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Tune to CNBC or the like for more than about 15 minutes, and you will hear a strategist, portfolio manager, or market pundit of some stripe explaining that the high market multiples of recent times are justified by low interest rates and/or inflation. "Well, Maria, you have to understand—stocks might look expensive, but that is fine because interest rates and inflation are low." Or so the refrain goes. In fact, to many on Wall Street and in the financial media this assertion has been elevated to the status of conventional wisdom.

The most widespread version of this comparison of stocks to bonds is often deemed the *Fed model*. This model, allegedly found in the annals of a Fed report, not named because of any official Fed endorsement, comes in various forms, but generally asserts that the stock market's earnings yield should be compared to current nominal interest rates (the earnings yield, or E/P, is the inverse of the well-known price-to-earnings ratio or P/E).[1]

Letting Y represent the yield on ten-year Treasuries, the model says we should look at E/P versus Y. In its simplest form, it asserts stocks are cheap when E/P exceeds Y, expensive when Y exceeds E/P, and fairly valued when Y and E/P are equal.

Even pundits who are united in their belief in the Fed model do not always agree on what it is telling them. Of course, as recent times make clear, the E in E/P is not a simple observable number. In addition, some adjust the basic comparison of E/P and Y for a growth assumption or a required equity risk premium, or change

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the functional form of the relationship.[2]

The basic widespread core belief implied by the Fed model, though, is that the stock market's E/P must be compared to Y, and that low interest rates permit a low E/P or, equivalently, a high market P/E (and vice versa). It is this core belief (whether or not it is labeled the Fed model) that I study here.

The evidence strongly suggests that the Fed model is fallacious as a tool for long-term investors. Essentially, the comparison of E/P to Y is erroneous as it compares a real number (P/E) to a nominal one (Y). The important point is that the stock market's P/E does not have to move with inflation since nominal corporate earnings already do so. Empirical evidence supports this theory. Investors forecasting future long-term stock returns would do much better relying on simple P/E, or the like, rather than the Fed model.[3]

While the Fed model fails as a predictive tool for future long-term stock returns, it does work as a descriptive tool for how investors choose to set current stock market P/Es. Even here, however, the simple Fed model needs help. Applying a relationship studied in Bernstein [1997b] and Asness [2000], it is clear that the Fed model relationship must be conditioned on the perceived volatility of stocks and bonds. Without conditioning on perceived volatility, the simple Fed model is a failure over 1926-2001, even to describe how investors set P/Es. Conditioned on perceived volatility, however, the Fed model explains the puzzle of why the relative yield on stocks and bonds has varied so greatly over the last century.

Note that this finding that the Fed model has descriptive power for how investors set P/Es in no way contradicts the finding that the Fed model fails as a predictive tool for stock returns. If investors consistently err and follow a poor model, it is not surprising that this same model fails those investors for making long-term forecasts.

DATA AND TERMINOLOGY

The data used in this article include:

- Monthly U.S. CPI inflation (continuously compounded).
- Monthly continuously compounded total real (after inflation) return of the S&P 500 and of the ten-year U.S. Treasury bond from 1871 through 2001. These monthly returns are added together to derive longer-term holding-period total returns.
- The price-to-earnings ratio (P/E) of the S&P 500 based on ten-year trailing earnings. Each month earnings-to-price ratios based on last year's trailing earnings are multiplied by the S&P 500 price index to determine a monthly earnings per share (EPS) estimate for the index. Each EPS estimate is then divided by the level of the CPI, and averaged over the last ten years to determine a ten-year average real EPS figure for the S&P 500. Finally, the current real price index is divided by this average real earnings figure to determine today's P/E ratio. Ten years of earnings are used in an effort to smooth out short-term transient fluctuations (following Shiller [2000]). Unless otherwise indicated, P/E refers to this measure.[4]
- The yield each month on the ten-year U.S. Treasury bond (Y).

All data sources in this article are, unless otherwise mentioned, the same as those used in Arnott and Asness [2003] or Asness [2000].

ARGUMENTS FOR AND AGAINST THE FED MODEL

There are a variety of arguments for why P/Es should or should not move with nominal interest rates.

Common Sense Rationale for the Fed Model

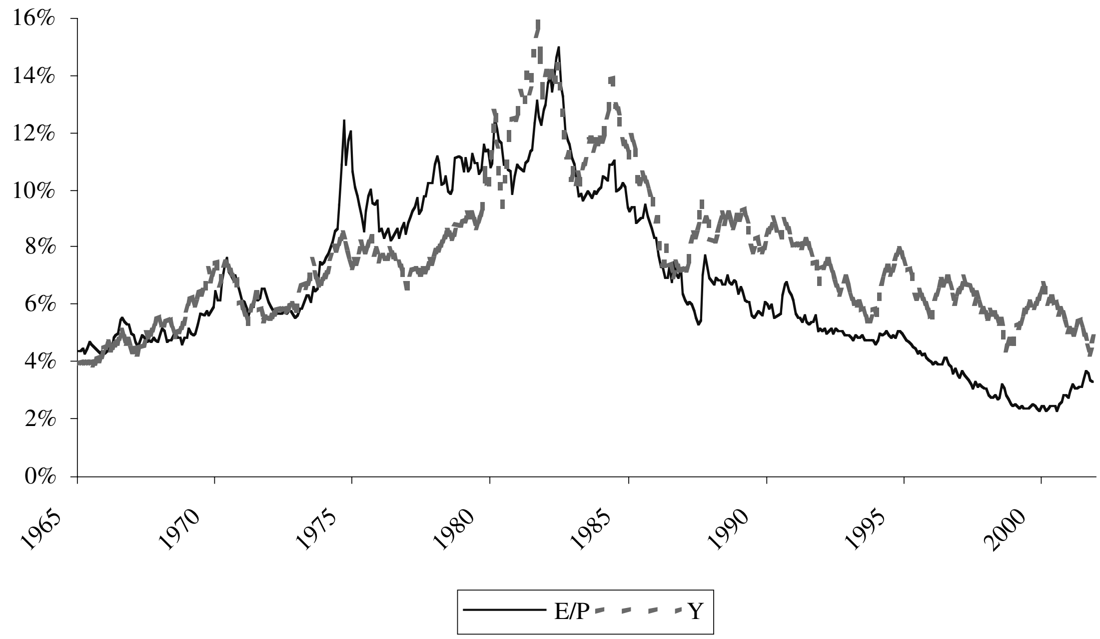
At first glance, the Fed model seems to be simple common sense. I will soon disagree with these widely believed arguments, but it's important to give the devil his due (but not to be his advocate).

Argument #1—The Competing Assets Argument. Many reason as follows. E/P, the annualized earnings on stocks divided by the price paid, is the yield you receive on your equity investment.[5] Y is the yield you get on Treasury bonds (ten-year Treasuries for this comparison).

Investors can invest in either stocks or bonds, and thus these are competing assets. Therefore, the comparison of E/P and Y is valid and important. When E/P exceeds Y, stocks are yielding more than bonds and are thus cheap, and when E/P is lower than Y, stocks are expensive. E/P = Y is the implied fair value point.

Argument #2—The PV Argument. There is a slightly more sophisticated (although ultimately similar) version of argument #1. Some correctly point out that the price of a stock today is the discounted present value

E X H I B I T 1
S&P 500 E/P and Ten-Year Yields



(PV) of the future cash flows to investors from the company or market in question (the famous dividend discount model or DDM approach). They argue that when interest rates fall, the PV today of future cash flow rises, and P/Es should also rise.

As an example, imagine the yield on the ten-year Treasury bond trading at par value is 10%. Well, viewing the 10% annual yield as income, the P/E on the bond is 1/10% = 10. Now, imagine that the ten-year par bond yield is 4%. Well, now the Treasury's P/E is 1/4% = 25.

Argument #2 says it would not be surprising to see stocks selling for higher P/Es when interest rates are 4% than when they are 10%, as the P/E on bonds is also higher.

Argument #3—Just Look at the Data. The final argument in favor of the Fed model is empirical. Exhibit 1 shows the stock market's E/P and the yield on the ten-year Treasury over 1965-2001.

Historically E/P and Y have been strongly related (with perhaps a small level shift down in E/P post-1985). The correlation of these two series over this period is an impressive +0.81. It's a rare Wall Street strategist who in the course of justifying the Fed model does not pull out a version of this graph, or an analogous table (showing that stock market P/Es move with either interest rates or inflation). The implicit argument is that high P/Es are fine if interest rates and inflation are low, as this is normal.

Why the Common Sense Is Likely Wrong

It is important to review these pro-Fed model arguments because belief in them is widespread. Yet obviously I have set up this ersatz common sense for a fall.

Let us start with the well-known Gordon model, which expresses the expected nominal return on the stock market as the dividend yield plus the expected growth of dividends:

$$E[R_S] = D/P + G_D \tag{1}$$

where $E[R_S]$ is the expected nominal stock return, D/P is the current dividend yield (current dividends per share divided by current stock price), and G_D is the assumed constant long-term nominal growth rate of dividends. Capital letters will represent nominal (before-inflation) values, while lowercase letters will represent real figures after accounting for inflation (e.g., $g_D = G_D - I$, where I equals inflation and g_D is thus, as a linear approximation, the expected real rate of dividend growth).

Dividend yields can be linked to earnings yields by the payout rate, PAY = D/E, the proportion of earnings paid out as dividends:

$$E[R_S] = PAY \times E/P + G_D \tag{2}$$

Now make some simplifying assumptions. First, use ½ for PAY, which is about its long-term historical average.[6] Furthermore, assume that PAY is constant, so the growth rate of earnings and dividends is the same. Equation (2) can be rewritten as:

$$E[R_S] = \tfrac{1}{2}\, E/P + G_E \qquad (3)$$

where G_E is the growth rate of earnings, which equals G_D.

All else equal, expected nominal stock returns are higher, the higher the earnings yield at purchase (or, equivalently, the lower the P/E) and the higher the expected long-term nominal earnings growth.

Now, expected real stock returns are (approximately) expected nominal returns minus inflation (assumed to be a known constant I):

$$\begin{aligned} E[r_S] &= E[R_S] - I \\ &= \tfrac{1}{2}\, E/P + G_E - I \\ &= \tfrac{1}{2}\, E/P + g_E \qquad (4) \end{aligned}$$

This is an important equation. Expected *real* stock returns are a positive function of starting E/P (or a negative function of P/E) and expected *real* long-term earnings growth.

The key issue is what happens when expected long-term inflation falls. Let's make some reasonable educated guesses. First, let's assume that nominal bond yields fall one-to-one with the fall in inflation. Next, as a starting point, let's expect an equal fall in the long-term nominal return on stocks.

In other words, as a starting point it is probably a good guess that the required *real* return on stocks does not go up when long-term inflation goes down. For instance, if expected nominal stock returns were 10% in a 5% expected inflation environment (5% real return), it would not be reasonable to expect 10% in a 2% inflation environment (8% real). Rather, a more reasonable guess is 7% nominal (5% real return).

If inflation falls, but expected *real* stock returns are to stay the same, expected *nominal* stock returns must fall. Equation (3) makes it clear that either E/P must fall (P/E rise), or G_E must fall. Fed model advocates would have you believe that the E/P must change, so when inflation falls, E/P must fall, and P/E rise. Of course, there is another obvious possibility ignored by Fed model proponents. Instead of E/P moving, G_E can move to partly or completely offset changes in inflation.

In fact, simple economic intuition argues that a G_E move is the likely scenario. Imagine a known permanent instantaneous shift in expected inflation.[7] Is it not plausible, at least as a first guess, to forecast that nominal revenue and expense growth move by the same amount (after all, is that not inflation?), and that long-term G_E moves with the change in expected inflation?

For instance, when expected inflation is very low (as in recent times), pricing power is low (for both firms and labor), and profits grow more slowly in nominal terms. To put it differently, isn't it plausible that real earnings growth (g_E) is largely insensitive to the level of constant known inflation, as inflation is a largely monetary (not real) phenomenon?

Empirical tests of the historical relationship of expected long-term inflation and nominal earnings growth are not straightforward. First, there is a dearth of independent long-term periods to observe, and second, inflation expectations are not directly observable over long periods. We can easily observe, however, actual realized inflation and actual nominal earnings growth.

The regression in Equation (5) has on the left-hand side monthly rolling decade-long nominal EPS growth on the S&P 500, and on the right-hand side the corresponding decade-long realized CPI inflation. The regression runs from 1926 through 2001 (t-statistics in parentheses):[8]

$$\begin{aligned} &\text{Nominal Earnings Growth} = 2.2\% + 0.94\ \text{Inflation} \\ &R^2 = 36.5\% \qquad\qquad (2.13)\quad (3.55) \qquad (5) \end{aligned}$$

Over this commonly studied period, realized inflation has been on average almost an exact pass-through to nominal earnings. On average, 94% of decade-long inflation showed up in nominal earnings growth, explaining 36.5% of the variation. Using only more recent data, this relationship does become weaker, but the strong positive relationship between inflation and nominal earnings growth remains.[9]

If this seems at all counter-intuitive, consider that one of the tried-and-true reasons to own equities is the belief that stocks are a good long-term inflation hedge.[10] This conventional wisdom is equivalent to believing that expected real (not nominal) earnings growth is relatively constant. If stocks are indeed a good inflation hedge, it is precisely because the nominal earnings of companies tend to rise with nominal inflation, making stocks into a *real* asset. A pundit who believes in the Fed model but also believes stocks are a good hedge for long-term inflation is inconsistent.

This point has been made before. Most notably (and over two-score years ago), Modigliani and Cohn [1979] made this point in somewhat the opposite environment from today's. They observed that in the late 1970s investors were using the Fed model (although they did not call it that) and wrongly pricing equities to a very high E/P (low P/E) because interest rates and inflation were high. Using this logic, they effectively predicted the bull market of the 1980s and 1990s.

Also notable, in an excellent survey of many of these issues, Ritter and Warr [2002] conclude that the Fed model makes the error of money illusion or what they call the "capitalization error." Siegel [2002a] also makes many of these same points.

While there is certainly a history of others who have noted that the Fed model is erroneous, its continued popularity indicates this dissenting view is losing in the court of public (and pundit) opinion. Thus, the Fed model must be fought further (even with alliteration if necessary).

Now reconsider the specific common sense arguments #1 through #3 in light of these counter-arguments.

Refuting Argument #1—The Competing Assets Argument. Argument #1 is that stocks and bonds are competing assets, and thus we should compare their yields. Now we see that the yield on the stock market (E/P) is not its expected return. The nominal expected return on stocks should, all else equal, move one-to-one with bond yields (and entail a risk premium that itself can change over time). But this is accomplished by a change in expected nominal earnings growth, not by changes in E/P.

Refuting Argument #2—The PV Argument. Argument #2 is that when inflation or interest rates fall, the present value of future cash flows from equities rises, and so should their price (their P/E). It is absolutely true that, *all else equal,* a falling discount rate raises the current price. All is not equal, though. If when inflation declines, future nominal cash flow from equities also falls, this can offset the effect of lower discount rates. Lower discount rates are applied to lower expected cash flows.

The typical "common sense" behind the Fed model ignores this powerful counter-effect, in effect trying to use lower nominal discount rates, but not acknowledging lower nominal growth. You would be hard pressed to find a clearer example of wanting to both have and eat your cake.

It is indeed possible to think of stocks in bond terms as the Fed model attempts. Instead of regarding stocks as a fixed-rate bond with known nominal coupons, one must think of stocks as a floating-rate bond whose coupons will float with nominal earnings growth. In this analogy, the stock market's P/E is like the price of a floating-rate bond. In most cases, despite moves in interest rates, the price of a floating-rate bond changes little, and likewise the rational P/E for the stock market moves little.

Refuting Argument #3—Just Look at the Data. Recall Exhibit 1. Historically, when interest rates or inflation are low, the stock market's E/P is also low, and vice versa. This, Fed modelers say, shows that the market does in fact set the equity market's P/E as a function of the bond yield, implying the Fed model is a good tool for making investment choices.

Pundits using this argument assume that because they show that P/Es are usually high (low) when inflation or interest rates are low (high), the Fed model is necessarily a reasonable tool for making investment decisions. This is not the case. If investors mistakenly set the market's P/E as a function of inflation or nominal interest rates, then Exhibit 1 is just documenting this error, not justifying it.

A simple analogy might be helpful. Say you can successfully show that teenagers usually drive recklessly after they have been drinking. This is potentially useful to know. But, it does not mean that when you observe them drinking, you should then blithely recommend reckless driving to them, simply because that is what usually occurs next. Similarly, the fact that investors drunk on low interest rates usually pay a recklessly high P/E for the stock market (the Fed model as descriptive tool) does not make such a purchase a good idea, or imply that pundits should recommend this typical behavior (the Fed model as forecasting/allocation tool).

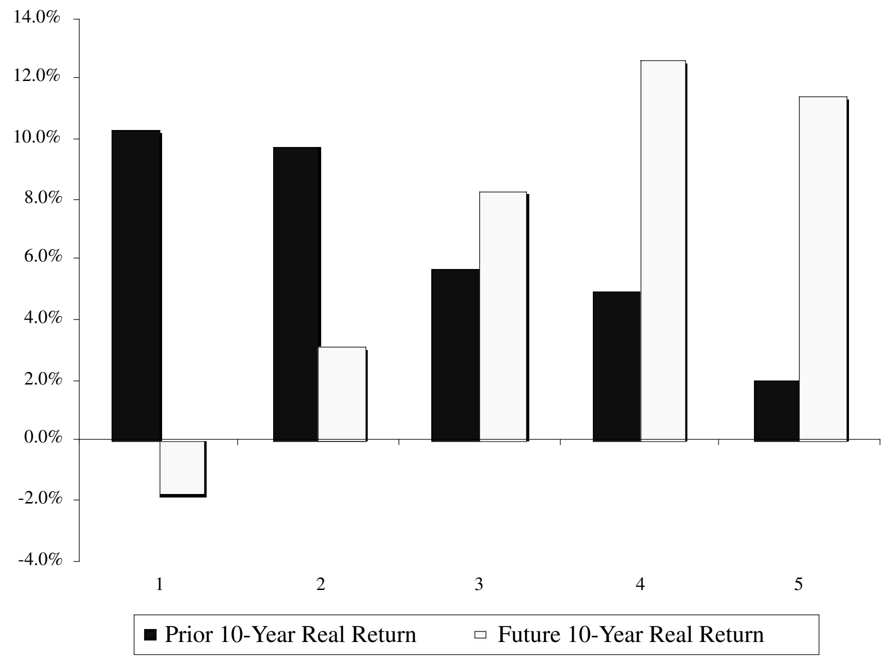
The pundits often confuse these two very different tasks put to the Fed model. They often demonstrate (each with a particular favored graph or table) that P/Es and interest rates move together contemporaneously. They then jump to the conclusion that they have proven that these measures *should* move together, and investors are thus safe buying stocks at a very high market P/E when nominal interest rates are low.

They are mistaken. The Fed model, in its descriptive form, documents a consistent investor error (or a strange pattern in investors' taste for risk); it does not justify or recommend that error.[11]

To illustrate this point, and to foreshadow the empirical findings on return predictability, Exhibit 2 examines different interest rate environments over 1965-2001. It puts each month over 1965-2001 into one of five buckets based on the end-of-month ten-year Treasury yield. Bucket 1 includes all months when interest rates were in the lowest one-fifth of the entire sample over 1965-2001 while bucket 5 includes all months when interest rates were in the highest one-fifth.

EXHIBIT 2

S&P 500 Decade-Long Real Return Sorted by Interest Rates



The dark bars represent the average ten-year annualized real return on the S&P 500 for the decades *ending* in the month in question. For example, the first dark bar indicates that the average annual real return on the S&P 500 was an impressive 10.3% for decades ending in any month when interest rates were in the bottom quintile.

Moving to the right, we see a strong relationship as returns drop while interest rates rise, culminating in a paltry 2.0% per year decade-long real return when ending interest rates were highest.

Of course, the dark bars are relatively useless to investors, as they indicate only what *has* happened in decades preceding low and high interest rates. The light bars in Exhibit 2, however, show what happens in the average decade *following* each interest rate environment.[12] Here the story is very different. The best results actually occur in the decades *starting* with high interest rates, and, conversely, buying when rates were lowest actually led on average to *negative* real returns in the next decade.

So, when pundits say it is a good time for long-term investors to buy stocks because interest rates are low, and then show you something like Exhibit 1 to prove their point, please watch the tense of what they say, as what they often really mean is that it *was* a good time to buy stocks ten years ago—as investors are *now* paying a very high P/E for the stock market (perhaps fooled into doing so by low interest rates as I contend)—and the story going forward may be painfully different.

Other Reasons Inflation Might Matter

Now, forgetting these battling "common sense" approaches, there are some other reasons inflation might matter to P/Es. And the potential impact of each of the other reasons is cumulative and possibly offsetting.[13]

Capital gains taxation is not indexed for inflation. Thus, in a high-inflation environment, equities are unfairly burdened with taxation on purely nominal profits, and might be priced to offer higher gross returns (lower P/Es and higher E/Ps) in order to simply maintain the level of net returns after taxes. This would induce a positive correlation between E/P and Y.

Inflation can distort corporate earnings. Depreciation is taken at historical cost, and in inflationary times, cost of replacement is generally higher than recorded depreciation charges, causing the overstatement of reported earnings versus real costs. When earnings are overstated, all else equal, one might expect a lower P/E ratio (higher E/P) on reported earnings. This is, of course, like the capital gains effect above, supportive of the Fed model assertion that E/P and inflation and interest rates are positively linked, although for different reasons from those most Fed model advocates normally cite. In addition, cost of goods sold is also recorded at historical cost, so in this case, when inflation is high, costs are again understated and earnings again overstated.

Interest costs go the other way. When inflation and interest rates are high, accounting methods overstate the cost of any short-term financing; that is, even though this financing may, in real terms, be no more expensive than normal, nominal cost goes up. Similarly, for firms with long-dated nominal liabilities, accounting earnings fail to recognize the gain to shareholders from the reduction in the real value of these liabilities in the face of rising inflation. Thus, earnings are understated along this dimension at these times.

Historically, very high (and also very low or negative) inflation has been associated with uncertainty, perhaps mechanically from the cost of planning in such an environment, but perhaps also from the macroeconomic difficulties and political uncertainty that often accompany inflation extremes. This can cause investors to demand a high risk premium when inflation is high, and thus high inflation is associated with high required real stock market returns (high E/Ps and low P/Es).

For most of my analysis, the assumption is that expected real stock returns move with inflation and nominal interest rates, because investors suffer from the error of money illusion (wrongly comparing a real to a nominal quantity). Of course, the irrational case cannot be distinguished easily from the simple assertion that investors' taste for equity risk changes with inflation, and they demand higher expected returns when inflation is high (set lower P/Es and higher E/Ps). This again would mean the Fed model works for very different reasons from those its supporters generally proffer.

Perhaps most basically, the various contentions constitute an argument, not a proof. Even without the distortions above, there is no QED proof that E/P is a purely real quantity with expected real earnings growth independent of steady-state inflation—merely several arguments and some empirical evidence that make it likely so.[14]

Overall, there are quite a few reasons why inflation might matter to P/Es. Obviously, the net sign and the magnitude of all of these effects are unknown, so testing the Fed model becomes an empirical issue, with the added implication that the answer may be partial.[15]

FORECASTING RETURNS

The central issue is forecasting power.

Regressions

The next logical step is to turn to the data and test whether the Fed model (E/P – Y) or the traditional model (P/E or E/P) has historically been a better tool for investors looking to forecast real stock returns.

Regressions are used to measure forecasting performance. The left-hand side is the real return on the S&P 500 over either a 20-, 10-, or 1-year horizon. The right-hand side is alternatively the E/P of the S&P 500 (the traditional model); the E/P of the S&P 500 minus the ten-year Treasury bond yield (the Fed model); or both the S&P's E/P and the ten-year Treasury bond yield separately in a two-variable regression.

If E/P has univariate forecasting power, it should show up in the single-variable regression, thus supporting the traditional model. If the Fed model has power, this should be seen in the test of E/P – Y. Finally, running the bivariate regression on E/P and Y separately is useful, as E/P – Y can appear to have statistical power even if only E/P itself has actual efficacy, simply because E/P – Y can be a noisy measure of E/P itself. Also, it is possible that E/P should be compared to Y, but not at the one-to-one ratio of the Fed model.

The regressions are run over different time periods using different forecasting horizons. For forecasting 10-year horizon returns, the regressions are run over 1881-2001, 1926-2001 (the classic Ibbotson period), and 1955-2001 (the modern period when interest rates have been freely floating). For forecasting 20-year returns, the last 1955-2001 period is skipped as it constitutes very few independent periods. For forecasting 1-year returns, the latest 20 years ending in 2001 (the great bull market) are added.

Exhibit 3 provides the results of nine regressions for forecasting ten-year real S&P 500 returns. Each row represents a different regression; t-statistics are in parentheses (adjusted for overlapping observations). A row with values for only E/P or E/P – Y represents a univariate regression, while a row with values for both E/P and Y represents a bivariate regression.

For example, the first row shows that a monthly regression over 1881-2001 of overlapping ten-year S&P 500 real returns on the starting E/P of the S&P 500 reports an intercept of –0.8% (t-statistic of –0.43), a coef-

EXHIBIT 3
Forecasting Ten-Year Real S&P 500 Returns

Date	*Intercept*	*E/P*	*Y*	*E/P – Y*	*Adj. R^2*
1881-2001	-0.8% (-0.43)	0.95 (5.66)			30.2%
	4.6% (2.39)			0.50 (1.41)	11.9%
	-0.8% (-0.51)	0.95 (4.13)	0.02 (0.06)		30.1%
1926-2001	-2.9% (-0.91)	1.31 (3.85)			34.9%
	5.7% (2.34)			0.47 (1.03)	9.7%
	-2.6% (-0.98)	1.37 (3.07)	-0.13 (-0.36)		35.5%
1955-2001	-2.5% (-0.57)	1.20 (3.08)			29.6%
	6.3% (2.72)			-0.36 (-0.47)	1.4%
	-2.4% (-0.53)	0.85 (0.82)	0.36 (0.44)		31.0%

ficient of 0.95 on E/P (t-statistic of 5.66), and an adjusted R^2 of 30.2%.

Essentially, the message of Exhibit 3 is simple. The traditional model (E/P alone) has strong forecasting power for ten-year real stock market returns, while the Fed model is wholeheartedly rejected. Expected real ten-year returns are higher, the higher the starting E/P (the lower the P/E you buy in at), and this occurs regardless of (and in fact unaffected by) the level of starting interest rates.

The Fed model itself, E/P – Y, seems to have some weak power in the earlier periods, but clearly this is only because E/P is part of E/P – Y. When E/P and Y are tested in bivariate regressions, E/P matters, and the Y part of the Fed model is ignored (with the wrong sign over 1955-2001).

Exhibit 4 shows very similar results, but with even higher R^2s (Arnott and Bernstein [2002] find a similar result for 20-year horizons). In particular, over the 1926-2001 period, the power of simple E/P to forecast 20-year stock returns is truly impressive. Now, at first glance, it again appears there is some supporting evidence for the Fed model; E/P – Y comes in with a 2.30 and 2.78 t-statistic over the two time periods. This again occurs, however, only because E/P – Y is a noisy proxy for E/P. When E/P and Y are tested separately in the bivariate regression, it is quite clear that Y adds very little. Y does have the hypothesized negative sign, but over both time periods its coefficient is roughly one-sixth of that predicted by the Fed model (i.e., the Fed model predicts Y to have an equal but opposite sign to the coefficient on E/P), and is not statistically strong.

Finally, Exhibit 5 presents the shorter-horizon results when the left-hand side of the regression is rolling one-year real returns.

As shown by others, at shorter horizons R^2 values fall dramatically (see Fama and French [1988]). This occurs because the predictable component of stock returns is small but slowly changing, leading to reasonably reliable long-term forecasts, but poor short-term ones. In English, short-term market timing is hard.

Looking at the longest time periods (1881-2001 and 1926-2001), there is a very similar story as for 10-year and 20-year horizon returns. E/P alone has some forecasting ability (as usual, higher E/Ps are better for future returns). E/P – Y (the Fed model) has some power, but again only because it is a poor man's E/P. The period 1955-2001 is the stuff of an efficient market fan's dreams. Basically, nothing has forecasting power for short-horizon returns over this period.

Only by looking at the recent 1982-2001 bull market is there any support for the Fed model. No specification has a very high t-statistic (this is apparently too much to ask of 20-year regressions), but R^2s are high (for one-year forecasts), and in a bivariate regression the coefficient on Y is negative and about two-thirds the size of the positive coefficient on E/P (i.e., two-thirds of the way to the Fed model).

Now, one could simply dismiss this result as a lone and very narrow victory won over a short period for the Fed model (adding Y takes the R^2 only from 10.3% to 11.2%, and E/P – Y still works worse than plain old E/P). This dismissal is probably warranted, although the recent results do give some hope to those using the Fed model for tactical purposes.[16]

The bottom line is that for forecasting long-term stock returns the Fed model is an empirical failure, and the traditional model (regular old P/E) is a success story.

EXHIBIT 4
Forecasting 20-Year Real S&P 500 Returns

Date	*Intercept*	*E/P*	*Y*	*E/P – Y*	*Adj. R^2*
1881-2001	1.4% (0.84)	0.63 (2.59)			37.2%
	4.3% (3.85)			0.48 (2.30)	25.5%
	1.6% (0.83)	0.65 (2.52)	-0.09 (-0.24)		37.6%
1926-2001	-2.2% (-1.15)	1.22 (5.69)			65.4%
	4.6% (2.86)			0.64 (2.78)	33.9%
	-1.8% (-0.86)	1.27 (5.92)	-0.22 (-1.38)		68.1%

EXHIBIT 5
Forecasting One-Year Real S&P 500 Returns

Date	*Intercept*	*E/P*	*Y*	*E/P – Y*	*Adj. R^2*
1881-2001	-3.6% (-0.88)	1.38 (2.66)			4.5%
	4.1% (2.34)			0.82 (2.04)	2.4%
	-3.3% (-0.76)	1.40 (2.62)	-0.08 (-0.16)		4.4%
1926-2001	-9.4% (-1.64)	2.35 (3.29)			8.3%
	5.0% (2.37)			1.09 (2.14)	3.7%
	-8.3% (-1.36)	2.42 (3.38)	-0.31 (-0.54)		8.4%
1955-2001	2.0% (0.38)	0.72 (1.01)			1.3%
	6.8% (3.71)			0.57 (0.65)	0.4%
	2.5% (0.49)	0.96 (0.93)	-0.32 (-0.35)		1.3%
1982-2001	1.9% (0.29)	1.65 (1.89)			10.3%
	20.1% (4.57)			4.08 (1.84)	8.8%
	9.2% (1.16)	3.19 (1.66)	-2.05 (-1.02)		11.2%

Are We Forecasting Stocks or Stocks versus Bonds?

So far the focus has been on forecasting future real stock returns, and the empirical evidence has strongly favored the traditional model versus the Fed model for this task. Still, this does not address the issue of forecasting relative (stock versus bond) returns.

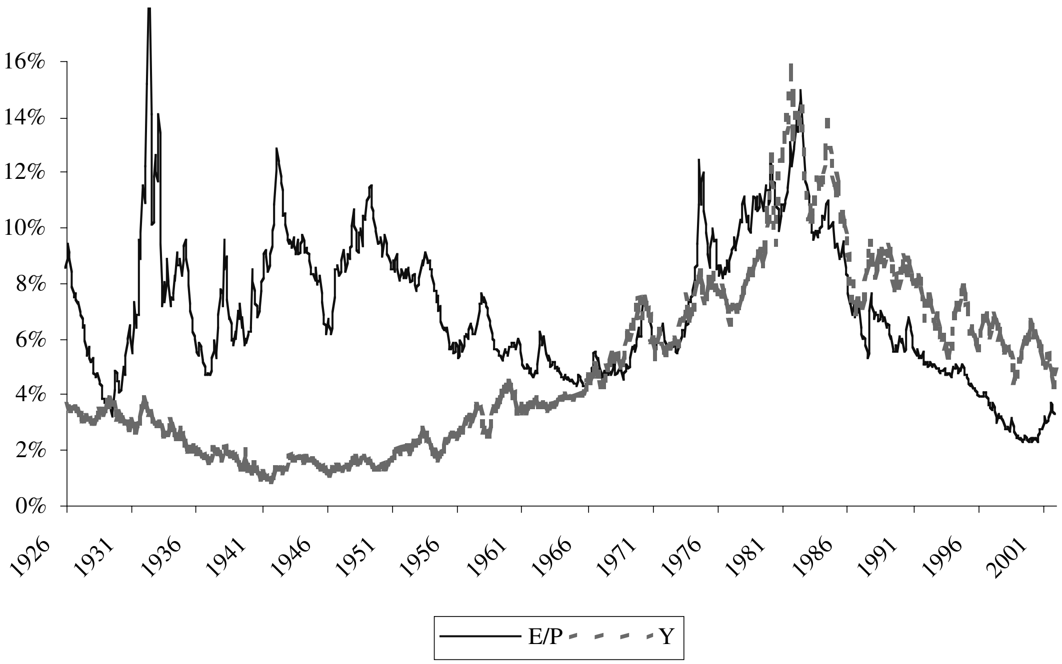
Simple economic intuition as well as the findings of others (Arnott and Bernstein [2002], for example) indicates that the best and most reasonable forecast of future real bond return is the current real bond yield (Y minus forecasted future inflation or Y – I). Thus, if E/P is a real quantity as argued here, a strong candidate to forecast future stock versus bond returns would be E/P minus the current real bond yield, or E/P – [Y – I].

Furthermore, while E/P – [Y – I] might be a fair comparison, it excludes any risk premium for stocks.[17] Thus, a very simple formula for *relative* value might look something like something like E/P – [Y – I] – RP (letting RP equal the required risk premium). When that is positive, stocks are probably more attractive than usual versus bonds, although not necessarily attractive on an absolute basis. Of course, this necessitates adding an estimate of expected inflation, and an estimate of the required risk premium, neither an easy measure to observe with certainty. While additional complication is regrettable, such additions are necessary for the equation to make any sense at all.[18]

Essentially, declaring it a relative-value tool does not save the Fed model. Even for this task, the Fed model specification of E/P – Y can be rejected on first principles.

Forgetting the fact that the Fed model is misspecified, even for relative value, an interesting practical question is what Wall Street pundits think they are forecasting

EXHIBIT 6
S&P 500 E/P and Ten-Year Yields



with the Fed model. When they say something like "stocks are undervalued according to the Fed model," might they actually sometimes mean "stocks are overvalued, but less so than bonds"? One would hope that in this case they would actually say so, as that would perhaps be useful information to long-term investors.[19]

Instead of calling stocks cheap it would be clearer at these times to say "stocks are expensive, but bonds are more expensive." Of course, this is a less catchy sales pitch than "stocks are cheap on the Fed model."

What are the consequences of this phraseology? Consider the small investor who might hear pundits say stocks are fair or cheap, according to faulty Fed model logic. It seems reasonable that this investor might take this to mean the stock market's long-term prospective real return is favorable when compared to historical returns. Someone who is retiring, assuming fair or cheap means equities will perform up to or exceeding their historical standards going forward, and who budgets and saves accordingly is potentially in for real trouble.

HOW P/Es AND NOMINAL RATES MOVE TOGETHER

Our evidence should make it clear that traditional valuation (P/E) is what matters in forecasting long-term real stock returns, not the Fed model. Yet recall that Exhibit 1 demonstrates that the Fed model indeed seems to have power to describe how investors actually go about setting P/Es. I now examine this descriptive power, showing it to be genuine, but robust only over the long term if investors' changing perceptions of stock and bond risk are also taken into account.

Exhibit 1 goes from 1965 through 2001. Exhibit 6 shows the same data over the longer 1926-2001 period.

What happened? Over this whole period, E/P and Y have been correlated at only +0.18. This is in stark contrast to 1965-2001 when the correlation was +0.81. Furthermore, over 1926-1965 E/Ps were almost uniformly substantially above ten-year Treasury yields, but over 1965-2001 they were generally a bit below interest rates. Clearly, if one is unwilling to simply dismiss the 1926-1965 data, the empirical support for the Fed model (in its descriptive role) is dealt a serious blow.

An answer comes from applying the models examined and discussed in Bernstein [1997b] and Asness [2000]. They argue that the simple Fed model, even used only as a tool to document investors' error of money illusion, leaves out a crucial variable: investors' changing perception of risk. Whether in error or not, if investors compare E/P to nominal Y, why would they always demand a constant E/P = Y? Should not investors demand more from stocks when they perceive stocks to be riskier versus bonds, and vice versa?

In Asness [2000] I specify a functional form for this relationship and fit parameters to this model. Equation (6) demonstrates a highly similar specification:

$$E/P = a + bY + c\sigma_{stocks} + d\sigma_{bonds} \quad (6)$$

The motivation for Equation (6) is as follows. Even if investors erroneously move E/Ps with nominal rates, it is arbitrary to assume E/P = Y. This can be generalized in two ways. First, E/P does not have to equal Y; rather it can be any linear function of Y, as in E/P = a + bY. Next, note that the simple equation E/P = a + bY is still missing an adjustment for risk. In Asness [2000] I proxy for perceptions of stock and bond market risk by adding two new terms to (6): the prior realized 20-year volatility of equities and bonds.

Essentially, when σ_{stocks} is high versus σ_{bonds}, investors have experienced more volatility in stocks versus bonds over the last generation.[20] The hypothesis for Equation (6) is now that b is positive, c is positive, and d is negative. With c positive and d negative, it means that the weighted difference of stock and bond volatility is relevant to the level of E/P. In other words, investors do in fact (through the mistake of money illusion) set E/P as a function of nominal interest rates (positive b), but they also require a higher E/P versus Y when their generation has experienced relatively more volatility in stocks as compared to bonds (positive c and negative d).

When Equation (6) is estimated over 1926-2001, the results are as follows:

$$\begin{aligned} E/P = {} & 0.3\% + 0.96\ Y + 0.37\ \sigma_{stocks} - 0.78\ \sigma_{bonds} \\ & (1.1) \quad (34.7) \quad (32.5) \quad (-25.4) \\ R^2 = {} & 62.0\% \end{aligned} \quad (7)$$

The 0.18 correlation of E/P and Y over 1926-2001 corresponds to an adjusted R^2 of 3%. The addition of σ_{stocks} and σ_{bonds} raises this to 62%—considerable improvement.

E/P is strongly related to the difference between stock and bond volatility, and conditioning on this relationship returns the relationship between E/P and Y to almost exactly the level expected by the Fed model (a 0.96 coefficient) over the entire 1926-2001 period.[21] Once volatility is adjusted for, investors have empirically moved stock market E/Ps one-to-one with nominal interest rates.

I show in Asness [2000] that this relationship, although laced with econometric difficulties, survives all robustness tests with flying colors (including working back to 1871, and working better than all competing models for out-of-sample forecasting).

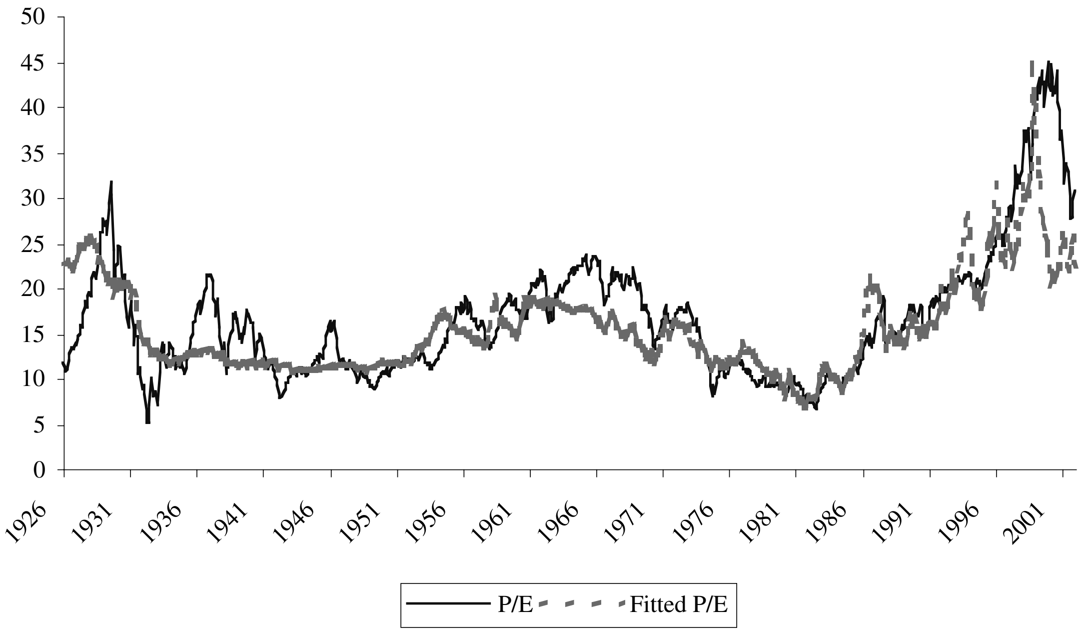
Exhibit 7 plots the actual and fitted P/E from Equation (7) (inverting fitted E/Ps to get fitted P/Es).[22] While the simple Fed model implicitly produces a horizontal line as a best fit (R^2 = 3%), Equation (7) produces quite an impressive fit. The most notable errors occur at the start in the mid-1920s and in the bubble of 1999-2000, although much of that spectacular rise is captured. The peak in the fitted series in 1999 is similar to the actual peak P/E, although the fitted series does not stay there as long.

In fact, 1999-2000 is a nice example of the difference between describing how P/Es are set versus justifying them. When the fitted series peaked in the 40s in 1999, it was not saying that this P/E is rational for the S&P 500 (it was not). It was saying that, assuming investors act the way they have in the past, and given how low equity volatility had been versus bond volatility, and how low interest rates were, *such an irrationally high P/E was to be expected*. The Fed model, alone or modified for volatility, offers no solace to those buying the S&P 500 at a P/E of 44, but it does explain what tricked them into doing so.

In fact, this model very neatly resolves the conundrum of why E/P and Y are very highly correlated over 1965-2001, but very weakly correlated over 1926-2001, and why E/P is approximately equal to Y in magnitude over 1965-2001, but generally dwarfs Y over 1926-1965. While interest rates were low in the first half of 1926-2001, realized stock market volatility was very high versus bond market volatility (even after October 1929 rolls out of the sample). A simple model of E/P based on nominal interest rates cannot hope to capture the fact that investors, rightly or wrongly, demanded a very high E/P versus Y over this time, largely to compensate them for their perception of very high equity versus bond risk. Over 1965-2001, the ratio of stock and bond volatility was more stable and thus the model without the volatility adjustment fits well (Exhibit 1).

There is strong evidence that investors contemporaneously set stock market E/Ps (P/Es) as a function of nominal interest rates. All else equal, higher Y implies higher E/P (lower P/E). Over a long period like 1926-2001, however, changing perceptions of stock and bond market risk must be accounted for, or this missing variable obscures the relationship. Accounting for this properly, we see that for at least 75 years, while it may have all been because of the error of money illusion, investors have indeed been following the Fed model.

EXHIBIT 7
S&P 500 P/E and P/E Fitted on Y and Volatility



CONCLUSION

The very popular Fed model has the appearance but not the reality of common sense. Its lure has captured many a Wall Street strategist and media pundit. However, the common sense is largely misguided, most likely due to a confusion of real and nominal (money illusion). The empirical evidence tells us the Fed model has no power to forecast long-term real stock returns. To the contrary: Traditional methods, like examining the market's unadjusted P/E alone, are very effective.

In its practical recent use, the Fed model offers a toxic combination of comparing an often exaggerated E/P (using forecasted operating earnings) to an irrelevant benchmark (nominal Y). Effectively, the Fed model is a misleading sales tool for stocks. Its popularity is presumably driven by its simplicity; its flexibility (if you don't like the E/P, just call some expenses non-recurring); its superficial rigor (it looks like math); its false initial resemblance to common sense (pundit after pundit enjoys explaining to a presumably impressed audience how bonds really have a P/E too); and most assuredly the fact that it is now, and for some time has been, more bullish than the traditional model.

Now, as opposed to its failure for forecasting long-term stock returns, the Fed model seems to be a success at *describing* how investors actually set current market P/Es. There is strong evidence that investors set stock market E/Ps lower (P/Es higher) when nominal interest rates are lower (and vice versa). This relation is strong and clear over the last 30 to 40 years. Over the 1926-2001 time period, however, it is apparent only when we properly account for a missing variable, perceived stock versus bond risk.

Many market commentators confuse this *descriptive* power of the Fed model for a proof that one should use the Fed model to make investment decisions. These are different issues. It is a strange leap to observe that investors consistently make an error—and then recommend that error, citing precedent.

ENDNOTES

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Jeremy Siegel, Lawrence Siegel, and Katherine Welling for comments on this article or an earlier version.

[1]While stories vary, it is often claimed to have been first found in a 1997 Federal Reserve Monetary Policy Report to Congress.

[2]The Fed model is often presented in both the form of a difference (E/P − Y) and a ratio (E/P ÷ Y). I focus on E/P – Y. The logic and the statistical tests in this article differ little if differences are replaced with ratios. Also, ratios obviously get increasingly strange as interest rates fall.

[3]I do not promote the P/E ratio versus other reasonable measures of valuation like the dividend yield or Tobin's Q, rather only the concept of looking at raw versions of valuation (unadjusted for interest rates or inflation) when forecasting long-term real stock returns.

[4]Many use next year's forecasted stock market earnings for the E in the Fed model's E/P. I use long-term trailing earnings because forecasted earnings are available for only a small fraction of the time period studied, and are essentially unusable for tests of whether the Fed model forecasts long-term returns. While forecasted earnings may be a better or a worse measure than trailing earnings (depending on one's faith in Wall Street), it is difficult to imagine this choice of E mattering a great deal in tests of the viability of comparing any E/P to interest rates.

In addition, my E/P and the IBES forecast E/P are highly correlated time series (0.97 since 1976), and any level differences are irrelevant (e.g., forecasted P/Es are generally lower than trailing P/Es both because earnings grow over time and because Wall Street on average is overoptimistic), as level differences end up in the regression intercepts. Additionally, my U.S. time series results are essentially replicated in the cross-section of country returns, this time using forecasted E from IBES.

[5]Actually, as a portion of earnings must be reinvested, you get only the dividend yield plus other distributions, not the earnings yield. This distinction is quite important itself, rendering a comparison of E/P and Y a bit silly.

[6]Recent times have seen PAY values considerably lower than historical averages. The impact of this is unclear. When PAY is low, it is possible that firms are simply retaining earnings for productive use, or to give to shareholders through other means that are equivalent to dividends (e.g., share repurchases). Arnott and Asness [2003] and Bernstein [1997a, 1998] would argue that historically there is a strong tendency for low payouts to lead to lower than normal future earnings growth (low G_E), so the assumption in the text may be optimistic when payouts are low.

[7]One can argue with this assumption of a permanent instantaneous shift in expected inflation, but this argument goes against the Fed model. If one argues that inflation changes are transient and will regress to the mean, then the Fed model is complete gibberish, as a very long-dated asset like the stock market cannot have a radically different fair P/E based on a temporary blip in the CPI.

[8]All t-statistics are adjusted for overlapping observations where appropriate. All R^2 values are adjusted for degrees of freedom.

[9]Asikoglu and Ercan [1992], in a related study, find a 73% flow-through from inflation to nominal earnings for industrial stocks over 1974-1988, with considerable variation by industry. Leibowitz and Kogelman [1993] also discuss this issue in depth.

[10]Boudoukh and Richardson [1993] confirm that over the long term, unlike over the short term, stocks are a good inflation hedge. In fact, this ongoing conundrum—why aren't stocks a good short-term inflation hedge while they are a good long-term inflation hedge?—is in all likelihood related to the issue of the Fed model's predictive versus descriptive efficacy.

[11]See Polk, Thompson, and Vuolteenaho [2003] for another example of the Fed model's explanatory efficacy.

[12]Note that the backward-looking dark bars actually cover an extra decade of returns (1955-1964) versus the forward-looking light bars. The story of Exhibit 2 is robust to shifting either series forward or backward by a few years. However, if we stray far from the 1965-2001 period when E/P and Y track each other so well, Exhibit 2 would change appropriately.

[13]These points are not original. In particular, see Modigliani and Cohn [1979], Ritter and Warr [2002], and Siegel [2002b].

[14]Thanks to Matthew McLennan and Thomas Philips in particular for making this point clear to me.

[15]Ritter and Warr [2002] do argue that the net of the accounting effects is that P/Es should be higher not lower when inflation is high, and thus the Fed model is not simply wrong but backward.

[16]In Asness [2000], I show some short-term forecasting success for a modified Fed model that incorporates the information in the volatilities of stocks and bonds. Even if the Fed model is misspecified and followed in error, if investors make this error with great regularity, and often return to it when they diverge from its norms, some tactical efficacy may be achieved.

[17]See Siegel [2002a], among others, for evidence that not only is E/P a real quantity, but also it is itself a reasonable estimate of the complete expected real return on equities.

[18]Another alternative is to replace Y − I with the yield on long-term TIPS. Note that, when coincidentally RP is approximately equal to I, the Fed model will be a valid relative value tool by accident.

[19]Inker [2002] makes the interesting point that if stocks and bonds are equally overvalued, stocks are the more dangerous asset as they are "longer duration," meaning if both stock and bond expected returns revert to normal, stocks have further to fall.

[20]The relationship is quite robust to other reasonable time periods for measuring volatility.

[21]The coefficient is higher on bond volatility presumably because bond volatility itself varies less through time.

[22]Ignoring certain relatively small convexity issues that arise from inverting an estimate of E/P.

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