel F: Japan



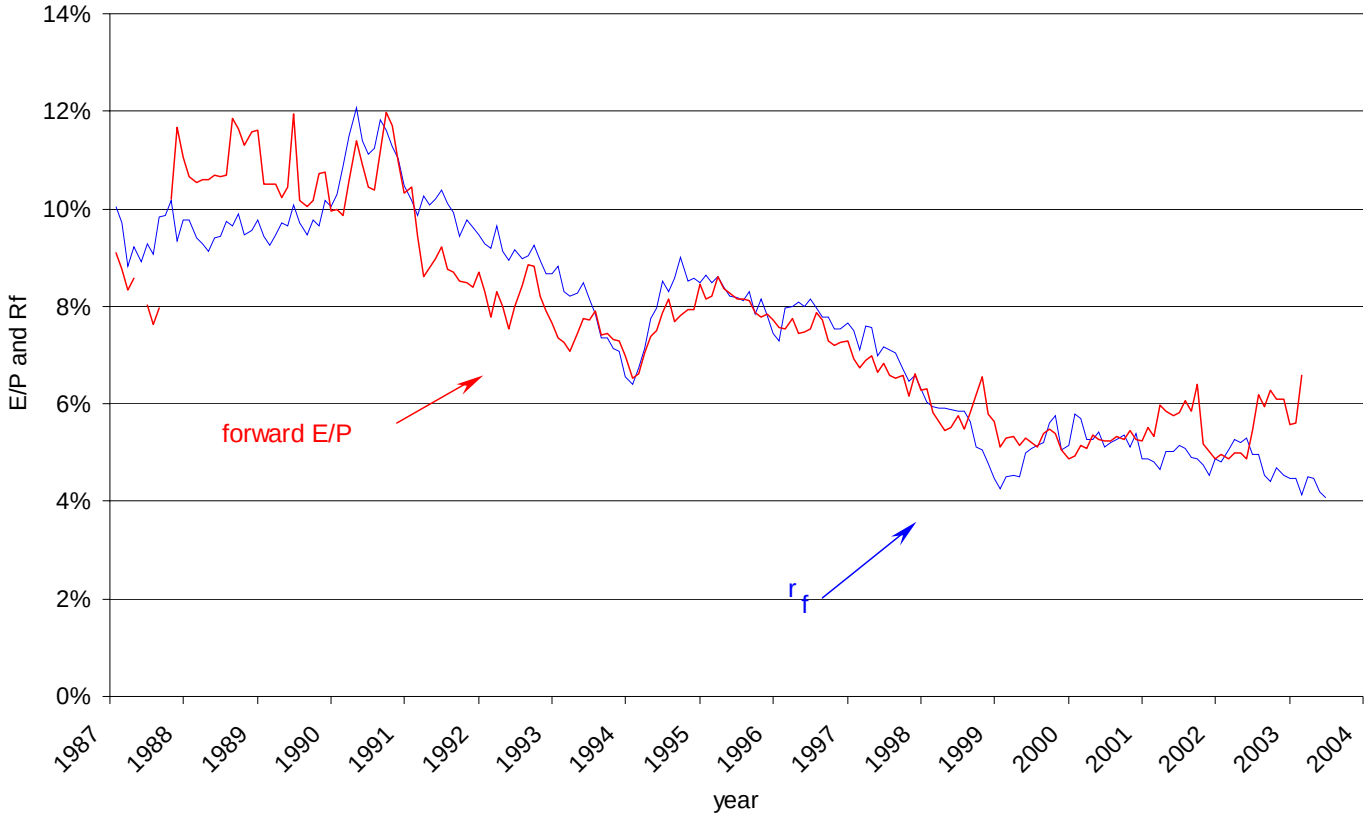
Panel G: South Africa



Panel H: Taiwan



Panel I: UK



Panel J: US

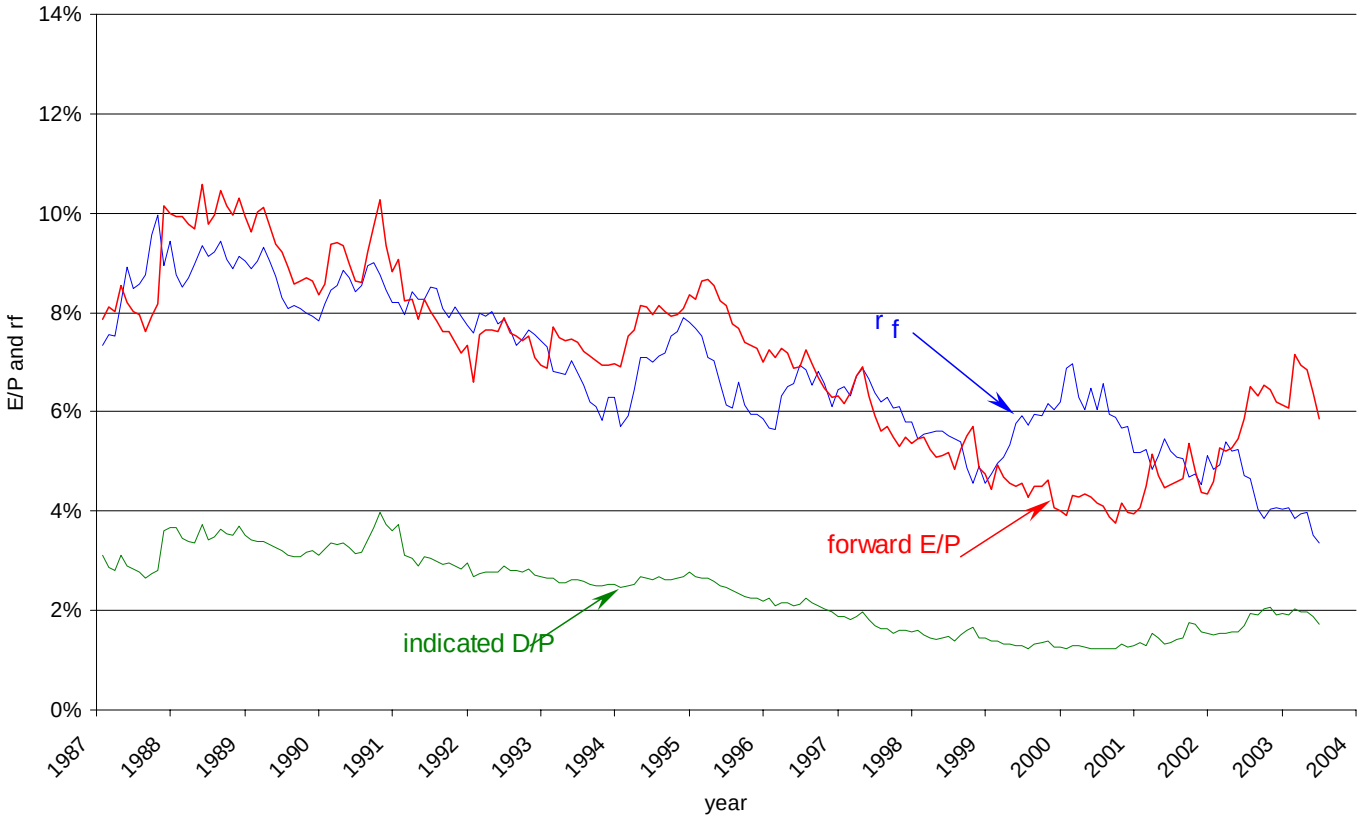
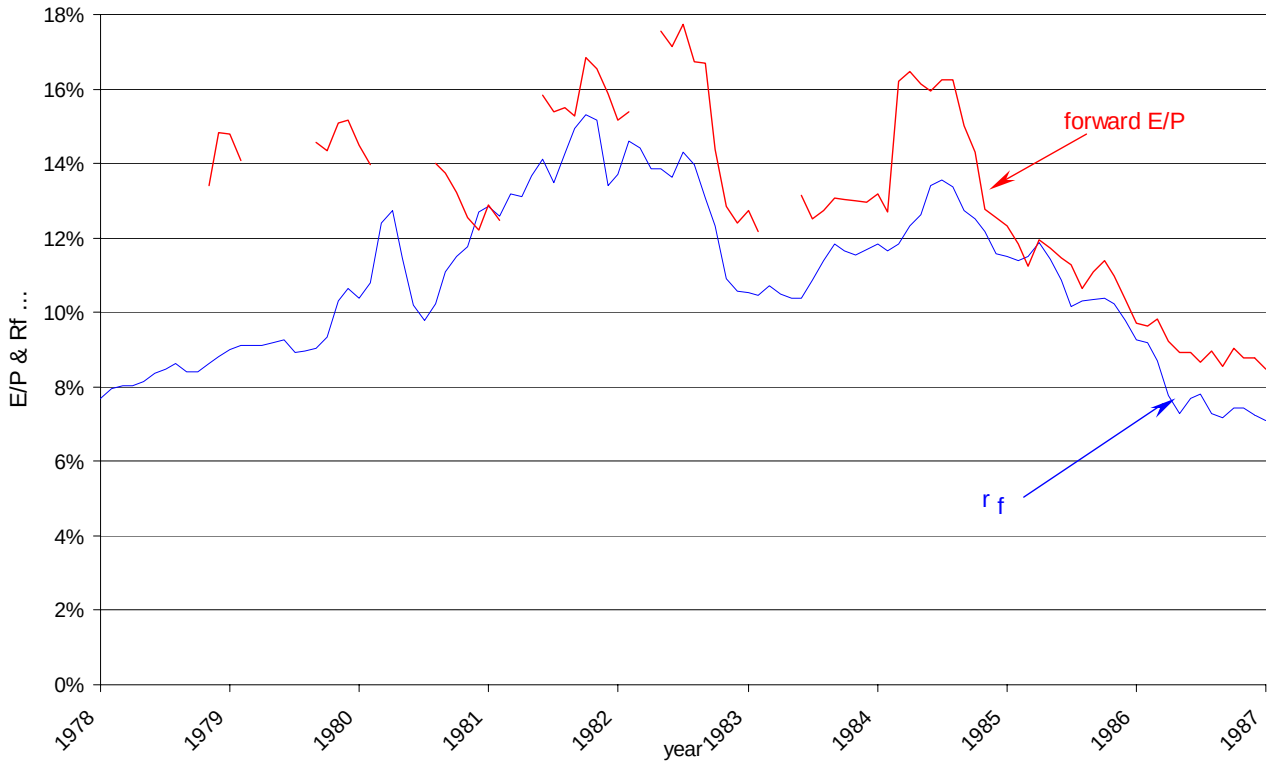


Figure 2
US experience before 1987: aggregated forward E/P ratios and 10-year risk-free rates

Panel A: 1978 to 1987: based on IBES, for months with at least 100 firms with available data



Panel B: 1961 to 1968: based on 174 firms with data covered in Cragg and Malkiel (1982)

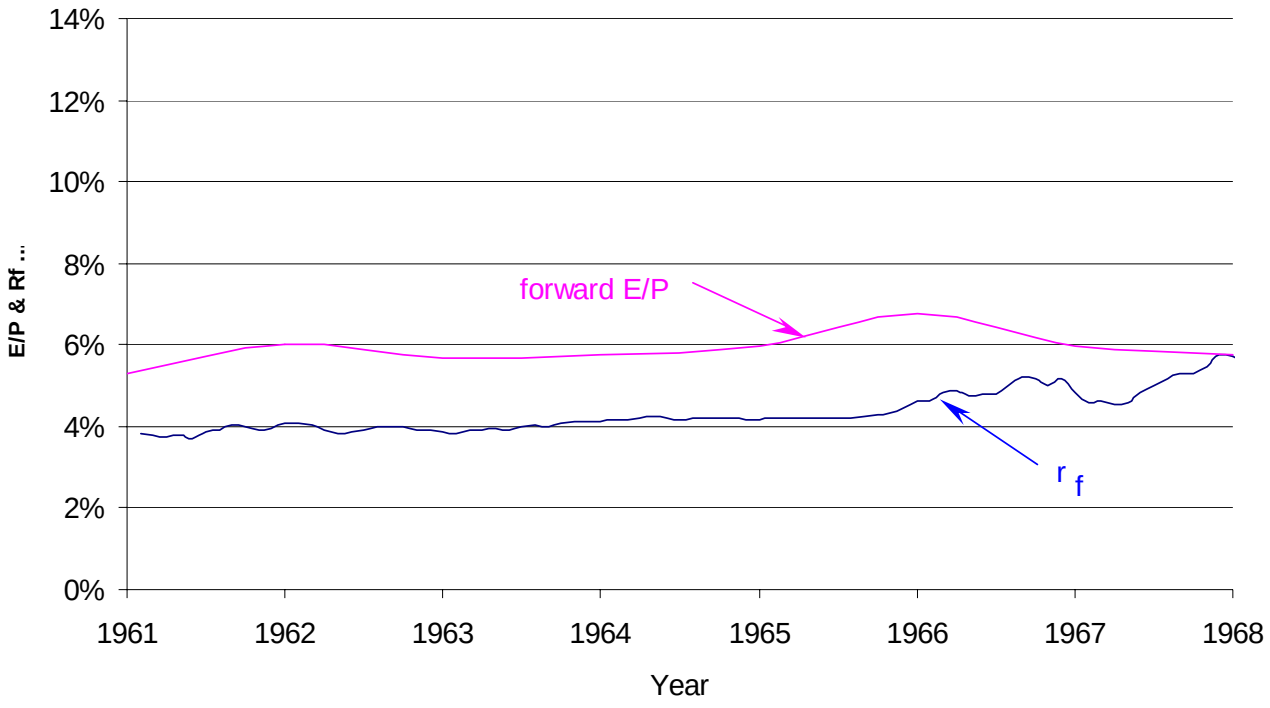


Figure 3

Trailing earnings yields for the S&P 500 and 10-year risk-free rates for the US

The ratio of trailing earnings to prices for the S&P 500 are taken from http://aida.econ.yale.edu/~shiller/data.htm and risk-free rates are taken from FRB H15 Report of the U.S. Federal Reserve (= tcm10p through 3/31/1953, and = tcm10y after that).

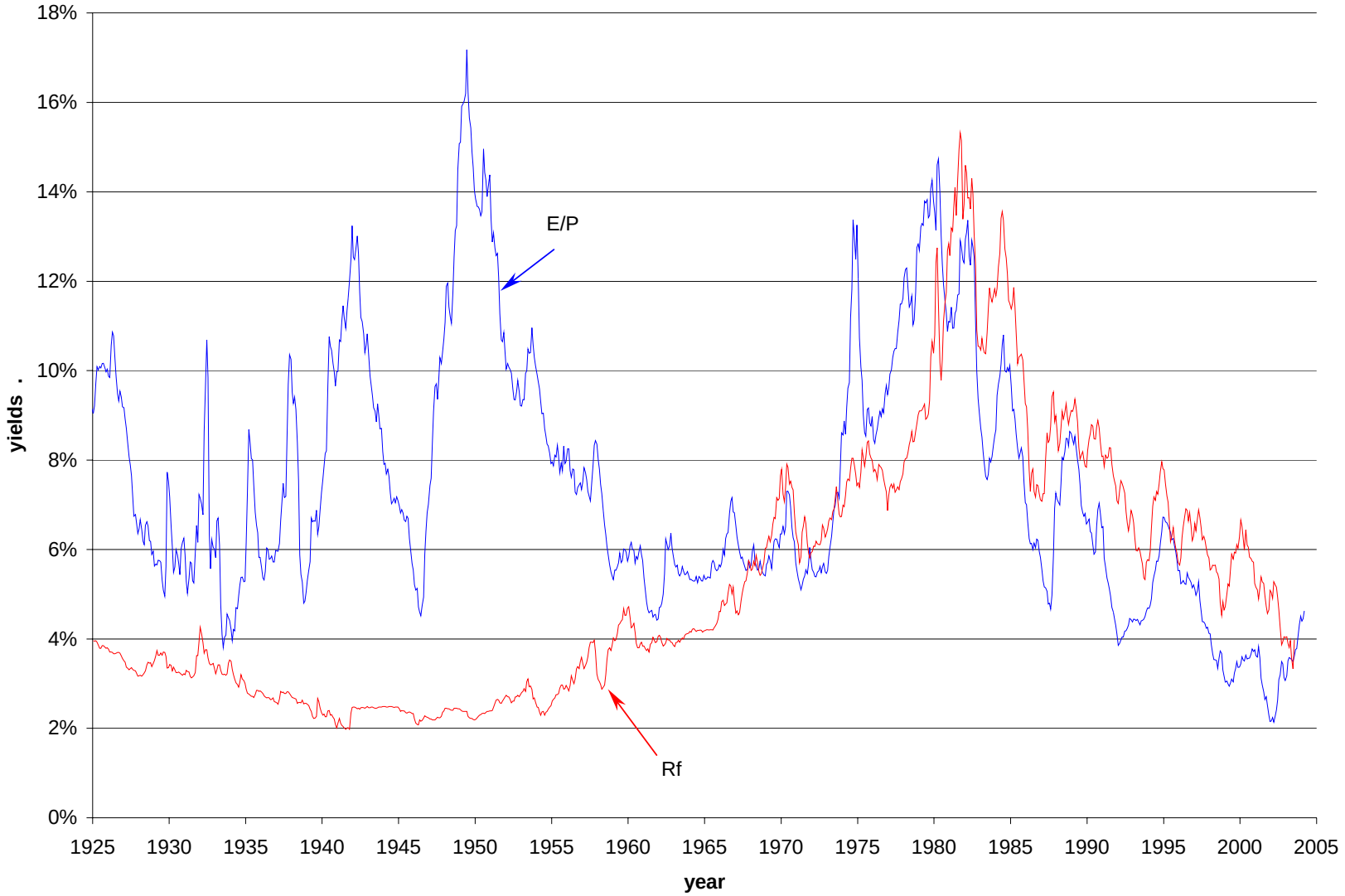
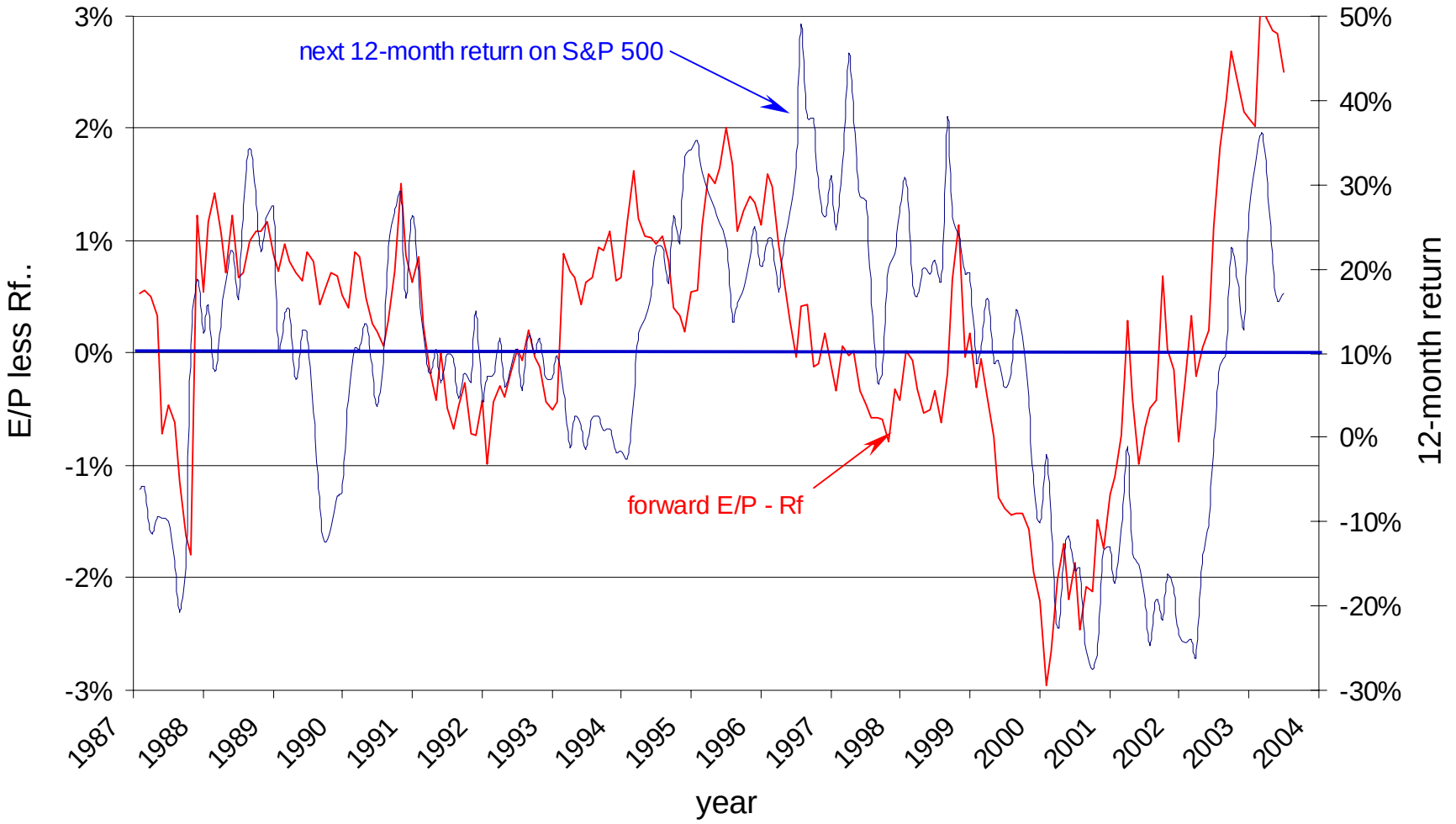


Figure 4
Ability of Fed model (forward E/P less 10-year risk-free rate) to predict next 12 months' return

As of the middle of each month, all US firms with available data on IBES are used to calculate the ratio of aggregate earnings forecast for the next year to total market capitalization. The 12-month return series is calculated from the end of the following month for the S&P 500 Index (including distributions).

Panel A: Time series of (forward E/P less 10-year risk free rates) and next 12 months' return.



Panel B: Relation between (forward E/P less 10-year risk-free rate) and next 12 months' return

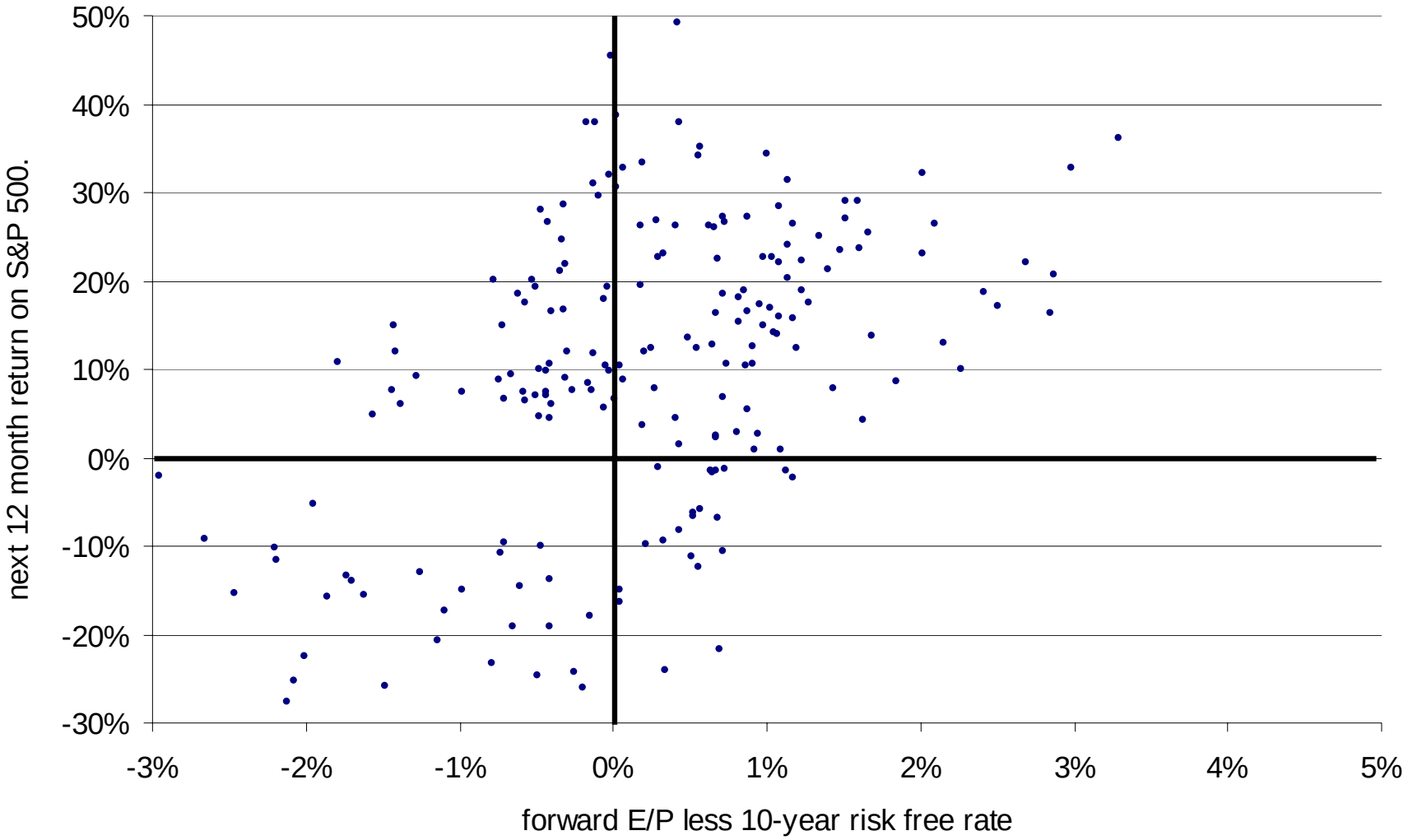


Figure 5
Evidence of excess volatility provided in Grossman and Shiller (1981)

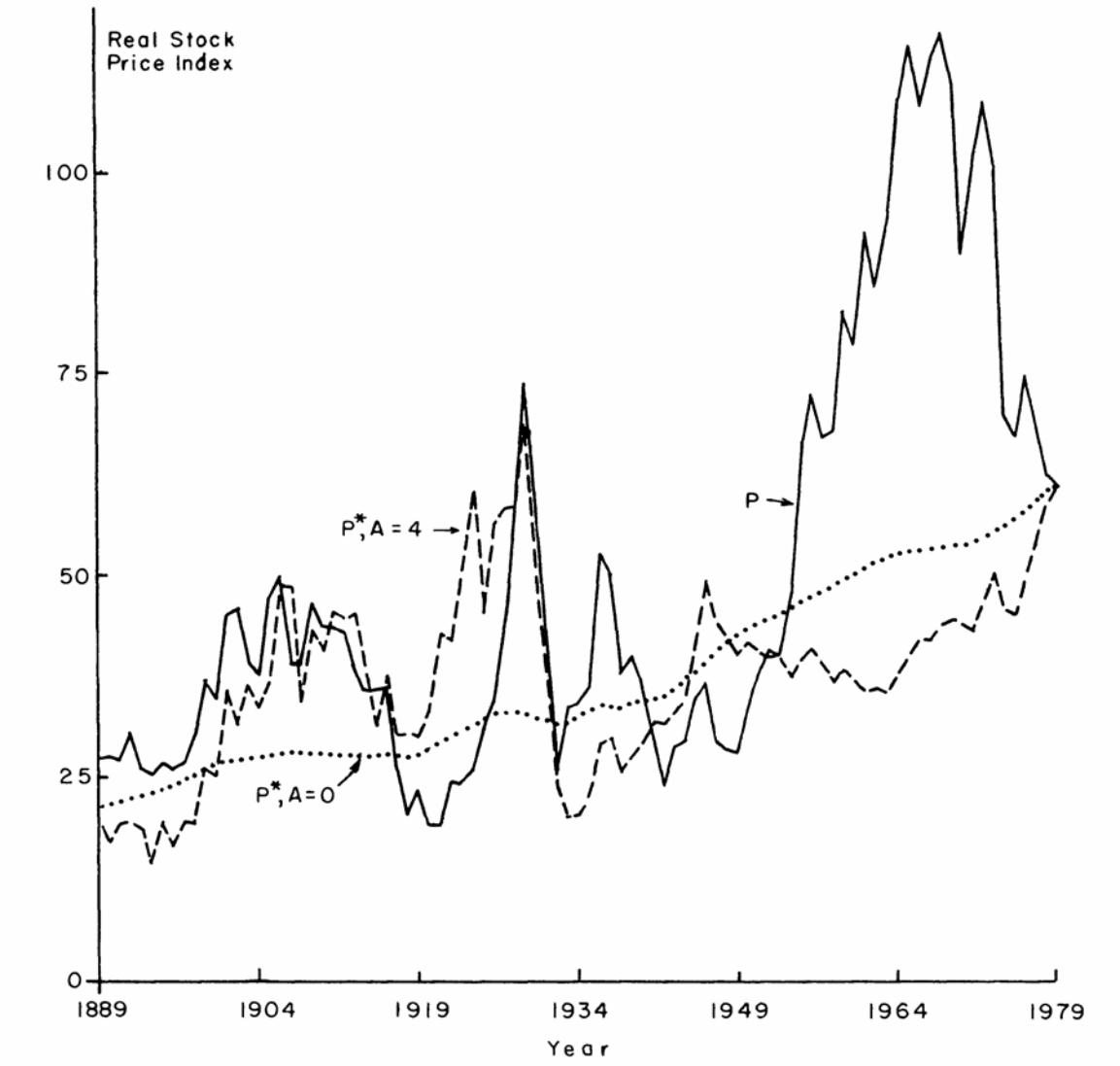


FIGURE 1. ACTUAL AND PERFECT FORESIGHT STOCK PRICES, 1889–1979

Note: The solid line P_t is the real Standard and Poor Composite Stock Price Average. The other lines are: P_t^* (as defined by expression (6) and (7), the present value of actual subsequent real dividends using the actual stock price in 1979 as a terminal value. With $A=0$ (dotted line) the discount rates are constant, while with $A=4$ (dashed line) they vary with consumption.