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Fight the Fed Model
The Relationship Between Stock Market Yields, Bond Market Yields, and Future Returns

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[2] This paper is based on, and is an extension of, a short editorial with the same title appearing in welling@weeden.com on 7/26/02. I would like to thank Robert Arnott, Ted Aronson, Peter Bernstein, Richard Bernstein, William Bernstein, several other random Bernsteins, John Brynjolfsson, James Clark, Robert Krail, Kevin Lansing, Marty Leibowitz, John Liew, Matt McLennan, Tom Philips, Jeremy Siegel, and Kate Welling, for comments on this paper and/or the earlier short editorial.

Summary of "Fight the Fed Model"

The "Fed Model" has become a very popular yardstick for judging whether the U.S. stock market is fairly valued. The Fed Model compares the stock market's earnings yield (E/P) to the yield on long-term government bonds. In contrast, traditional methods evaluate the stock market purely on its own (i.e., by its P/E ratio or similar measure) without regard to the level of interest rates. My goal is to examine the theoretical soundness, and empirical power for forecasting stock returns, of both the "Fed Model" and the "Traditional Model". The logic most often cited in support of the Fed Model is that stocks should yield less and cost more (lower E/Ps and higher P/Es) when bond yields are low, as stocks and bonds are competing assets. Unfortunately, this reasoning compares a real number (P/E or E/P) to a nominal number (bond yield), ignoring the fact that over the long-term companies' nominal earnings should, and generally do, move in tandem with inflation. In other words, while it is a very popular metric, there are serious theoretical flaws in the Fed Model. Empirical results support this conclusion. The crucible for testing a valuation indicator is how well it forecasts long-term returns, and the Fed Model fails this test, while the Traditional Model has strong forecasting power. Long-term expected real stock returns are low when starting P/Es are high and vice versa, regardless of starting nominal interest rates. I also examine the usefulness of the Fed Model for explaining how investors set stock market P/Es. That is, does the market contemporaneously set P/Es higher when interest rates are lower? Note the difference between testing whether the Fed Model makes economic sense, and thus *forecasts* future long-term returns, versus testing whether it *explains* how investors set current P/Es. If investors consistently confuse the real and nominal, high P/Es will indeed be contemporaneously explained by low nominal interest rates, but these high P/Es lead to low future returns regardless. I confirm that investors have indeed historically required a higher stock market P/E when nominal interest rates have been lower and vice versa. In addition, I show that this relationship is somewhat more complicated than described by the simple Fed Model, varying systematically with perceptions of long-term stock and bond market risk. This addition of perceived risk to the Fed Model also fully explains the previously puzzling fact that stocks "out yielded" bonds for the first half of the 20th century, but have "under yielded" bonds for the last 40 years. Finally, I note that as of the writing of this paper, the stock market's P/E (based on trend earnings) is still very high versus history (about 24 versus a historical average of about 15, or 60% above average). A major underpinning of bullish pundits' defense of this high valuation is the Fed Model I discredit. Sadly, the Fed Model perhaps offers a contemporaneous explanation of why P/Es are high, but no true solace for long-term investors. Regardless of low nominal interest rates, stocks are likely to experience lower than normal long-term *real* returns going forward. Lower long-term returns are not necessarily bad news, or irrational, as past real stock returns (1926-2001) have, perhaps, been a better deal then investors expected or should demand going forward. However, it is very bad news if you are counting on the strong history of stock returns from 1926-2001 repeating.

I. Introduction

One does not have to turn on CNBC or the like for more than about 15 minutes to 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 it is O.K. as 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 common sense.[3]

The most widespread version of this comparison of stocks to bonds is often deemed the "Fed Model." This model, named for allegedly being found in the annals of an obscure Fed report, not because of any official Fed endorsement, comes in various forms, but generally asserts that one must compare the stock market's earnings yield (the earnings yield or E/P is the inverse of the well known price-to-earnings ratio or P/E) to current nominal interest rates. Letting Y represent the yield on 10-year Treasuries, the model says we should look at E/P vs. Y, and in its simplest form asserts stocks are cheap when E/P exceeds Y, expensive when Y exceeds E/P, and fairly valued when they 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 the functional form of the relationship.[4] However, whether in complex or simple form, the widespread core belief typified by the Fed Model 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 I study (whether or not it is labeled the "Fed Model"), leaving many of the side arguments and model tweaks to future research.

While not unanimous, there is certainly a broad consensus in much of the non-academic investing community that the basic comparison underlying the Fed Model is valid. For instance, many argue that stocks and bonds are competing assets, so when the yield on bonds falls, so should the yield on stocks fall (and the P/E rise[5]). Others then add the related argument that stock prices are the "present value" of future cash flows, so when interest rates fall, present values rise, and thus so should the market's fair P/E (and its E/P should thus fall with interest rates as per the Fed Model). Finally, in addition to these

[3] To unfairly pick two examples from the print media note two recent Wall Street Journal (WSJ) editorials. The first was entitled "A Buying Opportunity" by Arthur Laffer on July 15, 2002, and the second "The Market's P/E is Low, Not High" by Marc Miles on September 25, 2002. Both argued that the market's still very high P/E was more than justified by low interest rates, leaving stocks not just fairly valued, but dirt cheap. Interestingly, the WSJ ran both of these within 2½ months of each other, despite both these men making the same argument and working for the same firm. One wonders if a less "happy" repeated editorial would fair as well...

[4] I have seen the Fed Model presented in both the form of a difference (E/P - Y) and a ratio (E/P ÷ Y). I focus on E/P – Y. I will ultimately argue that the difference, E/P – Y, makes little economic sense. However, at least there was hope. The ratio is just patently silly, in particular at extremes where it most radically differs from the difference. In general, the logic and the statistical tests in this paper differ little if I replaced differences with ratios.

[5] I will probably throw in many more of these condescending parenthetical statements making clear that P/Es are the inverse of E/Ps, but sometimes I'll just use P/E and E/P interchangeably, hoping to get the sign right myself, and trusting the reader to reciprocate as needed. Long-term WSJ readers please also note that bond prices move in the opposite direction from interest rates.

theoretical salves, the more quantitative Fed Model supporters can show us that historically (at least for the last 30-40 years) stock market P/Es and interest rates have indeed tended to move together, with P/Es being reliably higher when interest rates are lower and vice versa, exactly as the Fed Model would augur. These arguments, and the ensuing conclusion that the Fed Model (or something very similar) is valid, are widely believed, often seem to drive market behavior, and are repeated as truth daily by a legion of strategists and media seers.

Of course, now is the time for the rub. While there are no bright line answers to a question with many dimensions, for most intents and purposes the above "common sense" arguments are wrong, and the Fed Model is fallacious as a tool for long-term investors. Essentially, I argue that the comparison of E/P to Y is erroneous as it compares a real number (P/E) to a nominal one (Y). The important observation is that the stock market's P/E does not have to move with inflation as the nominal earnings of companies already do so. I next show empirically that the facts back up this theory. Investors looking to forecast future long-term stock returns would do better to rely on simple P/E, or the like, rather than the Fed Model.[6]

While the Fed Model fails as a predictive tool for future long-term stock returns, I find more success for it as a descriptive tool for how investors choose to set P/Es. Applying a relationship studied in Bernstein [1997, 2002] and Asness [2000] I show that investors do in fact set current market E/Ps as a direct function of nominal interest rates. However, the relationship is subtle, as it must be conditioned on the perceived volatility of stocks and bonds. Without conditioning on perceived volatility, the simple Fed Model is a failure, even for only description, over 1926-2001. On the other hand, with conditioning on volatility, the Fed Model cleanly explains the puzzle of why the relative yield on stocks and bonds has varied so greatly over the last century.

Note the seeming contradiction, and potential confusion, in my assertions. I first argue that the Fed Model is theoretically flawed and, consistent with this, is a poor forecaster of long-term future stock returns. I then turn around and argue that the Fed Model, if properly adjusted for changing perceptions of stock and bond market risk, is a powerful descriptive tool for how investors actually set stock market P/Es. Am I typing out of both sides of my keyboard? No, these assertions are not contradictory. I show that investors do contemporaneously set P/Es based on nominal interest rates (the Fed Model as explanatory tool). However, I argue that they most probably do so in error, largely because they consistently confuse the real and the nominal (an error often called "money illusion"). Because they do so in error, it is not a contradiction but follows quite naturally that the Fed Model is a poor forecaster of stock returns.

Many pundits confuse these two very different tasks put to the Fed Model. They often demonstrate (each with their own favored graphic or table) that P/Es and interest rates contemporaneously move together. They then jump to the conclusion that they have

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

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 probable investor error (or a strange pattern in investors' taste for risk), it does not justify or recommend that error.

A simple off-topic analogy might be helpful. Say I can successfully show that teenagers *usually* drive recklessly after they have been drinking to excess. This is interesting and potentially useful to know. But, it does not mean that when I observe them drinking to excess, I should then blithely recommend reckless driving to them, simply because that is what *usually* occurs next.[7] Similarly, the fact that investors drunk on low interest rates *usually* recklessly pay a high P/E for the stock market does not make such a purchase a good idea, or imply that pundits should recommend this *usual* behavior.

A current outlook serves as a constructive example. As of the writing of this paper, nominal interest rates are quite low versus history, and, despite a punishing multi-year bear market, the stock market's P/E is still quite high (a P/E of 24 vs. a historical average of about 14-15, using the trend "E" I will use in this paper, not depressed recent earnings). In particular, coming out of recessions / bear markets, it's common to see P/Es in the high single to low double digits, making current P/Es 2x to 3x normal valuations. Traditional modelers note this and declare stocks expensive, but Fed Model advocates are much more optimistic (some very optimistic), noting that today's low inflation / interest rates makes today's high P/E palatable. My findings clearly come down on the side of tradition. I find that a high P/E implies the market is expensive (meaning it offers lower than normal prospective real return) regardless of starting interest rates. In contrast to my rejection of the Fed Model as a tool for long-term investors deciding their stock allocation, my findings do support the Fed Model when used as a descriptive tool. Applying this to today, I find that it is indeed "normal" that investors pay high P/Es when interest rates are as low as today. However, I find that this is likely so because investors "normally" make the error of money illusion, as they are now. In other words, today's low *nominal* interest rates are the hook that gets investors to mistakenly accept high P/Es, and low future *real* stock returns. At times like this the Fed Model is the problem not the solution.

A brief outline of this paper follows. Section II presents the data and terminology I will use. Section III examines the arguments for why P/Es should or should not move with nominal interest rates. Section IV examines the central issue of forecasting power. Section V resolves the conundrum of how and why P/Es and interest rates move together, showing that the Fed Model has power to explain (not to justify) when investors will pay higher/lower stock market P/Es, but this only works over the long term if adjustments are made for changes in perceived stock and bond market risk. Section VI conducts an out-of-sample test on the cross-section of country returns supporting my empirical results for the U.S. Section VII concludes.

II. Data and Terminology

[7] Obviously this is a rather standard confusion of causality with inebriation.

The data used in this paper include:

- Monthly U.S. CPI inflation (continuously compounded).

- Monthly continuously compounded total real (after inflation) return of the S&P 500 and the 10-year U.S. Treasury bond from 1871 through 2001. I will often add up these monthly returns to derive longer term holding period total returns.

- The price-to-earnings ratio (P/E) of the S&P 500 based on 10-year trailing earnings. I take price-to-earnings ratios based on last year's trailing earnings each month and multiply by the S&P 500's price index to determine a monthly earnings-per-share (EPS) estimate for the index. I then divide each EPS estimate by the level of CPI, and average this value over the last ten years to determine a ten-year average real EPS figure for the S&P 500. Finally, I divide the current price index by this average real earnings figure to determine today's P/E ratio. I use ten years of earnings in an effort to smooth out short-term transient fluctuations (following Shiller [2000]). When I say "P/E" in this paper, unless otherwise indicated, I am referring to this measure (a notable exception being my tests on non-U.S. data).[8]

- The yield each month on the 10-year U.S. Treasury Bond (Y).

- Analogous data to the above for each of ten global markets: Australia, Belgium, Canada, France, Germany, Japan, Netherlands, Switzerland, UK, and again the U.S.

All data sources in this paper are, unless otherwise mentioned, the same as those used in Arnott and Asness [2002] and if not used there, Asness [2000]. An exception is this paper's use of international equity data. The source for these monthly country returns, exchange rates, 10-year government bond yields, and P/Es for these countries is MSCI, DataStream, and I/B/E/S.

Throughout this paper I will use the term "Traditional Model" to mean judging the attractiveness of the stock market based on P/E or E/P. Obviously, stocks are more attractive using traditional methods when the market's E/P is higher (P/E lower). I will use the term "Fed Model" to mean judging the attractiveness of the stock market based on the difference between the reciprocal of P/E and the 10-year government bond yield (E/P – Y). Stocks are attractive on the Fed Model when E/P – Y is positive, despite whether P/Es themselves are high or low.

[8] Most commonly the "E" in the Fed Model's P/E is a forecasted one for next year. In this paper I'll use trailing earnings because forecasted earnings are only available for a small fraction of the time period I study. It is difficult to imagine this choice of "E" making a great deal of difference in my specific tests of the viability of comparing E/P to interest rates. Note, in particular, for my international cross-sectional comparisons in section VI I do use the more normal forecasted earnings, and find very similar results to those found over the longer term in the U.S. using trailing 10-year earnings.

III. The Arguments For and Against the Fed Model

The "Common Sense" Rationale for the Fed Model

At first glance the Fed Model simply reeks of 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).

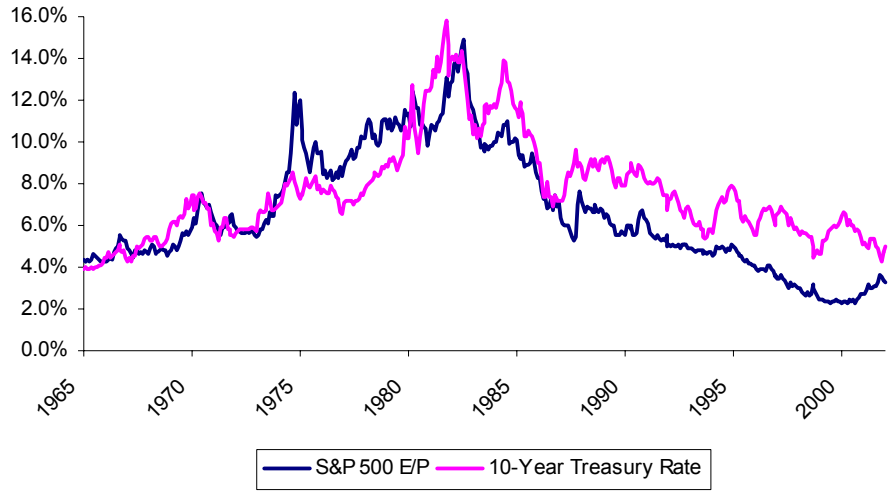
Argument #1 – The Competing Assets Argument
Many reason as follows: E/P, the annualized earnings on stocks divided by the price you pay, is the yield you receive on your equity investment.[9] Y is the yield you get on Treasury bonds (I follow convention and use ten-year Treasuries for this comparison). Investors can invest in either stocks or bonds, and thus they are "competing assets", therefore the comparison of E/P and Y is a valid and important one. When E/P is exceeding Y stocks are yielding more than bonds and are thus cheap, and when E/P is smaller than Y stocks are expensive. E/P = Y is thus the fair value point. On CNBC this logic flows as follows. "Well Maria, 10-year Treasuries are at 4.15%, so the fair E/P on the S&P 500 is 4.15%, so the fair P/E is 1/4.15% or about 24."

Argument #2 – The PV Argument
There is another slightly more sophisticated (though ultimately equivalent) version of this argument. Some correctly point out that the price of a stock today is the discounted present value (PV) of the future cash flows to investors from the company or market in question (this is the famous "Dividend Discount Model" or DDM approach). They argue that when interest rates fall the PV today of future cash flow rises, and thus so do fair P/Es. As an example, imagine the yield on the 10-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 10-year par bond yield is 4%. Well, then the Treasuries "P/E" is now 1/4% = 25. Thus, it would not be surprising to see stocks selling for higher P/Es when interest rates were 4% than when they were 10%, as the "P/E" on bonds is also higher (and again they are competing assets).

Argument #3 – Just Look at the Data
The final argument in favor of the Fed Model is empirical. It seems to work. Below I graph the stock market's E/P and the yield on the 10-year Treasury from 1965-2001:

[9] Actually you get the dividend yield plus other distributions, not the earnings yield, and this distinction is quite important, but I'll not quibble too much at this point.

Figure 1
S&P 500 E/P and 10-Year Yields



Historically E/P and Y have been strongly related (with perhaps a small level shift down in E/P post about 1985). The correlation of these two series over this period is an impressive +0.81. I am far from unique in presenting a graph like figure 1. It's a rare Wall Street strategist that in the course of justifying the Fed Model (or similar analytic) does not pull out a version of this figure, or a table like the following (this time, for variety, vs. inflation instead of interest rates, though the corresponding interest rate table shows a similar relationship):

Table 1
Median S&P 500 P/E
Sorted into Quintiles by Trailing One-Year CPI Inflation

Inflation	Median S&P 500 P/E
1.0% to 2.7%	23.3
2.7% to 3.4%	20.9
3.4% to 4.4%	16.4
4.4% to 6.6%	16.0
6.6% to 13.8%	9.4

I look at every month from 1965-2001 and put them into one of five buckets based on trailing CPI inflation over the prior year. I then examine the median P/E of the S&P 500 in each of these buckets. There is a clear tendency for the S&P 500's P/E to be high when inflation has been low, and vice versa. Again, the conclusion is simple. Historically, low interest rates and/or inflation come hand-in-glove with a low stock market E/P (a high stock market P/E). Tables like this are very common on Wall Street,

with the implicit argument being that high P/Es are fine if inflation is low, as this is "normal".[10]

The logical noose is now completely tight. Common sense tells us that the stock market's P/E should move with nominal interest rates and inflation, and, empirically, looking at 35 or so years of data, they do indeed reliably move together. It appears to be a wonderful marriage of theory and empirics.

Why the "Common Sense" Is Likely Wrong

Not so fast. It is important to review the above pro-Fed Model arguments because belief in them is widespread. However, obviously, I have been setting this ersatz common sense up for a fall.

Let us start with the well-known Gordon Model, which expresses the expected nominal return on the stock market (or an individual stock) as the dividend yield plus the expected growth of dividends:

(1) $E[R_S] = D/P + G_D$

$E[R_S]$ 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. I will use the convention in this paper that capital letters represent nominal (before inflation) values, while lower case letters represent "real" figures after accounting for inflation (e.g., $g_D = G_D - I$, where I equals inflation and g_D is thus approximately the expected "real" rate of dividend growth).

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

(2) $E[R_S] = PAY * E/P + G_D$

Let me make some simplifying assumptions. First, I'll just use 50% for PAY, which is about historical average.[11] Furthermore, let's assume that PAY is constant so the growth rate of earnings and dividends is the same. I can now write (with G_E being the growth rate of earnings which equals G_D):

(3) $E[R_S] = ½ E/P + G_E$

[10] Of course, these tables are nowhere to be found on Wall Street when inflation is high!

[11] The average PAY is actually about 55% but that looks awkward in print. Recent times have seen PAY values considerably lower than historical average. 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). Here I make an assumption that even when firms are not paying out 50% of their earnings they in fact *could* do so but are choosing not to, and are instead husbanding or dispersing these non-paid funds wisely. Note, some (Arnott and Asness [2002], Bernstein [1997, 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), and thus the assumption in the text may be very optimistic when payouts are low (like now). However, this is not core to my study of the relationship between E/P, interest rates, and future stock market returns, and I leave this debate to others.

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

Now, expected real stock returns are (approximately) expected nominal returns minus inflation (which I assume here is a known constant):

(4) $E[r_S] = E[R_S] - I = \frac{1}{2}\, E/P + G_E - I = \frac{1}{2}\, E/P + g_E$

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.

Now, the key question is what happens when expected long-term inflation, and presumably the nominal interest rate, falls? One might, and probably should, expect a 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 equities does not come down when long-term inflation comes down. For instance, if expected nominal stock returns were 10% in a 5% expected inflation environment (5% real), it would not be reasonable to expect 10% in a 2% inflation environment (8% real), rather 7% nominal (still 5% real) is a much more reasonable starting point.

If inflation is going to fall, 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 (i.e., P/Es rise), or G_E fall. Fed model advocates would have you believe that it's the E/P that must change, so when inflation falls, E/P must fall, and P/Es rise. Of course, there is another glaring possibility ignored by Fed Model fans. Instead of E/P (and P/E) moving, G_E can move to partly or completely offset changes in inflation. In fact, simple economic intuition argues that this is by far the likely scenario. Imagine a known permanent instantaneous shift in expected inflation.[12] Is it not plausible to believe that nominal revenue and expense growth move by the same amount (after all, is that not inflation?), and that long-term G_E moves 1:1 with the change in expected inflation? For instance, when expected inflation is very low (like in 2002), does it not make sense that pricing power is low (for both firms and labor), and profits grow more slowly in nominal terms? If inflation stays low doesn't this make sense for the long term? Put 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? Finally, is it remotely possibly I could type something non-rhetorical?

It would be nice to use history as a guide to answering these questions. However, examining the historical relationship of expected long-term inflation and nominal earnings growth is not simple. First, one does not get to observe many long-term periods, and second, inflation expectations are not directly historically observable. However, one

[12] One can argue with this assumption of a permanent instantaneous shift in expected inflation. However, 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.

can easily observe actual realized inflation and actual nominal earnings growth. The following regression 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. I estimate this regression from 1926-2001 (t-statistics in parentheses[13]):

(5) Nominal Earnings Growth = 2.2% + 0.94 * Inflation, R-squared = 36.5%
(2.13) (3.55)

Over the most commonly studied "Ibbotson" period (1926-2001) 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 earnings' variation. If one examines this relation over only more recent periods (losing a lot of data) this relationship gets weaker.[14] However, even over shorter test periods there is always a strong positive relationship (i.e., higher/lower inflation comes with higher/lower nominal earnings growth). Furthermore, while one might expect nominal earnings growth to vary 1:1 with *expected* inflation, one would expect a smaller coefficient than 1.0 for the *realized* inflation tested in equation (5). This is because *realized* inflation contains both expected and unexpected inflation, and it's easy to believe that volatile unexpected inflation, often associated with bad or uncertain economic outcomes, and particularly when associated with supply shocks (e.g., the oil embargo of the early 1970s) would not necessarily be associated with 1:1 moves in nominal earnings.

The empirical results support the idea that inflation largely flows through to nominal earnings growth. However, the simple thought experiment is still more convincing. If the level of long-term expected inflation shifts, it appears to be simple common sense that the level of expected long-term *nominal* earnings growth would change with it. In fact, a belief that expected nominal earnings growth is independent of expected inflation is very strange (there is a reason we call it "nominal" earnings growth). 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 hedge for long-term inflation. This conventional wisdom is equivalent to believing 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 as opposed to nominal bonds. A pundit who believes in the Fed Model, but also believes equities are a good long-term inflation hedge, is not being consistent.

As one final example, consider that if equities have an analogy to bonds, it is probably to floating rate bonds not fixed rate bonds. If inflation and nominal interest rates fall, nominal returns on equities must also fall. But, like a floating rate bond, which typically trades near par[15], equity prices do not have to fall (i.e., P/Es don't need to change).

[13] All t-statistics are adjusted for overlapping observations where appropriate. All R-squared values are adjusted for degrees of freedom.
[14] Asikoglu and Ercan [1992], in a related study, find a 73% flow through from inflation to nominal earnings for industrial stocks from 1974-1988, with considerable variation by industry. Leibowitz and Kogelman [1993] also discuss this issue in depth.
[15] Barring credit concerns or caps/floors.

Rather, their floating rate "coupon" changes with inflation. In this case that floating rate "coupon" is earnings growth.

By no means am I the first to make this point. For instance, Siegel [2002] says the following:

> It is true that bonds are the major asset class that competes with stocks in an investors' portfolio, so one might expect that low interest rates would be favorable for stocks. But since in the long run low interest rates are caused by low inflation, the rate of growth of earnings, which depends in large part on the rate of inflation, will be lower also. Over long periods of time, changes in the inflation rate cause changes in earnings growth of the same magnitude and do not change the valuation of stocks.

In addition, there is a scattered history of others who have noted that the Fed Model (or, more generally, comparing stock yields to bond yields) is erroneous.[16] However, the continued prevalence, popularity, and widespread popular acceptance of the Fed Model indicate that this dissenting view is losing in the court of public (and pundit) opinion!

Let us now reconsider the specific "common sense" arguments in favor of the Fed Model in light of these counter-arguments.

Argument #1 – The Competing Assets Argument
Argument #1 was that stocks and bonds are competing assets and thus should yield the same (and when they do not, stocks are either cheap or rich). This is not common sense at all. The "yield" on the stock market (E/P) is not its expected return.[17] The nominal expected return on stocks should, in all likelihood, move 1:1 with bond yields (while possessing a risk premium). But, this is accomplished by a change in expected earnings growth, not changes in E/P.

An example might help. Say the market's P/E is 12.5, the nominal bond yield is 8%, inflation is 6%, and expected real earning's growth is 2% over inflation (a bit over historical average). Expected nominal earnings growth is approximately 8% per year (6% inflation + 2% real growth). Using equation (3) we see that the stock market's expected nominal return (again using a 50% payout ratio) is ½ E/P + G = ½ * 1/12.5 + 8% = 4% + 8% = 12%. Thus, stocks have a 4% expected return premium over bonds (12% vs. 8%), and a 6% return premium over inflation (12% vs. 6%). Now, let's say long-term expected inflation and bond yields both suddenly fall by 5%. Inflation is now

[16] Perhaps most notably, Modigliani and Cohen (1979) made this point in somewhat the opposite environment to recent times. They observed that in the late 1970s investors were using the Fed Model (though they didn't call it that) and wrongly pricing equities to a very high E/P (low P/E) because interest rates / inflation were high (in particular Modigliani and Cohen examined investors confusion of the real and nominal, and also the accounting system's failure to accurately reflect capital gains and losses to levered firms from changes in inflation). Effectively, using this logic, they predicted the bull market of the 1980s and 1990s. Not too shabby. 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" (what they call the "capitalization error").

[17] In fact, again, E/P is not even the yield! That honor belongs to the dividend yield (D/P) augmented with other cash distributions. E/P is the yield on stocks only in the magical world where reinvestment in the firm is not required.

1% and bonds are now yielding 3% (note that real bonds yields stay the same at 2%). Expected nominal earnings growth is inflation plus real growth or 1% + 2% = 3% (assuming, as I argue above, that expected real growth is independent of the long-term inflation level). Again using equation (3), expected nominal stock returns are now ½ * E/P + 3%. To garner the same 4% over bonds they used to have, stocks need to return the bond yield of 3% plus 4%, or 7%. Solving ½ * E/P + 3% = 7% leads to an E/P of 8% and a P/E of 1/8% = 12.5. But, this is the same P/E we started with! Any P/E higher than this (certainly the Fed Model's new assumed fair P/E of 1/3% = 33.33) implies that the stock market's expected nominal return falls more than bonds (and in the case of a P/E of 33.33 far more). This makes little sense if stocks and bonds are "competing assets", but is assumed to happen every day by Fed Modelers.

Argument #2 – The PV Argument

The argument is that when inflation / interest rates fall, the PV of future cash flow from equities rises, and so should their price (and thus their reasonable P/E). It is true that *all-else-equal* a falling discount rate (rising discount factor) raises the current price. However, all is not equal. If, when inflation declines, future nominal cash flow from equities also falls, this can offset the effect of lower discount rates. Higher discount factors are being applied to lower expected cash flows.[18] The typical "common sense" behind the Fed Model ignores this powerful counter-argument.

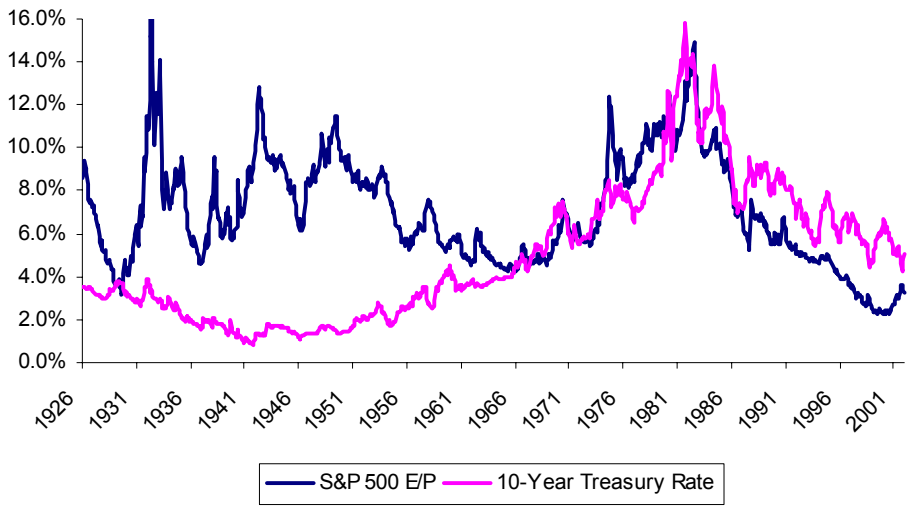
Argument #3 – Just Look at the Data

Recall figure 1 and table 1. Historically, when interest rates / inflation are low so too is the stock market's E/P 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 make a serious logical leap. They assume that because they show that P/Es are *usually* high (low) when inflation / interest rates are low (high), than the Fed Model is necessarily a reasonable tool for long-term asset allocation decisions. This is not the case. If investors *mistakenly* set the market's P/E as a function of inflation and/or nominal interest rates, then table 1 and figure 1 are documenting this error, not justifying it. There might be comfort in making the same error as everyone else seems to usually make, but not truth or prosperity. I will return to this issue. However, for now, let's ignore this logical broadside. Even if one accepts figure 1 and table 1 as evidence in favor of the Fed Model, a longer-term historical examination reveals very different results. Figure 1 was from 1965-2001. Let's look at this same data over the longer 1926-2001 period:

[18] Note, this is not a criticism of the Dividend Discount Model, but rather of those who would casually change discount factors without changing expected future dividends. Sometimes the DDM is mistakenly confused with the idea that stock prices should be higher when nominal interest rates are lower. That is one part of the DDM, but so is forecasting dividends! If the future dividends being discounted change (which I argue they would) with expected inflation, the DDM does not necessarily imply prices go up if rates fall. For an excellent discussion of the DDM, and many of the issues in this paper, that does not make this mistake, please see Ilmanen [2002].

Figure 2
S&P 500 E/P and 10-Year Yields



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, from 1926-1965 E/Ps were almost uniformly substantially above 10-Year Treasury yields, but from 1965-2001 E/Ps were generally a bit below interest rates. Obviously something happened between the early and later periods that made the simple Fed Model comparison break down.

In fact, if one simply compares E/P to Y, and is bullish when E/P is above Y, then one was almost always bullish from 1926 through the late 1960s, mixed until the mid to late 1980s, and uniformly bearish since then. If, instead, one compares E/P - Y to its average through history to decide if stocks are rich or cheap then one has been bearish even longer, and very bearish during the entire 1982-2000 bull market. Clearly, if one is unwilling to simply dismiss the 1926-1965 data, then the simple version of the Fed Model is dealt a serious blow.

I'll get back to resolving this conundrum (why are E/P and Y so strongly correlated over the latter period but relatively un-related over the long-term?, and why has E/P been consistently lower versus Y in recent times than over the earlier days?). For now, let's just say that both sides, pro and con on the Fed Model, can find solace in the historical relation of E/P and Y depending on the length of time period they prefer to examine. Thus, even if it was a valid metric to judge the Fed Model on, the empirical history of E/P and Y settles little.

Other Reasons Inflation Might Matter

Now, forgetting the battling "common sense" approaches above, there are some other reasons inflation might matter to P/Es. Note, the potential impact of each of the below is cumulative and possibly offsetting.[19]

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 larger 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.

If inflation is induced by supply shocks (again think OPEC in the early 1970s), and not a general monetary phenomenon, then it is not reasonable to believe corporate earnings will keep up with price levels. Of course, one might guess that any such shock would likely be temporary.

Inflation can distort corporate earnings. Depreciation is done at historical cost, and in inflationary times, cost of replacement is generally larger than recorded depreciation charges, causing reported earnings to be overstated versus real costs. When earnings are overstated, all else equal one would expect a lower P/E ratio (higher E/P) on reported earnings (i.e., the true P/E is normal but since "E" is overstated the P/E looks lower, or put another way, reported earnings are of lower quality than normal and thus fetch a lower P/E and higher E/P). This is, of course, supportive of the Fed Model assertion that E/P and inflation / interest rates are positively linked, though for different reasons than 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 large costs are again understated and earnings again overstated.

Interest costs go the other way. When inflation / interest rates are high, accounting methods overstate the cost of any short-term financing, as even though this financing may, in real terms, be no more expensive than normal, nominal cost goes up. Siegel [2002] discusses these issues in a bit more detail, noting that it's difficult to assign a magnitude to this effect, and that it will affect firms differently depending on their leverage and the maturity structure of their debt. Similarly, for firms with long dated nominal liabilities, accounting earnings fail to recognize the gain to shareholders from the reduction in real value of these liabilities in the face of rising inflation. Thus, earnings are understated along this dimension at these times.

Additionally, historically, higher (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 more macro economic and political uncertainty and difficulties that have often come with very high or low inflation. This can lead to an effect where investors demand a high risk-premium when inflation is high, and thus high

[19] These points are not original. In particular, I've drawn heavily on Siegel [2002], Ritter and Warr [2002], and Modigliani and Cohn [1979].

inflation is associated with high required real stock market returns (high E/Ps and low P/Es). Most of this paper will interpret the fact that expected *real* stock returns move with inflation / nominal interest rates as a sign that investors suffer from the error of "money illusion" (wrongly comparing a real to a nominal quantity). However, as often is the case in finance, 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 (set lower P/Es and higher E/Ps) when inflation is high. Once again, the battle between proponents of efficient and inefficient markets is left unresolved!

In summary, there are quite a few reasons why real world inflation might matter to P/Es. Importantly, none of these closely resemble the most common reasons publicly put forth to support the Fed Model (arguments #1 through #3 above). Obviously, the net sign and magnitude of all of the above effects is unknown[20], and thus testing the Fed Model becomes an empirical issue, with the added implication that the answer may be partial (i.e., perhaps Y affects the level of permissible E/P but not 1:1 like in the Fed Model).

IV. Forecasting Returns

I have, so far, presented the popular "common sense" in support of the Fed model, then the counter-case, ending with some real world complications that would make the Fed Model's efficacy an empirical issue, even if the theory were not in contention. Now, I let the data decide, testing which has historically been a better tool for investors looking to forecast real stock returns: raw valuation (P/E or E/P) or the relative valuations of the Fed Model (E/P - Y). This is indeed an acid test as most users of the Fed Model are implicitly employing it for this purpose, to advise long-term investors on when stocks are more or less attractive ("under" or "over" valued in Wall Street speak).

I run regressions where the left hand side is the real return on the S&P 500 over either a one-year, ten-year, or twenty-year horizon. The right hand side is alternatively the E/P of the S&P 500, the E/P of the S&P 500 minus the 10-year Treasury Bond yield (i.e., the "Fed Model"), or both the S&P's E/P and the 10-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 it 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 1:1 ratio of the Fed Model. Thus, we can learn additional information from the bivariate regression.

I run these regressions over different time periods, and using different forecasting horizons. For forecasting one-year returns I run the regressions over 1881-2001, 1926-

[20] 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 backwards. Furthermore, Ritter [2002] clearly interprets this as evidence of a market error (not a rational variation of the risk premium).

2001 (the classic "Ibbotson" period), 1955-2001 (the "modern" period where interest rates have been freely floating), and the latest 20 years ending in 2001 (the great bull market that, for many of us, has shaped so much of our knowledge of financial markets). For 10-year horizon returns I eliminate the most recent period (it would involve a regression with 20 years of data forecasting rolling 10-year returns!), and for 20-year returns I also eliminate the 1955-2002 period (for similar reasons).

Let's begin with an examination of forecasting regressions for 10-year real S&P 500 returns. Table 2 below contains the results of nine regressions. Each row represents a different regression, with t-statistics in parenthesis (again, adjusted in each case for overlapping observations). A row containing only values for E/P or E/P - Y represents a univariate regression, while a row containing values for both E/P and the 10-Year Yield represents a bivariate regression.

Table 2
Forecasting Ten-Year Real S&P 500 Returns

Date	Intercept	E/P	Y	E/P - Y	Adj. R-Squared
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%

An example should make the above table clearer. The first row in the table shows that a monthly regression from 1881-2001 of overlapping ten-year S&P 500 real returns on the starting E/P of the S&P 500 finds an intercept of -0.8% (t-statistic of –0.43), a coefficient of 0.95 on starting E/P (t-statistic of 5.66), and an adjusted R-squared of 30.2%.

Essentially, the message of this table is simple, and is perhaps the tag line of this paper. At modestly long horizons (ten years in this case), the Traditional Model (E/P alone) has strong forecasting power for real stock market returns, while the Fed Model is wholeheartedly rejected. Expected real ten-year returns are higher the higher is starting E/P (the lower 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 power over the earlier periods, but clearly that is only because E/P is part of E/P–Y. When E/P and Y are tested together, E/P matters, and the Y part of the Fed Model is ignored (with the wrong sign over 1955-2001).

10-years is my preferred period for examining long horizon returns (there is a balance needed between a desire to lengthen time horizon to better approximate the truly relevant

long-term vs. a loss of multiple independent data points). However, I next repeat the analysis on 20-year holding periods.

Table 3
Forecasting Twenty-Year Real S&P 500 Returns

Date	Intercept	E/P	Y	E/P – Y	Adj. R-Squared
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%

Essentially, this replicates the 10-year evidence with even higher R-squareds (Arnott and Bernstein [2002] found a similar result for 20-year horizons). In particular, over the Ibbotson period (1926-2001) the power of simple E/P to forecast 20-year stock returns is truly impressive. Now, at first glance, it again appears I have found some supporting evidence for the Fed Model with E/P - Y coming in with a 2.30 and 2.78 t-statistic over the two respective time periods. However, again, this occurs again only because E/P - Y is a noisy proxy for E/P. When I test E/P and Y together in one regression, it's quite clear that Y adds little. Y does have the hypothesized negative sign. However, over both time periods its coefficient is roughly $1/6^{th}$ of that predicted by the Fed Model (i.e., the Fed Model predicts equal but opposite sign to the coefficient on E/P), and is not statistically relevant.

Finally, let's look at shorter horizon returns, replacing the left-hand side of the regression with rolling one-year real returns.

Table 4
Forecasting One-Year Real S&P 500 Returns

Date	Intercept	E/P	Y	E/P – Y	Adj. R-Squared
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%

As shown by others (e.g., Fama and French [1988]), at shorter horizons R-squared values fall dramatically. 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, market timing is hard.

Looking at the longest horizons (1881-2001 and 1926-2001) I find 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's a poor man's E/P. The marginal power of including Y is nil. Next, looking at 1955-2001 I find the stuff of an efficient market fan's dreams. Basically, nothing has forecasting power for short-horizon returns over this period.

Now, only by looking at the recent 1982-2001 bull market do I finally find some support for the Fed Model! No specification has a very high t-statistic (this is too much to ask of 20 year regressions), but R-squareds are high (for one-year forecasts) and in a bivariate regression I find the coefficient on Y to be negative and about 2/3 the size of the positive coefficient on E/P (i.e., 2/3 of the way to the Fed Model). Now, one could dismiss this result as a lone victory won over a short period, for low R-squared market timing, for the Fed Model in a sea of losses vs. traditional methods. This dismissal is probably warranted. However, the results can be discounted on more substantive grounds. An issue with all regressions is that they must fit two statistical facts at once. First, they must fit how the right and left-hand side variables co-vary, but second, they also must fit the mean return of the left-hand side variable over the period in question. This is not a problem as the regression's constant intercept mechanically adjusts to match means. However, it is a problem for interpretation, particularly over short periods with large absolute value intercepts. Look at the large intercepts for the 1982-2001 regressions in table 4, particularly for the test of the Fed Model (E/P - Y). The intercept is incredibly high (approximately 20% per year). Essentially, what this regression is telling us is that if we already new that equities would do well over this period, the Fed Model would help explain intra-period variation. The utility of this is dubious. As mentioned earlier, E/P - Y has been below zero and below its long-term average for most to all of 1982-2001. Thus, if the Fed Model had been used this whole period to decide whether to be in stocks or not (and not just to vary the degree of bullishness) we would presumably see quite a different result. Casual observation of Wall Street research shows that many note the recent correlation of E/P - Y with future short-term returns as support for the Fed Model's power. However, few note that one would have to know that 1982-2001 was going to be a bull market before this correlation becomes useful.[21]

All considered the only support I find at all for the Fed Model is in forecasting short horizon returns. This support comes with low R-squared, only occurs over the recent bull

[21] While beyond the scope of this paper, Asness [2000] shows some short-term forecasting success for a modified Fed Model that incorporates the information in the volatilities of stocks and bonds (discussed in section V.). Short-term, if people follow the "Fed Model", adjusted for volatility, and return to it when they deviate, it can have some forecasting power even if the model is based on errors. Asness [2000] shows that this is indeed the case (at least for the improved version of the Fed Model studied in that paper). However, note, nothing produces very high R-squared values at short horizons. The long-term, at which the Fed Model is a failure, is far more important to investor wealth, and the main focus of this paper.

market from 1982-2001, and is only useful if you already knew stocks were going up but wanted to gauge just how bullish to be. In contrast, I generally find strong power for raw valuation (the Traditional Model) in forecasting long-horizon real stock market returns. The obvious consequence is that when P/Es are high (low), forecasted 10+ year real stock returns are low (high), regardless of starting interested rates and the Fed Model.

Forecasting Stocks, or Stocks Versus Bonds, And a Bit of a Current Market Outlook

In this paper I focus on forecasting future real stock returns, strongly finding in favor of tradition versus the Fed Model for this task. I do not focus on the issue of forecasting relative (stock vs. bond) returns. Simple economic intuition, and the findings of others (e.g., Arnott and Bernstein [2002]), shows 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, a strong candidate to forecast future stock vs. bond returns (there is no distinction between real and nominal as inflation effects both assets) would be E/P (which forecasts real equity returns) minus the current real bond yield, or E/P - [Y-I]. The Fed Model specification of E/P – Y can be rejected on first principles, even for the task of relative value.[22]

Let's leave aside this verdict of mis-specified for a while. An interesting practical question is simply, what do Wall Street pundits think they are forecasting with the Fed Model? When Wall St. pundits 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.[23] However, "less bad" is clearly an inferior sales pitch...

At the risk of dating this paper, as a case study let's look at markets as of the writing of this paper (8/31/2002). An investor is currently faced with a ten-year Treasury yield of about 4.15%, a real Treasury Bond (TIPs) yield of about 2.5%, and a P/E on the S&P 500 of about 24 (with an E/P of 1 ÷ 24 = 4.17%). Thus, by comparing the stock market's E/P to the Treasury yield of 4.15%, a Fed Modeler deems the stock market fairly valued.

Now, if firms pay out (or could pay out) ½ those earnings to investors you get about a 2% return (½ of 4.17% would be a dividend yield of around 2%).[24] Next, tack on another 2% in real earnings growth (somewhat more than long-term historical average).[25] Finally,

[22] Note, Y is positively correlated with Y-I. For instance, I form a measure of real bond yield by taking the 10-year Treasury yield and subtracting rolling 5-year annualized inflation. The correlation of the nominal 10-year yield with this real yield from 1955-2001 is 0.52. Thus, spuriously, you would expect the Fed Model to have forecasting power for long-term stock vs. bond returns going forward, which perhaps explains its usage for this task.

[23] 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.

[24] Recall that this is an optimistic assumption that ignores the evidence of Arnott and Asness [2002]. On the other hand, I am using a 10-year average E to calculate P/E, and thus my E/P will be biased down a bit versus a one-year trailing E/P (on average about 10%). Also, note that one criticism of using dividend yields, that it ignores share repurchases, does not apply here as I'm calculating what firms *could* pay out in any form.

[25] Some, circa the writing of this paper, are forecasting very large near-term earnings growth as current earnings are extremely depressed versus history. This paper works with normalized (10-year) earnings, so near term forecasts of

assume you believed economists forecasts of future inflation in the 2-3% range. Using these figures, a rational forecast for long-term nominal stock returns is about 2% + 2% + 2-3% or about 6-7% nominal. This is 4% over inflation, about 2-3% over nominal bonds, and, comparing real returns, about 1.5% over real Treasury Bonds (TIPs).[26] All of these are lower or far lower than corresponding historical return averages.

This estimate of 6-7% nominal return, or 4% real return, is for a *very* long-term investor (one who owns all the future cash flows from equities and never sells). What about returns over the next ten years? Unlike infinite horizon returns, decade long returns are highly sensitive to the change in P/E from start to finish. Let's look at table 2. Plugging in a 24 P/E to the 1926-2001 fitted equation using only E/P, I find a forecasted 10-year real return for the S&P 500 of about 2.5% (this is indicative of the forecasts that come out of the other models I test that showed statistical power). This is approximately equal to the real return you can lock in by purchasing real Treasury Bonds (TIPs). In other words, the forecasting model from table 2 is predicting a zero realized equity premium versus TIPs for the next decade, and this comes after a devastating 2½ year bear market for stocks.[27]

Presumably, when Wall Street pundits declare stocks fairly valued, or under valued, they mean that they are as attractive, or more attractive, than usual. That is clearly not the case in this example. It is not true for the stock market's expected real return (whether based on the *very* long-term forecast of 4% or the decade-long forecast of 2.5%). It is not true for stocks relative expected return versus bonds. While stocks are expected to beat bonds, it is by narrower margins than historical experience. However, instead of saying this, a legion of equity bulls go on CNBC, note how low nominal bond yields are, fail to note that this is largely a function of low inflation, also fail to note the consequences of this for nominal profit growth, pull out the fallacious Fed Model, and call stocks fairly valued. Some even go much further than this declaration of fair value. By using a combination of giant inflated assumptions for E in E/P (using "forecasted" "operating" "2003" earnings), then tacking on the fallacious Fed Model, some very bullish pundits currently declare stocks 30-40% undervalued.[28] To use a technical term here, that is just nuts.[29]

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earnings growth are not relevant, as effectively I assume we've already jumped to trend earnings, perhaps again actually leading to some over-optimism in my forecasts.

[26] If you want to be very optimistic indeed, also add another 1% because of a belief that future growth will be better than we have seen in the past, perhaps based on productivity improvements (which have historically had very little effect on EPS growth). Why you would perform this optimistic adjustment is between you, your broker, and your own higher power.

[27] The difference between this regression estimate of 2.5% and the very long-term estimate of 4% comes down to an implicit forecast, based on historical evidence, that P/Es mean revert over decades when they begin the decade very high or low. Mean reversion over the next decade is not a certainty. Some argue forcefully (e.g., Siegel 2002) that P/Es might justifiably remain permanently higher than historical average.

[28] I have left out the names to protect the guilty, but it's interesting to dig a little deeper into how the extremely bullish pundits came to their conclusion. Well, using "forecasted" "2003" "operating" profits they found the P/E to be about 16 (instead of the 24 Shiller P/E we used), and the "P/E" of the 10-year Treasury to be about 24 (1 divided by 4.15%). Thus, stocks would have to rise about 50% for "fair value" to be restored. It is difficult to catalogue the number of fuzzy ideas that go into this belief in massive undervaluation. There is the basic confusion between nominal and real, the fact that even if E/P should be compared with nominal rates there is no reason E/P = Y is "fair value", and then there's the giant silliness of using a 1 and 1/2 year ahead "forecast" of "operating" (i.e., excluding bad things) earnings. In particular, these operating earnings forecasts are brought to you by those Panglossian prognosticators who put a

What are the consequences of such wrong-headed declarations? Consider the small investor[30] who might hear pundits say stocks are "fair" or "cheap" based on faulty Fed Model logic. It seems reasonable that they might take this to mean the stock market's prospective real return is favorable when compared to history. Someone who retires, assuming "fair" or "cheap" means equities will perform up to or exceeding their historical standards going forward, and budgets accordingly, is potentially in for real trouble.

V. How P/Es and Nominal Rates Really Move Together

The above evidence makes it clear that if one's goal is to forecast long-term real stock returns, traditional valuation (P/E) is what matters, not the Fed Model. However, a conundrum was left unresolved. From roughly 1965-present the Fed Model has indeed been a startling empirical success at determining what P/Es investors actually will pay for stocks (i.e., in figure 1 the stock market's E/P moves nearly 1:1 with Y). A model that can explain how investors price stocks is interesting, even if only documenting consistent investor error. Recall that this neat story from 1965-present was ruined by the longer-term data. The conundrum I seek to resolve now is why for the last 35 to 40 years stock market E/P and bond market Y are highly correlated, but this correlation vanishes over longer data, and the related puzzle of why investors demanded stocks yield more than bonds for the first half of the century, but less than or equal to bonds in the second.

An answer comes from applying the models examined and discussed in Bernstein [1997, 2001] and Asness [2000]. They argued that the simple Fed Model, even used only as a tool to document investors' error of money illusion, leaves out a crucial variable, the changing perception of risk. Why would one assume that the error always takes the form of demanding E/P = Y? Should not investors demand more from stocks when they perceive stocks to be riskier versus bonds, and vice versa? Asness [2000] specified a functional form for this relationship and fit parameters to this model. I follow this here (using a slightly simpler, though highly analogous, specification):

(6) $E/P = a + b * Y + c * \sigma_{stocks} / \sigma_{bonds}$

The motivation for equation (6) is as follows. Even if investors erroneously move E/Ps with nominal rates, assuming E/P = Y is arbitrary. Let's generalize this in two ways. First, E/P does not have to equal Y, rather E/P can be any linear function of Y; i.e., E/P = a + b * Y. Given that I am asserting that any relation between E/P and Y is at least partly, and perhaps entirely, due to investor error, it seems a small leap to believe that this

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$400 "price target" on shaft_the_litte_guy.com in 1999 (and switched it to "underweight" in 2002). But, at least their kids can now get into fancy private schools.

[29] If 1999-2000 taught us anything, it's that someone will say anything for a buck, then someone will publish it, and then someone will believe it. Note, in 1999-2000 both the Fed Model and traditional methods were showing equities to be criminally overvalued, yet somehow many of the strategists who now love and endorse the fallacious Fed Model managed to be remain bullish at that time (to be fair, some of course were not).

[30] The term "small investor" might actually be too limiting considering the equity return assumptions still being made by some of the countries' largest pension funds.

erroneous relationship might not be fit perfectly by the Fed Model's implicit a = 0 and b = 1.

Next, if one accepts as a given that investors set the E/P of the stock market as a function of the nominal interest rate (without conceding that they should!), it seems reasonable, that all-else-equal they would demand more E/P for the same Y the riskier they perceive stocks to be compared to bonds. That is, the simple equation E/P = a + b * Y is still missing a key variable. Asness [2000] proxies for what is missing by adding two new terms to (6), the realized historical 20-year volatility of equities and that of bonds.[31] I follow this methodology, though slightly simplified to only one term, the ratio of 20-year historical stock to historical bond volatility. Essentially, $\sigma_{stocks} / \sigma_{bonds}$ is a measure of how much more volatility investors have experienced in stocks versus bonds over the last generation (correspondence to a "generation" is the motivation behind using 20 years[32]). The hypothesis for equation (6) is now that both b and c are positive and meaningful. Meaning that investors do in fact (though the mistake of "money illusion") set E/P as a function of nominal interest rates (i.e., a positive b), but they also require a higher E/P (are willing to pay a lower P/E) when their generation has experienced relatively more volatility in stocks as compared to bonds (i.e., a positive c).

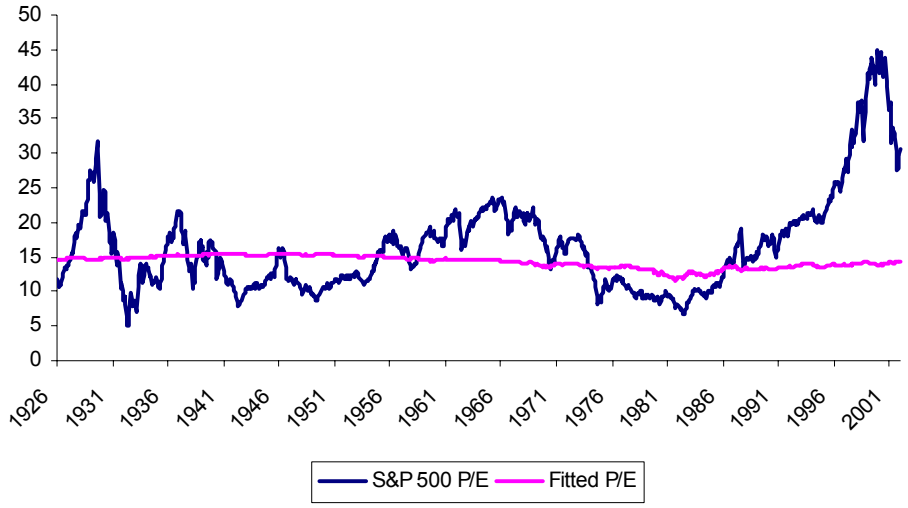
First, let's look at the simple linear relationship without adjustment for volatility. In other words, using monthly data from 1926-2001, let's empirically estimate the equation E/P = a + b * Y.

(7) $E/P = 6.3\% + 0.15 * Y, \qquad R^2 = 3.0\%$
(40.1) (5.42)

Obviously, the correlation is pretty weak (and the t-statistics, even with asymptotic correction, need to be interpreted with great care when the left and right hand side are so slowly changing). To put this in perspective, I form the fitted E/P each month using the equation 6.3% + 0.15 * Y from 1926-2001, inverting to get a fitted P/E, and plot this fitted P/E along with actual P/Es:[33]

[31] Bernstein [1997, 2001] focused on a shorter-term version of volatility than Asness [2000] or this paper.
[32] As discussed in Asness [2000] the relationship is quite robust to using other reasonable time periods for measuring volatility. It is also robust to using other measures of realized risk (e.g., worst cases). Focusing too much on the specific use of 20-year rolling volatility misses the point. Any reasonable measure of investors' realized experience regarding the risk of stocks vs. bonds is effective.
[33] I'm ignoring certain relatively small convexity issues that arise from inverting an estimate of E/P.

Figure 3
S&P 500 P/E and P/E Fitted on Y



Obviously, there is considerable variation in P/Es from 1926-2001 that is not explained by equation (7)!

Now, let's consider estimating the full equation (6) over 1926-2001:

(8) $E/P = -4.1\% + 0.95 * Y + 0.02 * \sigma_{stocks} / \sigma_{bonds}$, $R^2 = 58.1\%$
(-12.9) (32.6) (34.6)

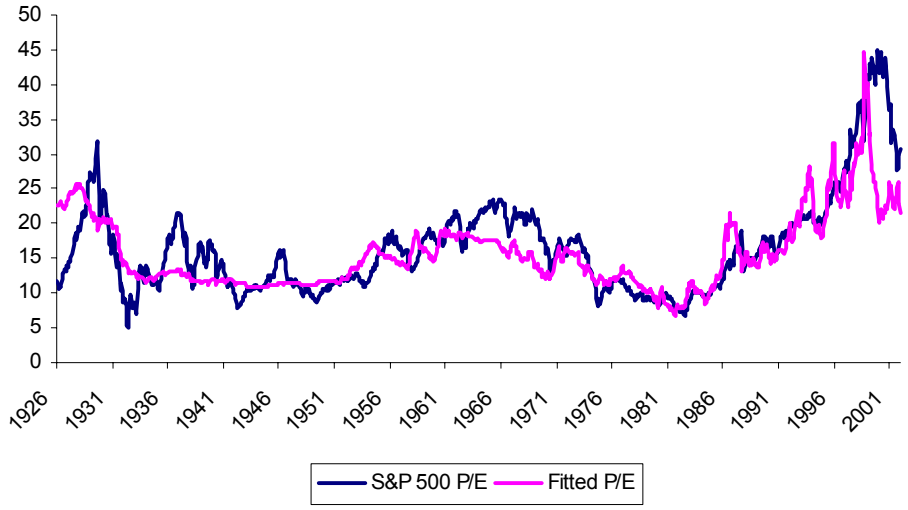
A considerable improvement! Re-running this over the 1955-2001 period (when interest rates were always freely floating) the relationship is even stronger:

(9) $E/P = -6.0\% + 1.11 * Y + 0.02 * \sigma_{stocks} / \sigma_{bonds}$, $R^2 = 78.9\%$
(-18.9) (45.8) (27.5)

$\sigma_{stocks} / \sigma_{bonds}$ is strongly positively related to E/P, and conditioning on this relationship resurrects the relationship between E/P and Y to almost the level expected by the Fed Model (i.e., a 0.95 coefficient) over the entire 1926-2001 period. Once volatility is adjusted for, investors do seem to empirically move stock market E/Ps 1:1 with nominal interest rates. Furthermore, Asness [2000] shows that this relationship, though 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).

Figure 4 below plots historical and fitted P/E again, but this time uses the reciprocal of the E/P fitted from equation (8).

Figure 4
S&P 500 P/E and P/E Fitted on Y and Volatility



This is obviously a pretty good fit! The most notable errors would be the model not fitting the very low P/Es at the start in the mid 1920s, and missing some of the very high P/Es in the bubble of 1999-2000, though much of that spectacular rise was captured. The peak in the fitted series in 1999 was similar to the actual peak P/E, though the fitted series didn't stay there as long (apparently real bubble last longer than fitted ones ☺).

In fact, 1999-2000 is a nice example of the difference between explaining and justifying P/Es. When the fitted series peaked in the 40s in 1999, in no way was it saying that this P/E was a rational one for the S&P 500 (it was not). What it was saying was, "assuming investors act like they have in the past, given how low equity volatility has been vs. bond volatility, and how low interest rates are, such an extreme irrational offensive P/E is to be expected!" The Fed Model, modified for volatility, offered no true solace to a long-term investor buying the S&P at a P/E of 44. But, it did explain why he might be tricked into doing so...

In particular, this model very neatly resolves the conundrum of why E/P and Y are very highly correlated from 1965-2001, but very weakly correlated from 1926-2001, with E/P approximately equal to Y in magnitude from 1965-2001, but generally dwarfing Y from 1926-1965. While interest rates were low in the early part 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 vs. Y, largely to compensate them for their perception of very high equity vs. bond risk. From 1965-2001 stock and bond volatility was more stable and thus the correction of adding volatility was less needed, and thus the model without volatility fits well (figure 1) and E/P and Y appear correlated. These explanations also apply to the analogous puzzle for stock market dividend yields, which have fallen short of bond yields for many years now, but were more competitive in the past.

In sum, 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). However, over a long period like 1926-2001 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, and again probably in error, investors have been following the Fed Model!

Finally, I would note that in this section I document a strong ex ante relationship between investors perceptions of stock vs. bond market risk and their perceptions of stock vs. bond market expected return. A relationship between ex ante expected return and risk is one of the most basic tenets of modern finance. However, empirical searches for such measures have been spottily supportive at best (e.g., Merton [1980] testing ex ante volatility and market return, Fama and French [1992] testing beta, Shefrin [2001] questioning whether investors actually expect/require higher returns from higher risk stocks).[34] Thus, these results are important beyond a simple test of the Fed Model. They show that investors clearly require higher expected returns when they perceive risk to be higher (even if they are not correct about either!).

VI. The International Cross-Sectional Evidence

The above tests all focus on time-series evidence for the U.S. Of course, while I believe they are compelling, those tests suffer from only observing history once, and not observing very many independent long-term periods. I now look at another potentially fertile area for study, the cross-section of countries, hoping to construct an out of sample test of my findings. I examine ten developed liquid countries back to 1987. For each I require the following data:

- Monthly local returns after inflation.
- Forecasted E/Ps (P/Es) each month for each country using I/B/E/S estimates of next year's earnings.[35]
- Starting 10-year government bond yields each month for each country.

For each of the above I gather monthly data back to August 1987 with forecasted P/Es being the binding constraint on going back further. The international data is obviously available for a much shorter time period than the U.S. data. However, while data length

[34] An important exception being the general unconditional finding that riskier assets classes have higher long-term expected returns than less risky ones (e.g., small stocks > large stocks > bonds > cash).

[35] Most popular versions of the Fed Model use forecasted forward earnings to form P/E not the 10-year trailing earnings I use for most of this paper. I use 10-year trailing P/Es for most of this paper because forecasted P/Es are only available for small fraction of the U.S. time series. Again, it is difficult to imagine this making a meaningful difference to tests of whether E/P should be compared to interest rates or not. However, in the case of international tests, the availability of forecasted P/Es and 10-year trailing P/Es is similar, and thus I use forecasted P/Es for these tests. The fact that I find similar results in these cross-sectional tests to my previous time-series tests is comforting.

is limited, you do get something else with international data, the ability to test cross-sectional relationships. I test cross-sectional analogies to my earlier time-series U.S. tests. I first test whether countries with higher interest rates systematically have higher E/Ps (and lower P/Es). That is, I first test how well a cross-sectional version of the Fed Model helps *explain* P/Es.

For each month t I run the following cross-sectional regression on month-end data:

(10) $E/P_{i,t} = \alpha_t + \beta_t * Y_{i,t,}$ where i goes from country 1 to 10

Running regression (10) each month from 8/1987 to 6/2002 yields an average β of +0.67 with an average t-statistic of 2.35 and an average adjusted R-squared of 32.2%. In other words, countries with higher/lower interest rates tend to have higher/lower earnings yields.

I next examine short-term return predictability running the following cross-sectional regressions every month:

(11) $RET_{i,t} = \alpha_t + \beta_{1,t} * E/P_{i,t,}$ where i goes from country 1 to 10

(12) $RET_{i,t} = \alpha_t + \beta_{2,t} * E/P_{i,t} + \beta_{3,t} * Y_{i,t,}$ where i goes from country 1 to 10

$RET_{i,t}$ is the real (CPI inflation adjusted) local return in each country each month. Following Fama and Macbeth [1973] one can interpret the monthly series of estimated β coefficients as returns to zero investment portfolios with unit exposure to each variable in question and zero exposure to the other variables.[36] The t-statistic for $\beta_{1,t}$ is a test of the statistical significance of the average return of a zero investment portfolio of countries formed to maximize exposure to E/P (i.e., long high E/P countries short low E/P counties). The t-statistic of the time-series mean of $\beta_{2,t}$ and $\beta_{3,t}$ represent tests of whether each variable is systematically related to the cross-section of expected country returns, holding the other constant. Put simply, if neither E/P nor Y (alone or in combination) has power to forecast the cross-section of country returns, we expect insignificant t-statistics. If E/P has power but Y does not, we expect a significant t-statistic for the series of $\beta_{1,t}$ and $\beta_{2,t}$ but nothing on $\beta_{3,t}$. Finally, if the Fed Model has cross-sectional power, we expect a significant positive t-statistic for the series of $\beta_{2,t}$ observations and a significant negative t-statistic for the series of $\beta_{3,t}$ observations. If the Fed Model holds in naïve form (where E/P = Y is the "fair value" point) then we might further expect the average of $\beta_{2,t}$ observations to be positive and equal but opposite in sign to the average of $\beta_{3,t}$ observations.

Running these regressions each month I find an average $\beta_{1,t}$ of 0.19 with the t-statistic of this average 2.57, $\beta_{2,t}$ of 0.21 with the t-statistic of this average 2.62, and an average $\beta_{3,t}$

[36] These real local returns do not lead to investable portfolios from any single countries perspective. Repeating these tests on "currency hedged" returns from a U.S. perspective, which are achievable gross of transactions costs, has no effect my conclusions.

of –0.07 with the t-statistic of this average of –1.00. E/P is clearly a more important variable for forecasting relative country returns than Y. There is some very weak evidence that a scaled down version of the Fed Model is helpful, with Y entering with the Fed Model's hypothesized negative sign (though 1/3 the coefficient of E/P, not 1:1 like in the Fed Model proper). However, unlike E/P, the average coefficient on Y is not statistically significant.

I next examine long-term forecasting power. Due to the short 1987-2002 period, I only have only one data point through time, but unlike the time-series evidence for the U.S., I have a cross-section of ten different countries. Consider the following single regression (note unlike 11 and 12 there are no subscripts for time) :

(13) $RET_i = \alpha_t + \beta_{1,t} * E/P_{i,}$ where i goes from country 1 to 10

Instead of running (13) every month I run it one time for future average annualized real return. In other words, I run one regression with 10 data points where RET_i is the average annualized monthly return on country i from August 1987 to June of 2002, and E/P_i is the earnings yield on country i at the end of August of 1987.
Estimating (13) I find the following:

(14) $RET_{i,t} = -5.73\% + 1.82 * E/P_{i,t}$, R-squared = 86.7%
(-3.36) (+7.73)

Running a similar bivariate regression on both forecasted E/P and starting ten-year yield I find:

(15) $RET_{i,t} = -4.46\% + 1.87 * E/P_{i,t} - 0.20 * Y$, R-squared = 87.3%
(-2.25) (+8.00) (-1.17)

Clearly, whatever long-term predictability exists is driven by E/P. Real returns over the long-term are highly correlated with starting E/P but hardly related at all to starting interest rates. Y is very weakly negatively related to future returns conditional on the same level of E/P. But, the coefficient on Y is less than 1/9 the negative of the coefficient on E/P.[37]

In sum, nominal bond yields help *explain* the cross-section of stock market E/Ps. So, like for the U.S. through time, investors do require higher interest rate countries to have higher earnings-yields (lower P/Es) and vice versa. However, again mimicking the time series results for the U.S., when it comes to forecasting returns, particularly over the long-term, the Fed Model is a failure versus traditional methods. In other words, if you

[37] Excluding Japan from my tests, the R-squared of the univariate E/P regression falls from 86.7% to 43.7% and the bivariate regression from 87.3% to 51.1%. All coefficient signs remain the same, with E/P still significant, and the relative magnitude of the coefficients on E/P and Y in bivariate regressions remains the same. In other words, the long-term results are weaker, but hold up quite well without Japan. Of course, while it's always interesting to know the sensitivity of a regression to influential outlier points, the fact that Japan was selling for a very high relative P/E (low E/P) in 1987 and subsequently had terrible relative returns (despite the low starting bond yields favored by the Fed Model) is a pretty nice data point in the Traditional Model's favor!

are attempting to forecast which countries will relatively outperform over the next 10+ years, go with the low P/E countries, and ignore the Fed Model. This out-of-sample cross-sectional corroboration of the U.S. time series results, along both explanatory and return forecasting dimensions, is very comforting.

VII. Conclusion

The very popular "Fed Model" has the appearance but not the reality of common sense. The lure of this common sense has captured many a Wall Street strategist and media pundit. However, this common sense is largely misguided, most likely because of a confusion of real and nominal (money illusion). Backing up this assertion, I show that the Fed Model has no power to forecast long-term real stock returns. In contrast, traditional methods, like examining the market's P/E alone, have great efficacy.

Now, as opposed to its failure for forecasting long-term returns, the Fed Model seems to be a success at *explaining* 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 30-40 years using the simple Fed Model comparison. However, over the 1926-2001 time-period, it is only apparent when a missing variable, perceived stock vs. bond risk, is accounted for properly. Note, many market commentators confuse this *explanatory* 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 to current investors based on precedent.

All this begs one question. If the Fed Model is mis-specified, and does not work to forecast long-term returns, why is it so popular, particular among Wall Streets strategists and the financial media? I offer a few conjectures:

1) First and foremost it is simple. Sadly, simple wins the sound bite war. If a popular strategist goes on CNBC and says "if bond yields drop so should stock yields", and then I go on, with a much longer and more tedious explanation approximately the length of this paper, Maria is going to give me the hook before I get done with my third sentence.

2) Perhaps strategists are just honestly making the error of money illusion. Comparing real P/Es to nominal interest rates seems to be one of those things that is very obviously wrong, but perhaps only after you've thought about it for a very long time![38] Or, been forced to read a very long-winded paper about it...

3) Perhaps they honestly confuse the Fed Model's explanatory vs. predictive power. While the two are decidedly different things, there is an appealing plausibility to showing that two things have moved together for quite some time, and then

[38] In fact, some strategists have begun their own process of questioning the presumptions behind the simple Fed Model [e.g., Wein (2002)].

assuming that it must have been for good reason. Similarly, there is a great comfort for doing and recommending what is "normal" (i.e., paying high P/Es when nominal rates are low), even when it is a siren's song leading to the rocks.

4) The only period over which I found *any* success for the Fed Model as a forecaster was for short-horizon returns over the bull market of the last 20 years. While even this success is weak, and contingent on a kind of econometric cheating, it is possible that pundits overweight and misinterpret recent bull market experience to the exclusion of economic reasonableness and long-term evidence. It is also possible that everyone talks about the long-term, and pretends to eschew market-timing, but in reality, that is what they practice. In other words, the use of the Fed Model might be both a relative value call, and a short-term one at that.

5) The Fed Model is, and has been for some time, more bullish than traditional methods as P/Es have been high and interest rates low for quite some time. See Bubble Logic [Asness (2000)] for a survey of Wall Street's tortured attempts over the last few years to find logical ways to justify very high stock prices. Or, for that matter, see your 401K statement.

The bottom line: for forecasting real stock returns over long horizons use P/E or some other reasonable measure of valuation without regard to *nominal* interest rates. For forecasting relative stock versus bond returns, compare E/P or the like to *real* bond yields, and then make sure you are disclosing the relative nature of your forecast. If you are trying to *explain* why P/Es are where they are, based on investors behaving in a similar manner to the past (errors and all), then feel free to use the Fed Model (hopefully modified for volatility as per this paper), but do not confuse that with a tool for making long-term recommendations to investors. Finally, if you are using the Fed Model (in any form) to make relatively short-term forecasts, then feel free to continue, but note that this is a *very* difficult task, and make sure that a retiring investor knows that your call of "fair" or "under" valuation does not mean he can plug 1926-2001 type stock return numbers into his long-term worksheet.

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