The Fed Model:
The Bad, the Worse, and the Ugly

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Abstract

The negative relationship between stock market P/E ratios and government bond yields seems to have become conventional wisdom among practitioners. Both limited empirical evidence and a misleading suggestion that the model originated in the Fed are used to support the model's plausibility. This article argues that the Fed model is flawed from a theoretical standpoint and reports evidence from 20 countries that seriously questions its empirical merits. Despite its widespread use and acceptance, the Fed model is found to be a failure both as a normative and as a positive model of equity pricing.

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1. Introduction

Most practitioners like simple models. The valuation of stocks and equity markets, however, does not seem to lend itself to such models. But hope springs eternal and simple frameworks like the Fed model give investors hope. Some investors are lead to believe that by simply comparing two numbers, earnings yields and bond yields, they can easily determine whether the stock market is mispriced. Even worse, some are even lead to believe that such a simple comparison is the shortcut to abnormal returns.

A good model has to meet two conditions. First, it must follow from a solid theoretical framework; and second, it must be validated by the data. A third condition, simplicity, is essential if the model is to be adopted and widely used by practitioners. A case in point is the CAPM, the standard model used to estimate required returns on equity, which is simple, follows neatly from a theory of utility maximization, and is to a large extent supported by the data.[1]

However, a simple model that has questionable theoretical underpinnings and little empirical support is simplistic rather than simple. And when such model is widely used by practitioners it becomes dangerous, not just simplistic. The evidence from 20 countries reported in this article leads to the conclusion that the Fed model belongs to this category.

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[1] The empirical evidence on the CAPM is mixed, to be sure. Fama and French (2003) provide an overview and assessment of the last 40 years of evidence and controversy on this model.

The main arguments in this article can be briefly summarized as follows. First, the Fed model is flawed, or at least implausible, from a theoretical standpoint. Second, the evidence based on forward P/Es lends very little support to the model: Deviations from the proposed equilibrium are substantial; earnings yields and bond yields are cointegrated in just 2 of 20 countries; and P/Es outperform the Fed model as a tool to forecast real stock returns in 18 of 20 countries. Third, the evidence based on trailing P/Es casts even further doubts about the empirical merits of the Fed model.

Asness (2003) argues that although the Fed model fails as a normative model of how stock prices *should* be set, it does work as a descriptive tool of how stock prices *are* actually set. Put differently, he argues that the Fed model may be a good behavioral description, but not a rational explanation, of stock market prices. The findings in this article show that the Fed model is a failure both as a normative *and* as a positive model of stock prices.

Section 2 of this article discusses the pros and cons of the Fed model and evaluates its overall plausibility. Section 3 reports evidence from 20 countries that seriously questions the empirical validity of this model. Section 4 reports longer-term evidence from the same countries that casts further doubts on the empirical merits of the model. Finally, section 5 makes an assessment.

2. The Bad: The Plausibility of the Fed Model

Many analysts, portfolio managers, and financial commentators often (explicitly or implicitly) assume a negative relationship between the stock market's P/E ratio and the level of interest rates. In this view, high P/E ratios may not necessarily suggest an expensive stock market if prevailing interest rates are low. The Fed model is the best-known and most widely-used "formalization" of this argument.

2.1. The Model

The Fed model posits an equality between the forward earnings yield of the stock market (E/P) and the 10-year government bond yield (Y); that is,

$$E/P = Y. \tag{1}$$

The forward earnings yield of the stock market is simply the inverse of the market's forward P/E and is based on consensus earnings expected for the 12 months ahead. The idea behind (1) is that when $E/P>Y$, stocks yield more than bonds and are therefore relatively more attractive; conversely, when $E/P<Y$, stocks yield less than bonds and are therefore relatively less attractive.

Only when (1) holds, according to this model, stocks are neither more nor less attractive than bonds.

Often, the Fed model is alternatively presented as

$$P/E = 1/Y, \tag{2}$$

which compares the P/E ratio of stocks and bonds, the latter given by $1/Y$. Thus, when $P/E<1/Y$, stocks are cheaper than bonds and therefore more attractive; conversely, when $P/E>1/Y$, stocks are more expensive than bonds and therefore less attractive. Only when (2) holds, according to this model, stocks and bonds are properly priced relative to each other, in which case the equilibrium P/E of the stock market is given by the relationship depicted in Exhibit A1 in the appendix. As simple models go, it does not get much better than this. The question is, however, whether the model has any theoretical and empirical support.

The Fed model is based on the idea that investors view stocks and bonds as competing assets in their portfolio and therefore switch from one to the other whenever one yields more (or costs less) than the other. Note that, in order for this argument to be plausible, it must be the case that stocks and bonds are "comparable" assets. However, given the differential growth and risk characteristics of these two assets, the underlying idea behind the model seems flawed from the outset. (More on this below.)

The origins of the Fed model are not entirely clear. In its Humphrey-Hawkings report of July 22, 1997, the Fed noted that "…the ratio of prices in the S&P500 to consensus estimates of earnings over the coming twelve months has risen further from levels that were already unusually high. Changes in this ratio have often been inversely related to changes in long-term Treasury yields …"[2] The report also featured a graph depicting the close relationship between these two variables during the 1982-1997 period. Ed Yardeni, then an analyst at Deutsche Morgan Grenfell, apparently took a cue from the report, named the relationship the Fed's Stock Valuation Model, and published several reports using it to evaluate the level of the stock market; see Yardeni (1997, 1999).

Abbott (2000), however, contends that I/B/E/S has been publishing the relationship between the forward P/E of the S&P500 and the yield on 10-year notes since 1986. Without referring to any direct or indirect involvement of the Fed, he calls this relationship the I/B/E/S Equity Valuation Model.

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[2] Federal Reserve Board, Humphrey-Hawkins Report, Jul/22/1997, Section 2: Economic and Financial Developments in 1997.

Whatever its origins, the inverse relationship between the stock market (forward or trailing) P/E ratio and the yield on government bonds is widely used by practitioners. To illustrate, a recent Goldman Sachs report states that "… P/E multiples range widely over time depending on the level of interest rates, inflation, etc."[3]

Furthermore, any statement that justifies high P/E ratios with the existence of prevailing low interest rates, or that assesses the valuation of the stock market by comparing earnings yields and bond yields, is essentially using the Fed model. To illustrate, Marco Pirondini, global chief investment officer at Pioneer Investments, was quoted in the Wall Street Journal Europe saying "To see a market that is this cheap compared to interest rates, you have to go back 30 to 40 years …" and highlighting the positive environment to buy equity.[4] Andrew Teufell, director of research at Fisher Investments, was quoted in the Financial Times saying "In all the major markets the earnings yield on the benchmark equity index is higher than the yield on the 10-year government bond …" and arguing that history shows this to be an exceptionally reliable buying signal.[5]

For the purpose of valuation, the Fed model is often used to estimate the equilibrium level of the stock market (P^*) simply by solving (1) or (2) for P; that is, $P^*=E/Y$, which can be subsequently compared to the stock market's actual value (P). Alternatively, the model is also often used to estimate the ratio P/P^* (where, again, $P^*=E/Y$), which indicates stock market overvaluation when $P/P^*>1$ and undervaluation when $P/P^*<1$. Exhibit A2 in the appendix shows both P and P^* for the S&P500 over the Jan/1985-Jun/2005 period, and exhibit A3 shows the ratio P/P^* for the same index over the same period. It may be interesting to note that, according to the Fed model, the S&P500 has been continuously undervalued since May, 2002, and was almost 40% undervalued ($P/P^*=0.61$) by the end of June, 2005.

Some practitioners also use the Fed model as an informal tool for tactical asset allocation (TAA). Panel A of Exhibit 1 shows a simple relationship between the valuation of the stock market and a suggested proportion of stocks in the portfolio (the rest being allocated to bonds). Panel B of the same exhibit shows a relationship between the valuation of the stock market and a suggested percent of the maximum target allocation to stocks.[6] Note that neither TAA rule seems to stem from an optimization model; rather, they both seem to be based on each practitioner's best judgment.

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[3] US Economics Analyst, Issue 05/50, December 16, 2005, page 5.
[4] "Equities Shrug Off Gloom," Wall Street Journal Europe, Jun/7/2005.
[5] "Equities Make Little Headway as Investors Await US Trade Data," Financial Times, Apr/12/2005.
[6] To illustrate, if an investor decides that in the best-case scenario he should allocate not more than 80% to stocks, and if at a given point in time the stock market is 10% overvalued, then this investor should allocate 40% (=0.5·0.8) of his portfolio to stocks (and the rest to bonds).

Exhibit 1: The Fed Model and Tactical Asset Allocation

This exhibit shows two tactical asset allocation models. In panel A, x_s denotes the suggested proportion of stocks in the portfolio. In panel B, x_s^M denotes the suggested percent of the maximum target allocation to stocks.

Panel A: Yardeni (2002)		*Panel B*: Chaussée (2002)	
Stock market	x_s	Stock market	x_s^M
Over 30% overvalued	30%	Over 30% overvalued	0%
20-30% overvalued	50%	21-30% overvalued	10%
10-20% overvalued	60%	11-20% overvalued	25%
10% undervalued to 10% overvalued	70%	0-10% overvalued	50%
10-15% undervalued	80%	0-10% undervalued	75%
Over 15% undervalued	90%	Over 10% undervalued	100%

Lander, Orphanides, and Douvogiannis (1997), Harris and Sánchez-Valle (2000 *a*,*b*), Gwilym et al (2004), and Salomons (2005) implement different TAA rules based on earnings yields and bond yields and obtain varied (but generally positive) results. The last two articles, in particular, seem to agree that the Fed model may have some value as a (short-term) TAA tool, but little or no value as a (long-term) strategic asset allocation tool.

2.2. Theory and Problems

As argued above, the Fed model is based on the competitive-assets argument, which in turn is based on the idea that stocks and bonds are comparable assets. However implausible this idea may sound from the start, it turns out to be the case that, were the Fed model to be formally considered a special case of a standard equity valuation framework, this is what *must* be assumed. In other words, the Fed model can be thought of as following from the dividend discount model (DDM), but only after imposing several strong (and implausible) assumptions on it.

The constant-growth version of the DDM is given by

$$P = \frac{D \cdot (1+G)}{R_f + RP - G}\ , \tag{3}$$

where P and D denote the current price and dividend, G the expected long-term growth in dividends, R_f the risk-free rate (usually the yield on 10-year notes), and RP the risk premium. Beginning from (3), dividing both sides by forward earnings (E), and assuming 1) that all earnings are paid out as dividends and therefore $D\cdot(1+G)=E$; 2) that dividends are not expected to grow in the long term and therefore $G=0$; and 3) that investors require no more return from stocks than from bonds and therefore $RP=0$, we obtain $P/E=1/R_f$, which is precisely the Fed

model. In other words, buy these three assumptions, swallow hard, and you get a "simple" model to value the stock market – which is of course as valid as the assumptions that support it.[7]

The implausible assumptions underlying it, however, do not exhaust the problems of the Fed model. Asness (2003) argues the model erroneously compares a real magnitude (E/P) to a nominal one (*Y*). Earnings are a claim on the underlying assets of the corporate sector, which appreciate with inflation, and therefore the earnings yield is a real return;[8] the bond yield, in turn, is unambiguously a nominal return.

Similarly, Feinman (2005) argues that although inflation clearly affects bond yields, it should not affect earnings yields. This is due to the fact that although stock prices are inversely related to the rate of inflation through R_f, they are at the same time directly related to the rate of inflation through the expected growth of earnings (*G*). In other words, these two effects of inflation on prices should (approximately) offset each other and leave earnings yields unchanged.[9]

These arguments made by Asness (2003) and Feinman (2005) had been previously advanced by Modigliani and Cohn (1979), who argue that when valuing stocks investors tend to make two types of inflation-induced errors: First, they capitalize real cash flows at nominal rates; and second, they fail to recognize the gain stockholders obtain when inflation erodes the real value of fixed-income liabilities. Ritter and Warr (2002) call the first the capitalization rate error, the second the debt capital gain error, argue that the Fed model incurs in both, and report evidence showing that so do investors. Campbell and Vuolteenaho (2004) also find evidence consistent with the fact that investors misprice stocks because they suffer from money illusion.[10]

In order to account (and correct for) these and other problems, several variations of the Fed model have been proposed. These include comparing the forward earnings yield of the stock market to real government bond yields, yields on TIPS (Treasury Inflation-Protected Securities), government bond yields of different maturities, and corporate bonds yields. Other proposed variations of the model include the use of trailing earnings yields and smoothed (usually 10-year)

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[7] Siegel (2002) considers another possibility that would make the Fed model consistent with (3). He argues that, when inflation is an important factor, investors view the higher growth and risk of stocks (relative to bonds) as approximately offsetting each other. In that case, $RP=G$ and expression (3) again yields $P/E=1/R_f$.

[8] Siegel (2002) argues that the earnings yield is a good estimate of long-term real stock returns. He notes that between 1871 and 2001 the earnings yield of 6.8% in the US exactly matches the real return on US equity during the same period.

[9] Asness (2003) reports that between 1926 and 2001 inflation in the US has been almost an exact pass-through to nominal earnings.

[10] As suggested by Asness (2003), it is inconsistent to believe in the Fed model and at the same time that stocks are a good hedge against inflation. The second belief rests on the assumption that nominal earnings grow with inflation (leaving real earnings constant), which contradicts the assumptions underlying the Fed model.

trailing earnings yields, among several others. Unfortunately, little or no empirical evidence exists to support any of these alternative models.

Finally, note that the Fed model breaks down when inflation, and therefore interest rates, are low.[11] For this reason, Siegel (2002) argues that investors should be wary of using this model in a low-inflation world. Note, also, that even if the Fed model were a plausible description of the relationship between earnings yields and bond yields, it is not clear that deviations from its equilibrium could be used to forecast stock prices. This follows from the fact that the equilibrium could be restored not only by changes in stock prices but also by changes in earnings expectations or in bond yields.[12]

3. The Worse: The Evidence on the Fed Model (Forward Earnings)

As the previous section makes clear, the Fed model is hard to defend on theoretical grounds; that is, as a normative model of how investors *should* set stock prices. However, it may still be the case that the model explains how investors actually do (as opposed to should) set stock prices. The evidence discussed in this section and the next reveals that not even this is actually the case.

3.1. A Brief Review

Most practitioners usually validate the Fed model with a chart similar to panel A of Exhibit 2, which seems to indicate a strong relationship between (trailing) E/P and *Y* in the US during the Jan/1968-Jun/2005 period. However, as panel B of the same exhibit shows, the relationship over this period is not representative of that for the much longer 1871-2005 period. In fact, the correlation between E/P and *Y* is 0.75 between Jan/1968 and Jun/2005, –0.19 between Jan/1871 and Dec/1967, and only 0.10 over the whole Jan/1871-Jun/2005 period.

The widely touted empirical support for the Fed model, then, is based on carefully chosen and limited evidence. And the evidence is limited not only from a temporal perspective, as Exhibit 2 makes clear, but also from a cross-sectional perspective; as we will see below, the international evidence on the model is even more damning.

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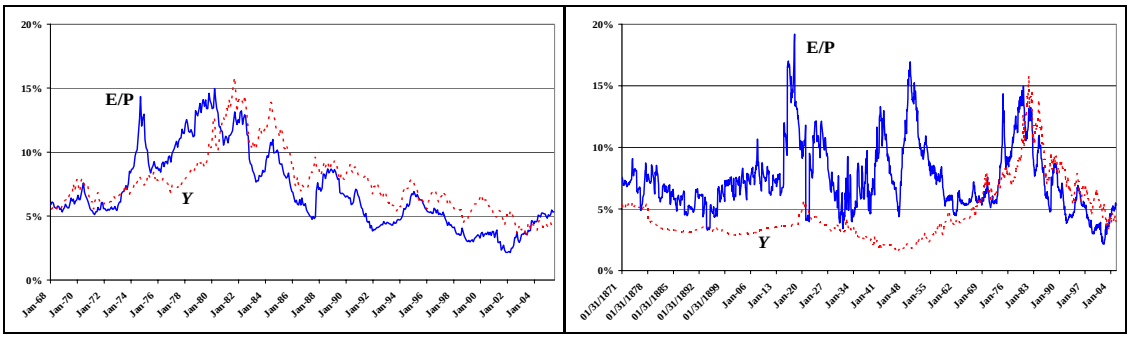
[11] Bond yields of 2% and 1% imply, according to the model, P/E ratios of 50 and 100, respectively.

[12] Put differently, the Fed model is typically used to assess stock prices, thus implying a causation that runs from the bond market to the stock market. This means that, *given the level of interest rates*, the model is used to obtain the equilibrium level of the stock market. This, in turn, effectively rules out mispricing in the bond market (as well as errors in analysts' expectations).

Exhibit 2: The Fed Model (USA)

This exhibit shows the trailing earnings yield of the S&P500 (E/P) and the yield on 10-year Treasury notes (*Y*). Panel A depicts both variables between Jan/1968 and Jun/2005, and panel B between Jan/1871 and Jun/2005.

Panel A **Panel B**



Lander, Orphanides, and Douvogiannis (1997) and Jansen and Wang (2004), however, do find some support for the Fed model in the US. The former find that deviations from this model help predict the month-ahead returns of the S&P500, use an error-correction model as the basis of a trading rule, and find that it outperforms a buy-and-hold strategy in terms of risk-adjusted returns. The latter find that the earnings yields on the S&P500 and the yield on the 10-year bond are cointegrated, as the Fed model would predict.

On the other side of the fence, Asness (2000, 2003) and Salomons (2005) find that earnings yields and bond yields in the US are correlated but only after adjusting for the (time-varying) differential risk of stocks and bonds, measured by their standard deviation of returns.[13] Both also find that, in the US, the earnings yield is a better predictor of real stock returns than the Fed model and conclude that this model is just a noisy proxy of earnings yields.

Studies on the Fed model from an international perspective are rather scarce. Contrary to most of the results reported below, Harasty and Roulet (2000) find that earnings, prices, and bond yields are cointegrated in the 9 countries they consider, over their relatively short sample periods. Koivu, Pennanen, and Ziemba (2005) also find that these three variables are cointegrated in the 3 countries they consider. Finally, Thomas (2005) plots earnings yields and bond yields in 10 countries and considers the (very limited) graphical analysis as supporting the Fed model.

Harris and Sánchez-Valle (2000 *a*,*b*) consider a variation of the Fed Model, the gilt-equity yield ratio (GEYR), defined as the ratio between the coupon yield on long government bonds and the dividend yield of the stock market. They find that in both the US and the UK the performance of the model varies depending on whether the underlying goal is explanatory power, forecasting accuracy, or trading profitability.

[13] These results are consistent with those of Kane, Marcus, and Noh (1996), who find that P/E ratios are strongly (and negatively) related to the volatility of stock returns.

Durré and Giot (2004) consider 13 countries and find that earnings, stock prices, and bond yields are cointegrated in 9 of them. However, in none of these 9 countries bond yields are statistically significant in the cointegrating relationship, implying that they do not affect the long-term equilibrium level of the stock market. Gwilym et al (2004) consider 6 countries and find that earnings yields outperform the Fed model as a tool to predict real stock returns.[14]

In short, then, the evidence supporting the Fed model is at best weak. The consensus seems to be that although bond yields may have a short-term impact on stock prices, they are irrelevant in the long-term equilibrium. In other words, stock prices are ultimately determined by valuation ratios such as P/E, not by inflation or interest rates. In the best-case scenario, then, the Fed model may be somewhat useful only as a (short-term) TAA tool.

3.2. Data and Preliminary Analysis

The Fed model as originally portrayed in the Humphrey-Hawkings Fed report mentioned above, or as originally published by I/B/E/S, also mentioned above, involves an equality between the *forward* earnings yield of the stock market and the 10-year government bond yield. I/B/E/S has been compiling data on forward P/E ratios at the aggregate level since December, 1987, for several international stock markets. The price behavior of each of these markets can be summarized by several benchmark indices, and the results discussed in this section are based on the widely-used Morgan Stanley Capital International (MSCI) indices.

Exhibit 3 shows the 20 countries included in the analysis in the first column and the month in which the analysis begins for each country in the last column; data for all countries covers the period between that date and Jun/2005. The exhibit also shows, for all countries, the average (forward) earnings yield and average (10-year) government bond yield, the correlation between them, the difference between them, and a test statistic for the difference in means, all of them over each country's whole sample period. Exhibit A4 in the appendix shows graphs depicting (forward) earnings yields and bond yields for all countries over their own sample period.

[14] Durré and Giot (2004) and Gwilym et al (2004) both find that bond yields do affect stock prices in the short term and conclude that the Fed model may have some value as a tool of (short-term) TAA.

Exhibit 3: Preliminary Analysis
This exhibit shows forward earnings yields (E/P), 10-year government bond yields (*Y*), and correlations between them (Rho), calculated between the beginning of data coverage (indicated in the last column) and Jun/2005. E/P and *Y* represent averages over each country's whole sample period. *E*, *P*, and E/P are based on MSCI indices. DM is the test statistic for a difference-in-means test; the asymptotic critical value at the 5% level of significance is ±1.96. Yield data for Finland are based on 5-year government bond yields.

Country	E/P	*Y*	Rho	E/P–*Y*	DM	Beginning
Australia	7.7%	8.1%	0.89	–0.4%	–1.88	Dec/87
Austria	6.9%	6.1%	–0.52	0.8%	4.76	Sep/88
Belgium	8.3%	6.5%	0.50	1.8%	9.66	Dec/87
Canada	6.9%	7.4%	0.67	–0.5%	–2.93	Dec/87
Denmark	6.5%	6.9%	0.39	–0.4%	–2.60	Dec/87
Finland	6.6%	7.5%	0.21	–0.9%	–2.59	Jan/88
France	7.0%	6.5%	0.73	0.5%	2.32	Dec/87
Germany	6.2%	5.9%	0.24	0.2%	1.38	Dec/87
Ireland	8.3%	6.5%	0.70	1.8%	9.39	May/90
Italy	6.1%	8.4%	0.26	–2.3%	–7.74	Dec/87
Japan	3.2%	3.3%	–0.50	–0.1%	–0.86	Dec/87
Netherlands	7.9%	6.0%	0.63	1.8%	9.93	Dec/87
New Zealand	8.8%	8.1%	0.88	0.7%	2.73	Jan/88
Norway	9.1%	7.5%	0.57	1.6%	6.76	Dec/87
Portugal	7.6%	7.4%	0.84	0.1%	0.32	Jul/91
Spain	7.8%	8.2%	0.72	–0.4%	–1.51	Dec/87
Sweden	6.8%	7.8%	0.67	–0.9%	–3.76	Dec/87
Switzerland	7.1%	4.1%	0.64	3.1%	18.79	Dec/87
UK	7.2%	7.4%	0.89	–0.1%	–0.62	Dec/87
USA	6.6%	6.3%	0.74	0.3%	1.98	Dec/87

As Exhibit 3 shows, the correlation between earnings yields and bond yields is quite high in many countries, and positive in all countries with only two exceptions, Austria and Japan. Although these numbers seem to lend support to the Fed model, this is actually not quite the case; the Fed model does not posit just a correlation between earnings yields and bond yields but an *equality* between them. That is a much stronger requirement and one that cannot be tested by a simple analysis of correlations.[15]

Exhibit 3 also shows the difference between the mean earnings yield and the mean bond yield for all countries over their own sample period. The Fed model suggests that these two numbers should be not significantly different from each other. However, a test for the difference in means shows that (at the 5% significance level) this is not the case in 14 countries of the 20 considered. Furthermore, note that earnings yields and bond yields may be equal in means and still differ substantially from each other on a period-by-period basis, with differences in one direction canceling out in the average with equal differences in the opposite direction. For this reason, a more thorough analysis of the differences between earnings yields and bond yields is performed immediately below.

[15] A second reason for which these correlations do not lend support to the Fed model is that, as will be discussed later, earnings yields and bond yields are random walks, which renders correlation analysis largely meaningless.

3.3. Valuation Gaps

Although the Fed model posits an equality between earnings yields and bond yields, Abbott (2000) suggests that the model is not intended to provide a precise valuation for the stock market. Rather, he argues that the model should be thought of as providing a "fair value range" with boundaries of ±10%. In other words, valuation gaps (relative departures from the equality) within the ±10% range are "reasonable" deviations that should not necessarily lead to short-term corrections in prices.

Exhibit 4 reports four valuation gaps that respond to the expressions

$$\text{VG1} = (1/T) \cdot \sum_t \{(E/P)_t - Y_t\} \tag{4}$$

$$\text{VG2} = (1/T) \cdot \sum_t \left\{ \frac{(E/P)_t - Y_t}{Y_t} \right\} \tag{5}$$

$$\text{VG3} = (1/T) \cdot \sum_t \left| (E/P)_t - Y_t \right| \tag{6}$$

$$\text{VG4} = (1/T) \cdot \sum_t \left| \frac{(E/P)_t - Y_t}{Y_t} \right| . \tag{7}$$

VG1 measures the average monthly gap between the earnings yield and the bond yield. The usefulness of this measure is limited given that a gap of, say, 200 basis points when bond yields hover around 2% implies a much larger deviation from equilibrium than when bond yields hover around 10%.[16] Therefore, VG2 measures the average monthly gap between the earnings yield and the bond yield relative to the level of the bond yield. Both VG1 and VG2 are also limited by the fact that positive and negative gaps of the same magnitude cancel out in the average, thus concealing deviations from the model's proposed equilibrium. Therefore, VG3 measures the average absolute value of the monthly gaps, and VG4 measures the average absolute value of the monthly gaps relative to the level of the bond yield. These four valuation gaps for all 20 countries are displayed on Exhibit 4.

VG1 seems to indicate that deviations from equilibrium are not very large overall. VG2, however, indicates that these gaps are far from negligible when measured relative to the level of the bond yields. VG3 and VG4 give an even better picture of these substantial gaps; the latter, in particular, reveals substantial departures from the model's proposed equilibrium, virtually all of them well above the 10% fair value range, and over 36% on average. Therefore, even if the Fed model is not thought of as a precise valuation tool but only as one that provides a fair value

[16] If E/P=4% and *Y*=2%, the relative gap is (4%–2%)/2%=100%. If E/P=12% and *Y*=10% instead, the relative gap is only (12%–10%)/10%=20%.

range, the data shows that departures from equilibrium are much larger than what can be reasonably expected from an accurate model.

Exhibit 4: Valuation Gaps
This exhibit shows four valuation gaps based on forward earnings. VG1 follows from expression (4), VG2 from expression (5), VG3 from expression (6), and VG4 from expression (7).

Country	VG1	VG2	VG3	VG4
Australia	–0.4%	–2.1%	1.1%	14.3%
Austria	1.0%	28.3%	2.5%	48.9%
Belgium	1.8%	35.3%	1.9%	36.7%
Canada	–0.5%	–3.4%	1.3%	18.5%
Denmark	–0.4%	2.1%	1.8%	27.9%
Finland	–0.7%	8.8%	3.3%	47.9%
France	0.5%	11.4%	1.2%	22.3%
Germany	0.2%	9.5%	1.6%	29.7%
Ireland	1.8%	36.6%	1.9%	37.9%
Italy	–2.3%	–14.5%	3.4%	37.7%
Japan	–0.1%	69.6%	2.4%	119.5%
Netherlands	1.8%	34.3%	1.9%	36.3%
New Zealand	0.7%	9.2%	1.2%	14.1%
Norway	1.6%	30.2%	2.4%	38.0%
Portugal	0.5%	18.5%	1.6%	29.0%
Spain	–0.4%	7.7%	1.9%	28.4%
Sweden	–0.9%	–4.4%	1.9%	25.9%
Switzerland	3.1%	84.8%	3.1%	84.4%
UK	–0.1%	0.7%	0.8%	12.1%
USA	0.3%	7.3%	1.0%	18.3%

3.4. Unit Roots and Cointegration

The correlations between earnings yields and bond yields reported in Exhibit 2 seem to suggest that the Fed model is a good description of the relationship between these two variables in many countries. However, it is well known that in the presence of nonstationary variables correlations are a misleading indicator of the strength of the relationship between them; the proper econometric framework is that of cointegration.

Beginning then from the Fed model expressed as $P/E=1/Y$, the first step is to determine whether these variables follow a random walk. The second and third columns of Exhibit 5 report the test statistics of augmented Dicky-Fuller (ADF) tests for a unit root in $\ln(P/E)$ and $\ln(1/Y)$. At the 5% level of significance, these tests reveal the existence of a unit root in both variables in all countries (the only very marginal exceptions being P/E ratios in Spain and inverse bond yields in Austria). In other words, both P/E ratios and inverse bond yields follow a random walk and, therefore, correlation analysis is largely meaningless. So much for supporting the Fed model with correlations such as those reported in Exhibit 2.

Exhibit 5: Unit Roots and Cointegration

This exhibit shows the results of tests for a unit root and cointegration. The second through sixth columns show test statistics of augmented Dicky-Fuller tests for a unit root; the asymptotic critical value for these tests at the 5% level of significance is –3.41. The last column shows test statistics for Engle-Granger (non)cointegration tests; the asymptotic critical value for these tests at the 5% level of significance is –3.78. FM = ln(P/E)–ln(1/Y).

Country	ln(P/E)	ln(1/Y)	Δln(P/E)	Δln(1/Y)	FM	Coint
Australia	–1.558	–2.468	–4.867	–4.554	–2.789	–2.975
Austria	–2.352	–3.458	–5.219	–3.545	–2.460	–2.344
Belgium	–2.096	–2.983	–3.652	–3.802	–2.155	–1.863
Canada	–1.980	–2.545	–5.246	–4.199	–2.276	–2.186
Denmark	–2.004	–2.859	–5.681	–3.783	–2.720	–2.303
Finland	–2.899	–2.596	–3.657	–4.607	–3.018	–2.851
France	–1.300	–2.941	–6.482	–3.706	–0.304	–1.258
Germany	–2.427	–3.013	–6.161	–3.854	–1.758	–1.953
Ireland	–3.300	–3.219	–5.529	–3.756	–3.925	–3.954
Italy	–2.640	–2.698	–8.345	–3.793	–2.842	–2.545
Japan	–2.180	–2.864	–3.456	–4.780	–2.811	–2.231
Netherlands	–1.377	–3.040	–3.774	–3.544	–1.873	–1.412
New Zealand	–2.780	–2.038	–3.925	–5.344	–4.661	–4.488
Norway	–3.305	–2.089	–4.971	–5.091	–2.769	–2.834
Portugal	–1.403	–2.102	–3.638	–3.394	–2.860	–2.939
Spain	–3.494	–2.052	–4.336	–4.978	–2.052	–2.153
Sweden	–2.245	–2.881	–3.613	–4.196	–2.386	–2.381
Switzerland	–1.485	–2.808	–4.404	–3.628	–2.650	–1.494
UK	–1.719	–2.834	–5.697	–3.847	–2.875	–2.379
USA	–1.264	–3.373	–4.272	–4.641	–1.998	–1.436

The fourth and fifth columns of Exhibit 5 report the test statistics of ADF tests on the first difference of ln(P/E) and ln(1/*Y*). At the 5% level of significance, these tests reveal that both variables in all countries become stationary after differencing (the only very marginal exception being inverse bond yields in Portugal). In other words, P/E ratios and inverse bond yields are all integrated of order 1.

The validity of the Fed model within a cointegration framework can be assessed in two slightly different ways.[17] First, note that if the model properly describes the relationship between P/E ratios and bond yields, then it must be the case that the variable FM = ln(P/E)–ln(1/*Y*) is stationary around a 0 mean. The sixth column of Exhibit 5 shows the test statistics of ADF tests for a unit root on FM. At the 5% level of significance, these numbers show that this variable has a unit root (and is therefore nonstationary) in all countries with only two exceptions, Ireland and New Zealand.

Second, and perhaps more straightforward, the last column of Exhibit 5 shows the test statistics of Engle-Granger cointegration tests between P/E ratios and inverse bond yields. At

[17] The fact that in Austria and Spain P/E ratios and inverse bond yields are integrated of different order implies a rejection of the Fed model without any further analysis. However, because the rejection of a unit root in Austrian inverse bond yields and in Spanish P/E ratios is very marginal, both countries are included in the cointegration analysis that follows.

the 5% level of significance, these numbers show that the null hypothesis of noncointegration is rejected in only two countries, again Ireland and New Zealand.

Only in these two countries, then, it makes sense to test the hypotheses $\lambda_0=0$ and $\lambda_1=1$ in the regression $\ln(P/E)_t = \lambda_0 + \lambda_1 \cdot \ln(1/Y)_t + \varepsilon_t$, where ε_t is an error term. As discussed above, the Fed model does not posit just a correlation between P/E ratios and inverse bond yields but an equality between them, which in turn imposes the $\lambda_0=0$ and $\lambda_1=1$ restrictions on the regression above. Exhibit 6 shows the estimation for both countries. At the 5% level of significance, the equality between P/E ratios and inverse bond yields is rejected in Ireland but not in New Zealand.

Exhibit 6: Hypothesis Testing

This exhibit shows the results of the regression $\ln(P/E)_t = \lambda_0+\lambda_1 \cdot \ln(1/Y)_t+\varepsilon_t$, where ε_t is an error term, for Ireland and New Zealand. The last two columns show the test statistic and *p*-value for the hypothesis $\lambda_1=1$. Significance is based on the Newey-West heteroskedasticity/autocorrelation-consistent covariance matrix.

Country	λ_0	*p*-value	λ_1	*p*-value	R^2	*t*-stat	*p*-value
Ireland	1.511	0.000	0.358	0.000	0.414	–14.482	0.000
New Zealand	0.065	0.642	0.944	0.000	0.780	–1.057	0.292

In short, then, despite the rather high correlations displayed on Exhibit 2, a proper analysis (given the characteristics of the variables involved) leads to the conclusion that the Fed model properly describes the relationship between P/E ratios and bond yields in only 1 of the 20 countries considered. Two out of three ain't bad, but 1 out of 20 certainly is.

3.5. The Fed Model and Expected Returns

As discussed above, practitioners widely use the Fed model both to assess the level of the stock market and to adjust the proportions of stocks and bonds in response to short-term conditions (TAA). In order to be a valuable tool for these purposes, however, it should be the case that deviations from the model set in motion corrective mechanisms that eventually restore the equilibrium. If that were the case, then deviations from the Fed model should provide useful information to forecast stock returns.

The relationship between the Fed model and real stock returns can be explored by estimating the regression

$$\ln(R_{t+60}) = \beta_0 + \beta_1 \cdot \{\ln(P/E)_t - \ln(1/Y)_t\} + u_t\,, \tag{8}$$

where R_{t+60} denotes the annualized real stock return 5 years (60 months) forward, u_t is an error term, and t indexes months.[18] Note that (8) asks whether deviations from the Fed model in month t are useful to forecast real stock returns over the following 60 months. Note, also, that according to the Fed model β_1 is expected to be negative; that is, the more expensive stocks are relative to bonds (the larger P/E with respect to $1/Y$), the lower real stock returns are expected to be.

It is also important to determine whether the P/E ratio by itself outperforms the Fed model as a tool to forecast real stock returns. This can be explored by comparing the results from (8) to those from the regression

$$\ln(R_{t+60}) = \gamma_0 + \gamma_1 \cdot \ln(\mathrm{P/E})_t + v_t\,, \tag{9}$$

where v_t is an error term. Note that (9) asks whether P/E ratios are useful to forecast real stock returns 5 years forward. Note, also, that γ_1 is expected to be negative, indicating that the more expensive stocks are, the lower real stock returns are expected to be.

The results of all estimations are shown in Exhibit 7. Panel A shows that β_1 has the wrong sign in 12 of the 20 countries considered, being significant (at the 5% level) in 8 of these cases. In fact, in only 4 of the 20 countries β_1 is significant *and* has the expected sign. In one of these countries (New Zealand) the R^2 is under 0.10, in two countries (Austria and the Netherlands) the R^2 is under 0.20, and in the remaining country (the US) the R^2 is just above 0.50. In other words, the Fed model as a tool to forecast real stock returns seems to be relevant almost exclusively in the US.

However, this success is not only limited by the fact that the Fed model performs poorly in most countries. It is also limited by the fact that in most countries the Fed model is clearly outperformed by the forecasting ability of the P/E ratio. In fact, Panel B shows that γ_1 has the expected sign in 18 of the 20 countries, and is significant (again at the 5% level) in 15 of these cases. The average R^2 in the 15 countries in which γ_1 has the expected sign and is significant is 0.30.

Finally, in only 2 countries of the 20 considered the Fed model outperforms the P/E ratio as a tool to forecast real stock returns in the sense of having a higher explanatory power (measured by the R^2) and at the same time β_1 having the expected sign. These countries are Austria and the US.[19]

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[18] Nominal stock returns for all countries are calculated using MSCI total return indices (which include both capital gains and dividends). Inflation rates for all countries are calculated using consumer price indices.

[19] Contrary to this result, Asness (2003) finds that earnings yields outperform the Fed model as a tool to forecast real stock returns in the US. His results, however, are based on smoothed trailing earnings.

Exhibit 7: Forecasting Real Stock Returns

This exhibit shows the results of the regressions $\ln(R_{t+60}) = \beta_0+\beta_1\cdot\{\ln(P/E)_t-\ln(1/Y)_t\}+u_t$ in panel A and $\ln(R_{t+60}) = \gamma_0 + \gamma_1\cdot\ln(P/E)_t+v_t$ in panel B, where u_t and v_t are error terms. All regressions run from the beginning of each country's sample period (indicated in Exhibit 3) through Jun/2000. Last 5-year real return for all countries estimated over the Jun/2000-Jun/2005 period. Nominal returns are based on MSCI total return indices and inflation rates on consumer price indices. Significance is based on the Newey-West heteroskedasticity/autocorrelation-consistent covariance matrix.

	Panel A: Fed Model					*Panel B*: P/E Ratios				
Country	β_0	*p*-value	β_1	*p*-value	R^2	γ_0	*p*-value	γ_1	*p*-value	R^2
Australia	0.064	0.000	0.069	0.001	0.101	0.187	0.000	-0.045	0.000	0.225
Austria	0.021	0.001	-0.055	0.001	0.153	0.220	0.002	-0.072	0.004	0.118
Belgium	0.087	0.000	0.084	0.132	0.018	0.462	0.000	-0.152	0.000	0.215
Canada	0.067	0.000	0.073	0.100	0.030	0.154	0.059	-0.028	0.339	0.013
Denmark	0.085	0.000	-0.014	0.771	0.001	0.476	0.000	-0.143	0.001	0.123
Finland	0.155	0.000	0.010	0.614	0.002	0.220	0.013	-0.021	0.479	0.009
France	0.084	0.000	-0.040	0.559	0.005	0.292	0.000	-0.078	0.002	0.089
Germany	0.061	0.000	0.058	0.183	0.016	0.371	0.000	-0.108	0.005	0.080
Ireland	0.131	0.000	0.384	0.000	0.273	1.082	0.000	-0.407	0.000	0.514
Italy	0.000	0.987	0.133	0.000	0.386	-0.013	0.840	0.027	0.234	0.013
Japan	-0.039	0.000	-0.004	0.596	0.003	0.033	0.655	-0.020	0.321	0.009
Netherlands	0.050	0.007	-0.251	0.000	0.157	0.767	0.000	-0.263	0.000	0.500
New Zealand	0.038	0.000	-0.112	0.028	0.077	0.210	0.000	-0.069	0.004	0.142
Norway	0.058	0.000	0.077	0.008	0.091	0.044	0.334	0.002	0.917	0.000
Portugal	0.040	0.029	0.244	0.003	0.095	0.920	0.000	-0.336	0.000	0.807
Spain	0.098	0.000	-0.035	0.427	0.004	0.587	0.000	-0.194	0.000	0.283
Sweden	0.096	0.000	0.108	0.037	0.053	0.459	0.000	-0.127	0.005	0.117
Switzerland	0.160	0.000	0.103	0.009	0.046	0.660	0.000	-0.210	0.000	0.369
UK	0.054	0.000	0.159	0.004	0.059	0.529	0.000	-0.182	0.000	0.427
USA	0.094	0.000	–0.404	0.000	0.539	0.713	0.000	–0.232	0.000	0.473

4. The Ugly: More Evidence on the Fed Model (Trailing Earnings)

Analysts' predictions of earnings have a relatively short history in most countries. Trailing earnings, however, have a longer history and can be used to assess the longer-term success or failure of the Fed model. The evidence discussed in this section is based on *trailing* earnings, broad indices of stocks, and 10-year government bond yields, all of them available in Global Financial Data.[20]

4.1. Preliminary Analysis

Exhibit 8, just as Exhibit 3 in the previous section, shows the same 20 countries included in the analysis in the first column and the date in which the analysis begins for each country in the last column; data for all countries covers the period between that date and Jun/2005. The exhibit also shows, for all countries, the average (*trailing*) earnings yield and average (10-year)

[20] This database offers several indices for each stock market and several maturities for the bonds of each country. Maturities were chosen at 10 years in all countries but two (Finland and Japan, which have longer histories for maturities of 5 and 7 years, respectively). The chosen benchmark stock index for each country was the one with the longest history.

government bond yield, the correlation between them, the difference between them, and a test statistic for the difference in means, all of them over each country's whole sample period. Exhibit A5 in the appendix shows graphs depicting (trailing) earnings yields and bond yields for all countries over their own sample period.

Exhibit 8: Preliminary Analysis

This exhibit shows trailing earnings yields (E/P), 10-year government bond yields (*Y*), and correlations between them (Rho), calculated between the beginning of data coverage (indicated in the last column) and Jun/2005. E/P and *Y* represent averages over each country's whole sample period. *E*, *P*, and E/P are based on benchmark stock market indices in local currency. DM is the test statistic for a difference-in-means test; the asymptotic critical value at the 5% level of significance is ±1.96. Yield data for Finland and Japan are based on 5-year and 7-year government bond yields, respectively.

Country	E/P	*Y*	Rho	E/P–*Y*	DM	Beginning
Australia	6.9%	9.4%	0.69	–2.5%	–12.77	Jul/69
Austria	4.2%	6.6%	–0.67	–2.5%	–15.24	Oct/81
Belgium	7.6%	8.1%	0.60	–0.5%	–3.03	Jul/69
Canada	6.5%	7.8%	0.46	–1.3%	–8.10	Jan/56
Denmark	8.7%	10.6%	0.73	–1.9%	–5.73	Jul/69
Finland	5.8%	7.5%	0.25	–1.7%	–5.61	Jan/88
France	6.9%	8.8%	0.52	–1.9%	–7.52	Sep/71
Germany	7.1%	7.0%	0.44	0.1%	0.92	Jul/69
Ireland	7.0%	6.5%	0.21	0.5%	2.85	May/90
Italy	5.0%	9.3%	0.03	–4.3%	–15.88	Apr/84
Japan	4.6%	6.2%	0.63	–1.7%	-9.67	Jan/56
Netherlands	11.0%	7.2%	0.72	3.8%	12.38	Jul/69
New Zealand	7.2%	8.1%	0.65	–0.8%	–3.12	Jan/88
Norway	8.1%	8.5%	0.51	–0.3%	–1.40	Jul/69
Portugal	6.0%	8.9%	0.09	–2.9%	–9.02	Jan/88
Spain	7.1%	10.3%	0.76	–3.2%	–11.58	Dec/79
Sweden	8.6%	9.0%	0.44	–0.3%	–1.43	Jul/69
Switzerland	7.4%	4.5%	0.58	2.9%	21.32	Jul/69
UK	7.9%	9.0%	0.75	–1.1%	–5.76	Apr/62
USA	7.4%	4.6%	0.10	2.8%	30.96	Jan/1871

The correlations between trailing earnings yields and bond yields are in some cases higher and in some cases lower than those reported in Exhibit 3 (based on forward earnings yields). The largest differences in correlations between the two exhibits correspond to Japan (from –0.50 to 0.63), Portugal (from 0.84 to 0.09), and the US (from 0.74 to 0.10). Still, as discussed before, these correlations say little about the empirical merits of the Fed model. First, the model poses an equality, not just a correlation, between earnings yields and bond yields; and second, correlations are largely meaningless when the underlying variables are random walks.

Exhibit 8 also shows the difference between the mean earnings yield and the mean bond yield for all countries over their own sample period and a test for the difference between these two means. At the 5% level of significance, the equality between these means is rejected in 17 of the 20 countries considered, thus adding to the evidence against the Fed model.

4.2. Valuation Gaps

As discussed above, beginning from the idea that the Fed model is not an exact valuation tool but rather one that provides a fair value range (with boundaries of ±10%), an analysis of valuation gaps is a better way to assess the departures from the equilibrium proposed by this model. The four valuation gaps that follow from expressions (4)-(7) are reported for all 20 countries in Exhibit 9.

Exhibit 9: Valuation Gaps
This exhibit shows four valuation gaps based on trailing earnings. VG1 follows from expression (4), VG2 from expression (5), VG3 from expression (6), and VG4 from expression (7).

Country	VG1	VG2	VG3	VG4
Australia	–2.5%	–25.3%	2.9%	29.2%
Austria	–2.4%	–25.5%	3.7%	53.9%
Belgium	–0.5%	0.8%	1.6%	22.1%
Canada	–1.3%	–12.0%	2.4%	29.2%
Denmark	–2.0%	–16.6%	3.1%	30.0%
Finland	–1.1%	4.8%	3.0%	47.1%
France	–1.9%	–16.5%	3.0%	35.1%
Germany	0.1%	5.6%	1.9%	31.3%
Ireland	0.5%	19.1%	1.8%	34.1%
Italy	–4.3%	–33.4%	5.0%	48.8%
Japan	–1.7%	–1.5%	2.6%	61.2%
Netherlands	3.8%	47.7%	4.3%	55.4%
New Zealand	–0.8%	–10.2%	1.7%	20.0%
Norway	–0.3%	0.9%	2.7%	32.0%
Portugal	–2.9%	–14.8%	4.1%	43.4%
Spain	–3.2%	–21.3%	3.7%	32.8%
Sweden	–0.4%	0.2%	2.9%	31.4%
Switzerland	2.9%	68.3%	3.0%	70.3%
UK	–1.1%	–9.9%	2.2%	25.3%
USA	2.8%	101.5%	3.5%	110.8%

VG1 and VG2 generally show substantially larger valuation gaps between trailing earnings yields and bond yields than those reported in Exhibit 4 (between forward earnings yields and bond yields). Still, these two measures suffer from the shortcoming discussed above (positive and negative gaps of the same magnitude cancel out in the average), and, therefore, VG3 and VG4 provide a clearer picture of departures from the Fed model. VG4, in particular, is larger in Exhibit 9 than in Exhibit 4 in 14 of the 20 countries, notably in the US (going from 18.3% to 110.8%). It is the case again, then, that even if the Fed model is not thought of as a precise valuation framework, departures from its proposed equilibrium are much larger than what can be reasonably expected from an accurate model.

4.3. Unit Roots and Cointegration

Beginning again from the Fed model expressed as P/E=1/*Y*, the second and third columns of Exhibit 10 report the test statistics of ADF tests for a unit root in ln(P/E) and ln(1/*Y*). At the 5% level of significance, these tests reveal the existence of a unit root in trailing P/Es in all countries with the exceptions of Austria, Belgium, New Zealand, Norway, and Sweden; inverse bond yields, on the other hand, have a unit root in all countries. The fact that in these five countries P/E ratios and inverse bond yields are integrated of different order implies a rejection of the Fed model without any further analysis. The fourth and fifth columns of the exhibit report test statistics of ADF tests on the first difference of ln(P/E) and ln(1/*Y*); at the 5% level of significance, the unit-root hypothesis is rejected for both variables in all countries, indicating that both variables become stationary after differencing.

Exhibit 10: Unit Roots and Cointegration

This exhibit shows the results of tests for a unit root and cointegration. The second through sixth columns show test statistics of augmented Dicky-Fuller tests for a unit root; the asymptotic critical value for these tests at the 5% level of significance is –3.41. The last column shows test statistics for Engle-Granger (non)cointegration tests; the asymptotic critical value for these tests at the 5% level of significance is –3.78. N/A indicates that ln(P/E) and ln(1/*Y*) have different orders of integration in that country. FM = ln(P/E)–ln(1/*Y*).

Country	ln(P/E)	ln(1/Y)	Δln(P/E)	Δln(1/Y)	FM	Coint
Australia	–3.299	–1.671	–4.825	–5.067	–2.619	–3.213
Austria	–3.483	–2.614	–5.055	–3.987	N/A	N/A
Belgium	–3.691	–1.262	–6.007	–4.696	N/A	N/A
Canada	–2.806	–0.699	–5.233	–5.304	–2.990	–3.043
Denmark	–2.577	–2.007	–5.771	–6.223	–2.077	–2.485
Finland	–3.137	–2.596	–3.559	–4.607	–3.067	–3.112
France	–3.110	–2.438	–5.957	–4.800	–2.404	–3.069
Germany	–2.214	–2.367	–5.639	–4.755	–2.793	–2.389
Ireland	–2.297	–3.219	–5.233	–3.756	–2.597	–2.441
Italy	–2.563	–2.110	–3.870	–3.957	–2.491	–3.022
Japan	–1.551	–1.417	–6.243	–5.520	–0.858	–2.385
Netherlands	–2.172	–2.008	–6.519	–5.127	–1.512	–1.667
New Zealand	–4.087	–2.038	–5.237	–5.344	N/A	N/A
Norway	–3.839	–1.154	–5.291	–5.068	N/A	N/A
Portugal	–2.418	–2.167	–3.968	–3.556	–3.274	–3.389
Spain	–3.269	–2.111	–5.957	–4.627	–2.639	–3.070
Sweden	–4.100	–0.654	–5.384	–5.574	N/A	N/A
Switzerland	–2.766	–2.133	–5.935	–4.722	–1.628	–2.629
UK	–2.414	–1.945	–4.889	–4.950	–2.188	–2.829
USA	–3.386	–1.710	–7.031	–7.204	–2.674	–3.420

As before, the validity of the Fed model within a cointegration framework can be assessed by testing whether the variable FM = ln(P/E)–ln(1/*Y*) is stationary around a 0 mean, or by running Engle-Granger cointegration tests on P/E ratios and inverse bond yields. The sixth column of Exhibit 10 shows the test statistics of ADF tests for a unit root on FM; at the 5% level of significance, these numbers show that this variable has a unit root (and is therefore

nonstationary) in all countries. The last column of Exhibit 10 shows the test statistics of Engle-Granger cointegration tests between P/E ratios and inverse bond yields; at the 5% level of significance, these numbers show that these two variables are cointegrated in *no* country of the 20 considered.

In short, then, the longer-term results of the cointegration analysis based on trailing earnings are even more damning than those discussed above based on forward earnings. The restrictions imposed by the Fed model on trailing P/E ratios and bond yields are rejected in *every* country considered. Or, put differently, the Fed model does not properly describe the relationship between P/E ratios and bond yields in any of these 20 countries.

4.4. The Fed Model and Expected Returns

Although the Fed model based on trailing earnings seems to be the same empirical failure as that based on forward earnings, it may still be the case that deviations from its proposed equilibrium set in motion corrective mechanisms useful to forecast real stock returns. As before, this can be explored by estimating the regression in (8), in which β_1 is expected to be negative. And also as before, it is important to determine whether the P/E ratio by itself outperforms the Fed model as a tool to forecast real stock returns. This can be explored by estimating the regression in (9), in which γ_1 is expected to be negative. The results of these estimations are shown in Exhibit 11.

Panel A of Exhibit 11 shows that β_1 has the wrong sign in 12 of the 20 countries considered, being significant (at the 5% level) in 7 of these cases. In only 5 of the 20 countries considered β_1 is significant *and* has the expected sign. In all these countries (Japan, Netherlands, Portugal, the UK, and the US) the R^2 is under 0.11.

As was the case before, the P/E ratio outperforms the Fed model as a tool to forecast real stock returns. Panel B of Exhibit 11 shows that γ_1 has the expected sign in 15 of the 20 countries considered, and is significant (again at the 5% level) in 11 of these cases. The average R^2 in the 11 countries in which γ_1 has the expected sign and is significant is 0.23.

Finally, in *no* country the Fed model outperforms the P/E ratio as a tool to forecast real stock returns in the sense of having a higher explanatory power (measured by the R^2) and at the same time β_1 having the expected sign. As far as this article is concerned, that is the last nail in the coffin of the Fed model.

Exhibit 11: Forecasting Real Stock Returns

This exhibit shows the results of the regressions $\ln(R_{t+60}) = \beta_0+\beta_1\cdot\{\ln(P/E)_t-\ln(1/Y)_t\}+u_t$ in panel A and $\ln(R_{t+60}) = \gamma_0 + \gamma_1\cdot\ln(P/E)_t+v_t$ in panel B, where u_t and v_t are error terms. All regressions run from the beginning of each country's sample period (indicated in Exhibit 8) through Jun/2000. Last 5-year real return for all countries estimated over the Jun/2000-Jun/2005 period. Nominal returns are based on benchmark stock market indices in local currency and inflation rates on consumer price indices. Significance is based on the Newey-West heteroskedasticity/autocorrelation-consistent covariance matrix.

	Panel A: Fed Model					*Panel B*: P/E Ratios				
Country	β_0	*p*-value	β_1	*p*-value	R^2	γ_0	*p*-value	γ_1	*p*-value	R^2
Australia	0.057	0.000	0.003	0.880	0.000	0.275	0.000	–0.081	0.000	0.176
Austria	0.041	0.000	0.029	0.003	0.060	–0.044	0.233	0.031	0.005	0.048
Belgium	0.059	0.000	0.031	0.349	0.004	0.588	0.000	–0.202	0.000	0.305
Canada	0.047	0.000	0.015	0.004	0.024	0.026	0.153	0.009	0.176	0.008
Denmark	0.066	0.000	0.006	0.522	0.002	0.070	0.005	–0.001	0.941	0.000
Finland	0.106	0.000	0.007	0.818	0.001	0.184	0.106	–0.025	0.529	0.010
France	0.052	0.000	0.058	0.000	0.104	0.040	0.250	0.013	0.290	0.006
Germany	0.049	0.000	0.016	0.340	0.005	0.115	0.024	–0.024	0.221	0.016
Ireland	0.102	0.000	0.214	0.000	0.199	0.869	0.000	–0.277	0.000	0.342
Italy	–0.016	0.141	0.068	0.000	0.303	–0.142	0.000	0.059	0.000	0.199
Japan	0.081	0.000	–0.066	0.000	0.101	0.319	0.000	–0.083	0.000	0.318
Netherlands	0.061	0.000	–0.083	0.000	0.089	0.275	0.000	–0.082	0.000	0.165
New Zealand	0.075	0.000	–0.013	0.172	0.018	0.099	0.000	–0.010	0.262	0.016
Norway	0.040	0.000	–0.009	0.537	0.003	0.173	0.001	–0.051	0.018	0.101
Portugal	0.081	0.002	–0.078	0.016	0.066	0.753	0.000	–0.246	0.000	0.431
Spain	0.133	0.000	–0.034	0.449	0.005	0.678	0.000	–0.212	0.000	0.324
Sweden	0.090	0.000	0.066	0.001	0.050	0.232	0.000	–0.055	0.020	0.037
Switzerland	0.099	0.000	0.110	0.000	0.149	–0.049	0.292	0.038	0.038	0.026
UK	0.077	0.000	–0.070	0.000	0.048	0.368	0.000	–0.118	0.000	0.251
USA	0.057	0.000	–0.011	0.030	0.007	0.197	0.000	–0.051	0.000	0.051

5. An Assessment

"Because economic and social phenomena are so forbidding, or at least so seem, … there is a persistent and never-ending competition between what is right and what is merely acceptable … Just as truth ultimately serves to create a consensus, so in the short run does acceptability … To a very large extent, of course, we associate truth with convenience … people approve most what they best understand …" wrote John Kenneth Galbraith when defining the concept of conventional wisdom in his classic book *The Affluent Society*.[21] Conventional wisdom is, precisely, what the Fed model has become: A simple, convenient, and therefore acceptable idea that links stock and bond valuation.

The evidence, however, lends little or no support to this simplistic model. Deviations from the model's proposed equilibrium are far larger than what could be considered reasonable even if the model is not thought of as a precise valuation tool. Cointegration analysis reveals that, at best, in only 1 country of the 20 considered earnings yields and bond yields are cointegrated

[21] Galbraith (1998), chapter 2 (The Concept of Conventional Wisdom), pages 6-7.

and meet the restrictions imposed by the Fed Model. Finally, P/E ratios by themselves outperform the Fed model as tool for forecasting real stock returns in 18 of the 20 countries considered when P/E ratios are based on forward earnings, and in every country when P/E ratios are based on trailing earnings.

Perhaps the Fed model is too restrictive by imposing not just a relationship but an equality between earnings yields and bond yields. Perhaps what really matters is that there is *some* positive relationship between these two variables; or, similarly, *some* negative relationship between the stock market P/E ratio and government bond yields. But the data questions even that. In fact, a casual look at the long-term trends of earnings yields and bond yields in Exhibit A5 says much about the very weak (if any) relationship between these variables.

However, most practitioners do seem to believe that the stock market P/E ratio and government bond yields are negatively related. Is it possible that they have simply surrendered to the conventional wisdom? After much reflection, Modigliani and Cohn (1979) conclude that it is, that most practitioners are unable to see through the veil of inflation. Still, the real puzzle is that although practitioners seem to believe in the Fed model, this belief does not seem to be reflected in market prices. That is, ultimately, what the evidence in this article shows.

Galbraith also wrote that the "… fatal blow to the conventional wisdom comes when the conventional ideas fail signally to deal with some contingency to which obsolescence has made them palpably inapplicable. This, sooner or later, must be the fate of ideas which have lost their relation to the world."[22] Perhaps this is the reason why the so-called Fed model was never officially endorsed by the Fed.

[22] Galbraith (1998), chapter 2 (The Concept of Conventional Wisdom), page 11.

Appendix

Exhibit A1: The Fed Model and the Market's P/E

This exhibit shows the equilibrium P/E of the stock market according to the Fed model, calculated as $P/E = 1/Y$.

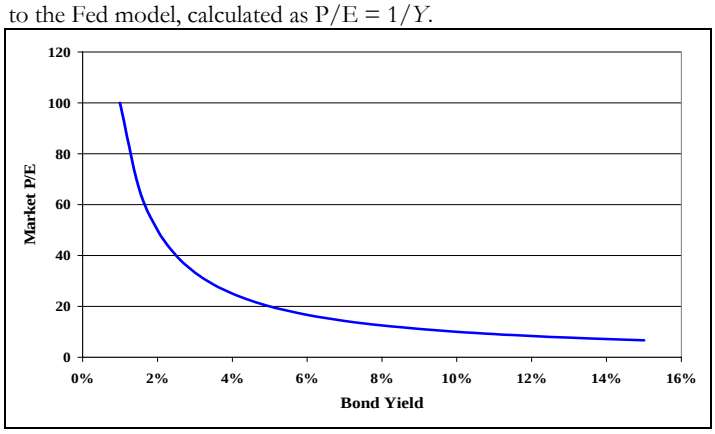


Exhibit A2: S&P500, P and P^*, Jan/85-Jun/05

This exhibit shows the value of the S&P500 (P) and its equilibrium value according to the Fed model (P^*), calculated as $P^*=E/Y$, where E denotes forward earnings and Y denotes the yield on 10-year bonds.

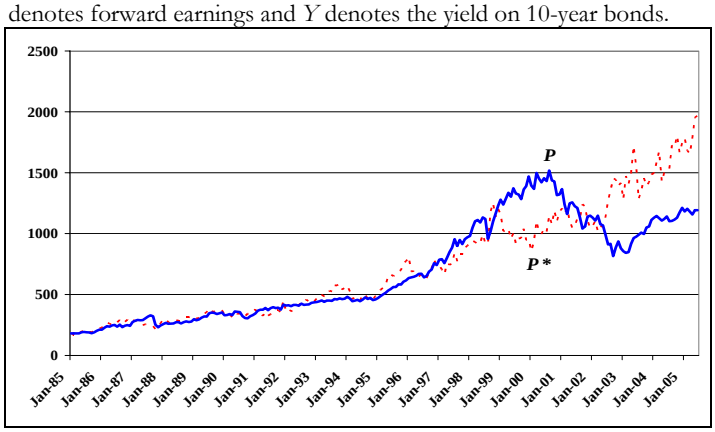


Exhibit A3: S&P500, P/P^*, Jan/85-Jun/05

This exhibit shows the ratio P/P^*, where P denotes the value of the S&P500 and P^* its equilibrium value according to the Fed model, calculated as $P^*=E/Y$, where E denotes forward earnings and Y denotes the yield on 10-year bonds.

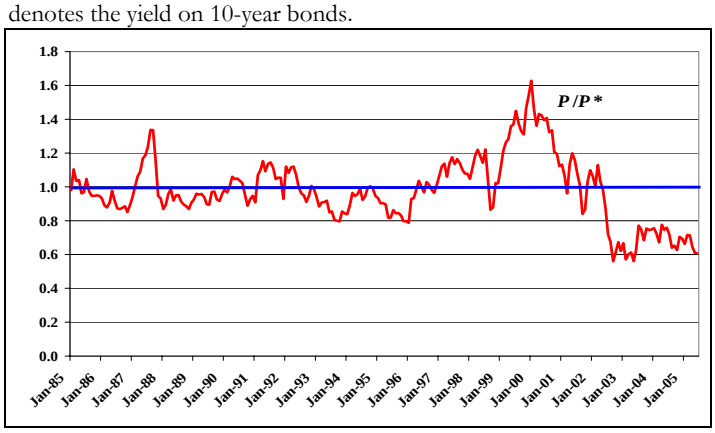


Exhibit A4: Forward Earnings Yields and Bond Yields

Exhibit A4: Forward Earnings Yields and Bond Yields (Cont.)

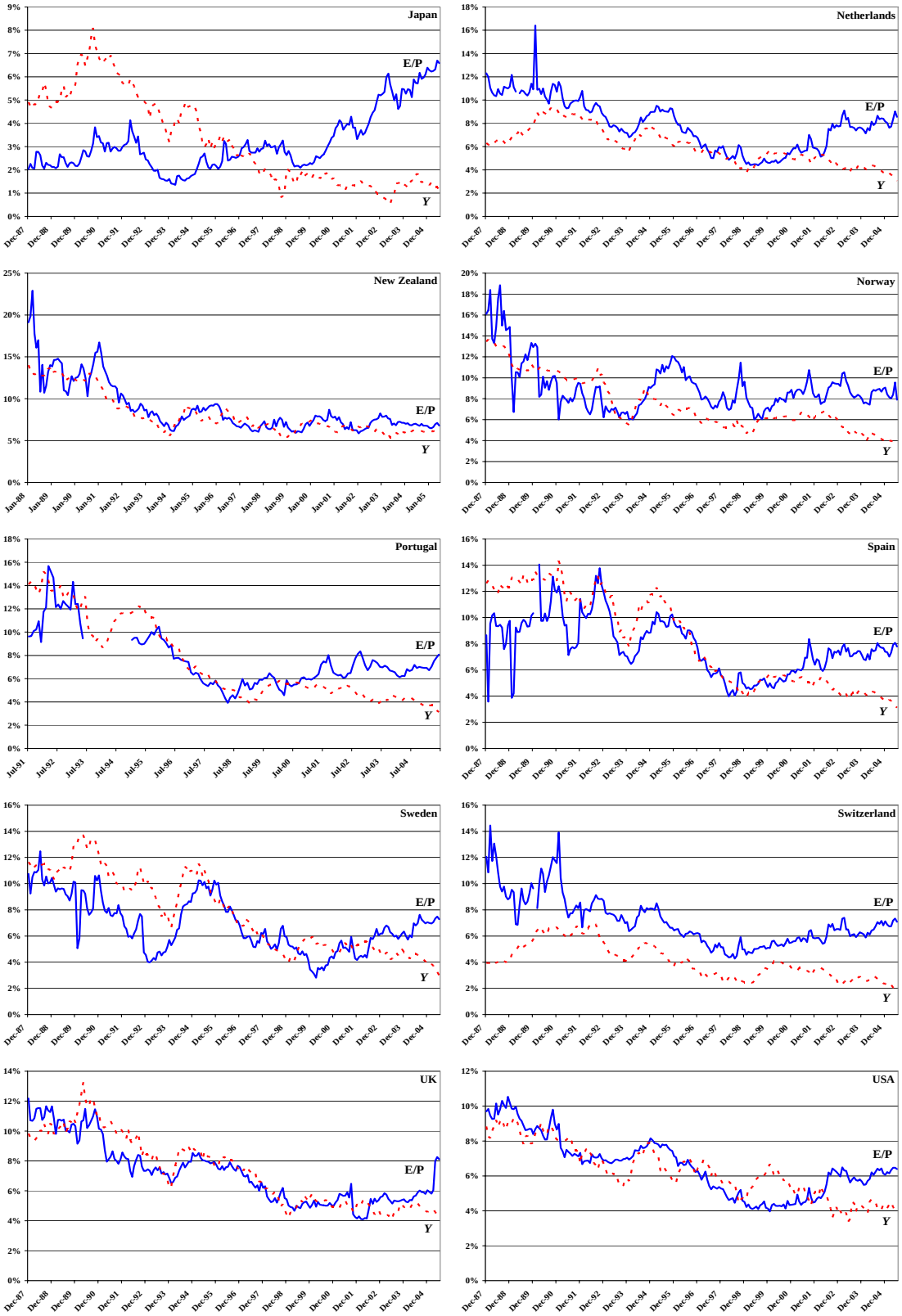


Exhibit A5: Trailing Earnings Yields and Bond Yields

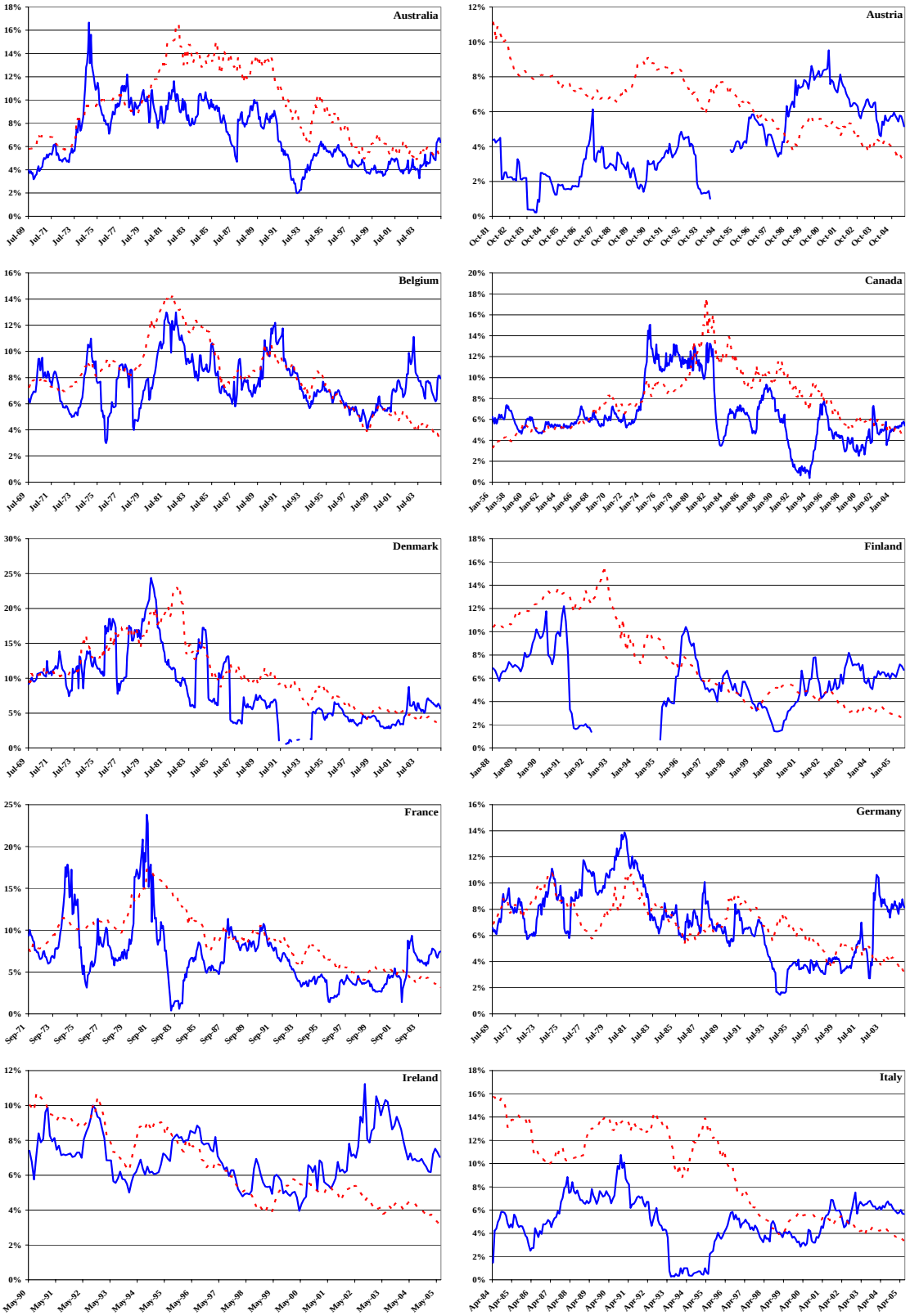
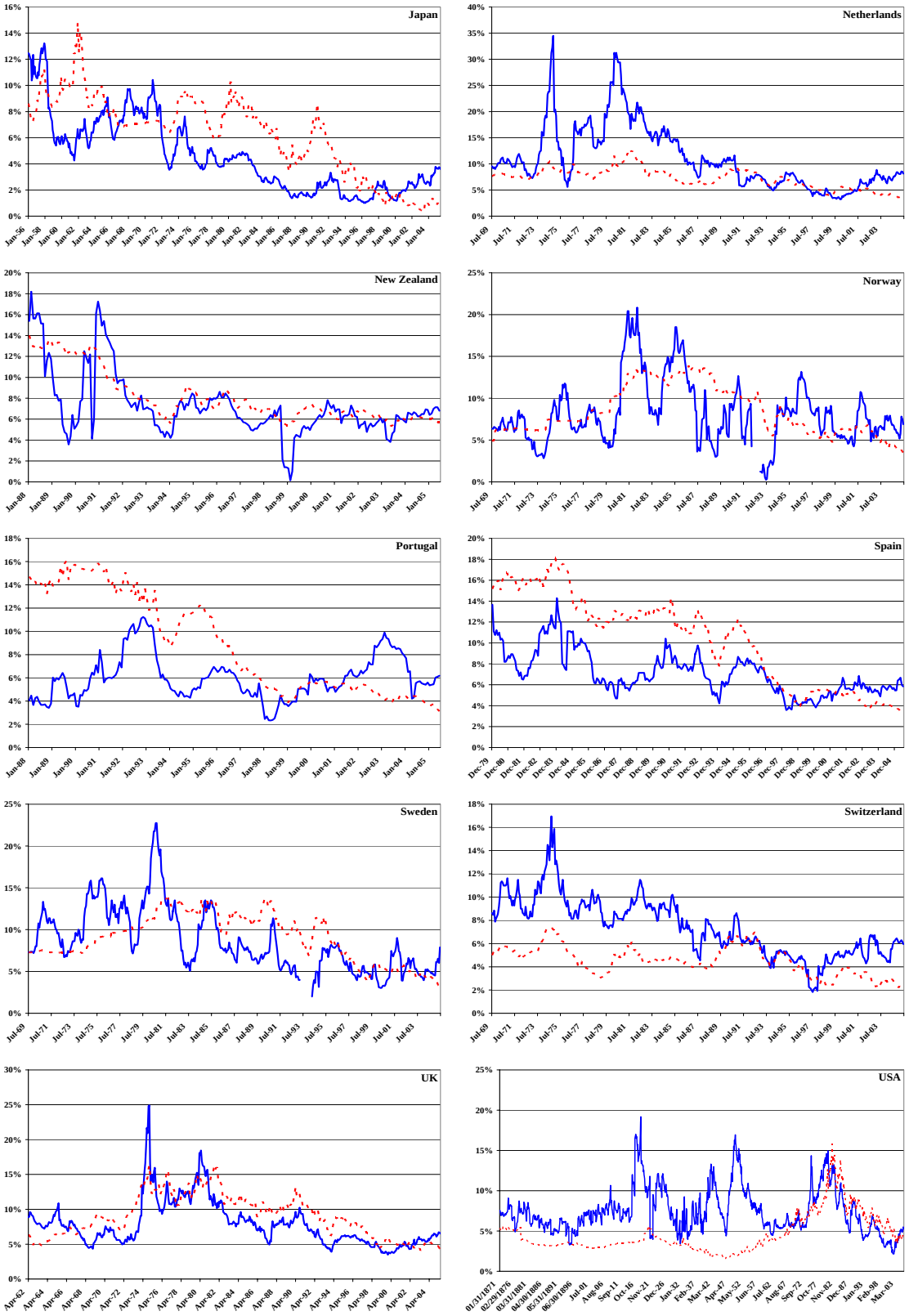


Exhibit A5: Trailing Earnings Yields and Bond Yields (Cont.)



References

Abbott, Joseph (2000). "Taking a Closer Look at the I/B/E/S Equity Valuation Model." I/B/E/S Innovator, March, 5.

Asness, Clifford (2000). "Stocks versus Bonds: Explaining the Equity Risk Premium." Financial Analysts Journal, March/April, 96-113.

Asness, Clifford (2003). "Fight the Fed Model." Journal of Portfolio Management, Fall, 11-24.

Campbell, John, and Tuomo Vuolteenaho (2004). "Inflation Illusion and Stock Prices." American Economic Review, May, 19-23.

Chaussée, Stuart (2002). *Stocks, Bonds, and the "Greenspan's Model*." Palisade Business Press.

Durré, Alain, and Pierre Giot (2004). "Endorse of Fight the Fed Model? An International Analysis of Earnings, Stock Prices and Bond Yields." Working paper.

Fama and French (2003). "The CAPM: Theory and Evidence." Center for Research in Security Prices, Working paper 550.

Feinman, Joshua (2005). "Inflation Illusion and the (Mis)Pricing of Assets and Liabilities." Journal of Investing, Summer, 29-36.

Galbraith, John (1998). *The Affluent Society*. Mariner Books.

Gwilym, Owain, James Seaton, Karina Suddason, and Stephen Thomas (2004). "Does the Fed Model Travel Well?" Working paper.

Harasty, Hélène, and Jacques Roulet (2000). "Modeling Stock Market Returns." Journal of Portfolio Management, Winter, 33-46.

Harris, Richard, and René Sánchez-Valle (2000*a*). "The Gilt-Equity Yield Ratio and the Predictability of UK and US Equity Returns." Journal of Business Finance and Accounting, 27, 333-357.

Harris, Richard, and René Sánchez-Valle (2000*b*). "The Information Content of Lagged Equity and Bond Yields." Economics Letters, 68, 179-184.

Jansen, Dennis, and Zijun Wang (2004). "Evaluating the 'Fed Model' of Stock Price Valuation: An Out-of-Sample Forecasting Perspective." Working paper.

Kane, Alex, Alan Marcus, and Jaesun Noh (1996). "The P/E Multiple and Market Volatility." Financial Analysts Journal, July/August, 16-24.

Koivu, Matti, Teemu Pennanen, and William Ziemba (2005). "Cointegration Analysis of the Fed Model." Working paper.

Lander, Joel, Athanasios Orphanides, and Martha Douvogiannis (1997). "Earnings Forecasts and the Predictability of Stock Returns: Evidence from Trading the S&P." Journal of Portfolio Management, Summer, 24-35.

Modigliani, Franco, and Richard Cohn (1979). "Inflation, Rational Valuation and the Market." Financial Analysts Journal, March/April, 24-44.

Ritter, Jay, and Richard Warr (2002). "The Decline of Inflation and the Bull Market of 1982-1999." Journal of Financial and Quantitative Analysis, 37, 29-61.

Salomons, Roelof (2005). "A Tactical Implication of Predictability: Fighting the Fed Model." Journal of Investing, *forthcoming*.

Siegel, Jeremy (2002). *Stocks for the Long Run*. McGraw-Hill.

Thomas, Jacob (2005). "Price Equals Forward Earnings Scaled by the Risk-Free Rate: The Implications of This Remarkable Empirical Regularity." Working paper.

Yardeni, Edward (1997). "Fed's Stock Market Model Finds Overvaluation." Topical Study #38, US Equity Research, Deutsche Morgan Grenfell.

Yardeni, Edward (1999). "New, Improved Stock Valuation Model." Topical Study #44, US Equity Research, Deutsche Morgan Grenfell.

Yardeni, Edward (2002). "Asset Valuation & Allocation Models." Prudential Financial Research, July 30.