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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. However, 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.

Keywords: Fed model; P/E ratios; Interest rates; Stock market valuation

1. Introduction

Although many practitioners are fond of simple models, the valuation of stocks and equity markets does not seem to lend itself to such models. And although some investors may be led to believe that simply by comparing two numbers, earnings yields and bond yields, they can easily determine whether the stock market is mispriced, both theory and evidence seem to point against that belief.

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

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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.

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rather than simple; the comprehensive evidence from 20 countries reported in this article leads to the conclusion that the Fed model belongs to this category.

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*/*E*s 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 the 20 countries considered; and *P*/*E*s outperform the Fed model as a tool to forecast real stock returns in 18 of those 20 countries. Third, the longer-term evidence based on trailing *P*/*E*s lends even less support to 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 fails both as a normative *and* as a positive model of stock prices.

One important caveat: many academics simply dismiss the Fed model; they consider it too simple, too naive, and not worth of much attention. It is important, then, to notice that all the arguments in this article are just as much about the Fed model as they are about the negative relationship between marketwide *P*/*E* ratios and interest rates (or inflation). Most investors do seem to be willing to pay higher (lower) *P*/*E*s when interest rates and inflation are low (high), though not necessarily the *P*/*E*s suggested by the Fed model. Therefore, those that dismiss the Fed model outright should view this article as an inquiry into the validity of the negative relationship between marketwide *P*/*E* ratios and interest rates.

This article assembles the largest cross-section of countries and the longest time series available to test both the Fed model and the relationship between marketwide *P*/*E* ratios and interest rates. It therefore offers not a partial view for a small subset of countries or short sample periods but a comprehensive view on the validity of this model and this relationship.

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. Finally, Section 4 makes an assessment.

2. The model and the literature

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,

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

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

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

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 Fig. 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 implausible from the outset (more on this below).

The origins of the Fed model are not entirely clear. In its Humphrey–Hawkings report of 22 July 1997, the Fed noted that "... the ratio of prices in the S&P500 to consensus estimates of earnings over the coming 12 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, for example, 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.

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, Goldman Sachs states in a report 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 30–40 years . . .,"

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

[3] US Economics Analyst, Issue 05/50, 16 December 2005, page 5.

Table 1
The Fed model and tactical asset allocation

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

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

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 $P/P^* < 1$. Fig. A2 in the appendix shows both P and P^* for the S&P500 over the January 1985 to June 2005 period, and Fig. 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 Table 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 Table 1 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.

Lander, Orphanides, and Douvogiannis (1997), Harris and Sánchez-Valle (2000a,b), Gwilym, Seaton, Suddason, and Thomas (2004), and Salomons (2006) 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. The bad: theory

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. Although this may sound

[4] "Equities Shrug Off Gloom," Wall Street Journal Europe, 7 June 2005.

[5] "Equities Make Little Headway as Investors Await US Trade Data," Financial Times, 12 April 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).

implausible, it is however what *must* be assumed if the Fed model is to be considered a special case of a standard equity valuation framework. To see this, consider the constant-growth version of the dividend discount model (DDM), which is given by

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

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 is 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 $D(1+G)=E$, (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, the Fed model follows from a widely accepted model backed by theory only under these three restrictive assumptions.[7]

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)

[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) yields $P/E=(1+G)/R_f$.

[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]

2.3. A brief review of the literature

Many practitioners validate the Fed model with a chart similar to panel A of Fig. 1, which seems to indicate a strong relationship between (trailing) E/P and Y in the US during the January 1968 to June 2005 period. However, as panel B of Fig. 1 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 January 1968 and June 2005, −0.19 between January 1871 and December 1967, and only 0.10 over the whole January 1871 to June 2005 period.

The empirical support for the Fed model highlighted by some practitioners, such as Yardeni (1997), is based on a period that is relatively narrow compared to the period in which the model does not work. And the evidence is limited not only from a temporal perspective, as Fig. 1 shows, but also from a cross-sectional perspective, as the international evidence discussed below shows.

Lander et al. (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 (2006) 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 three countries they consider. Finally, Thomas (2005) plots earnings yields and bond yields in 10 countries and considers the (limited) graphical analysis as supporting the Fed model.

[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).

[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.

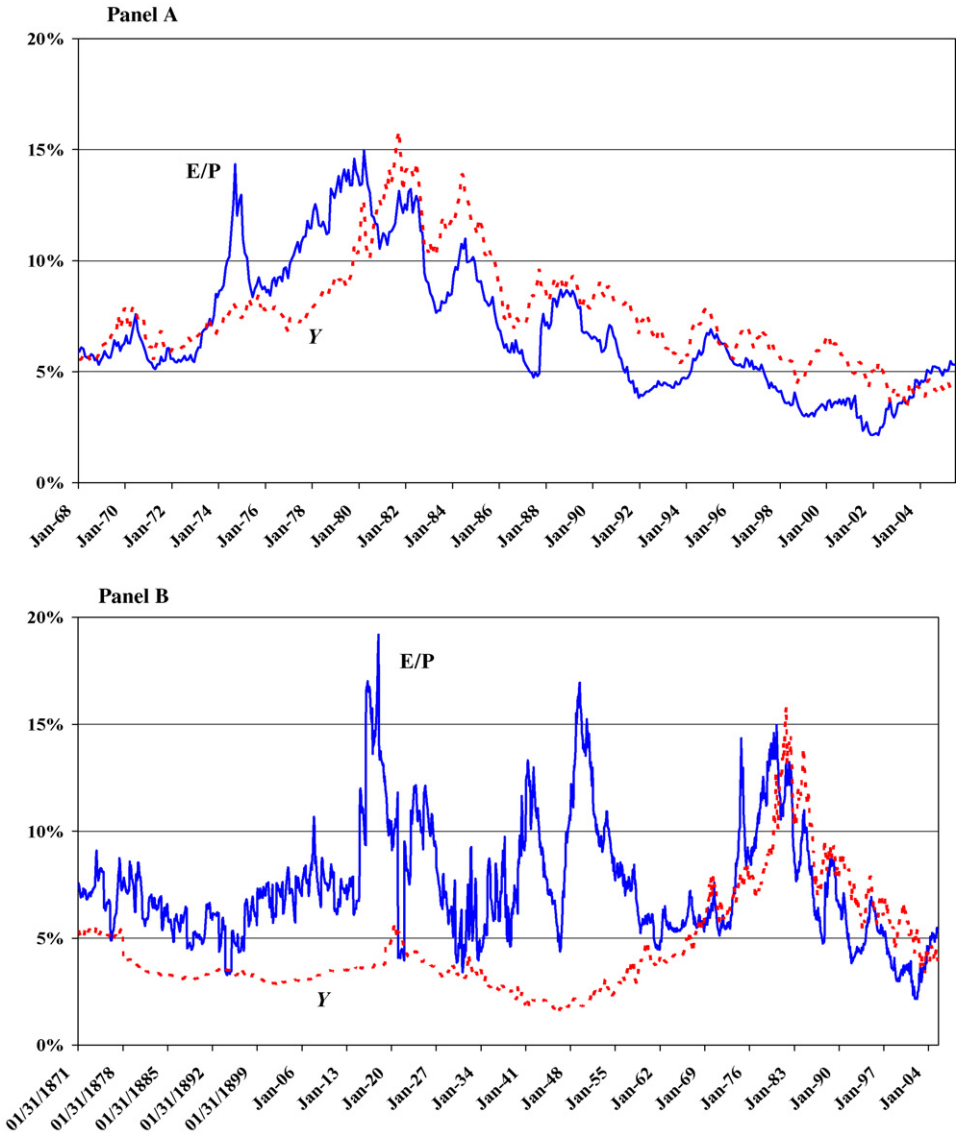

Fig. 1. The Fed model (USA). This figure shows the trailing earnings yield of the S&P500 (E/P) and the yield on 10-year treasury notes (Y). Panel A depicts both variables between January 1968 and June 2005, and panel B between January 1871 and June 2005.

Harris and Sánchez-Valle (2000a,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.

Durré and Giot (2004) consider 13 countries and find that earnings, stock prices, and bond yields are cointegrated in nine of them. However, in none of these nine 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 six 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 weak at best. The consensus seems to be that although bond yields may have a short-term impact on stock prices, they do not affect 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. At best, then, the Fed model may be somewhat useful only as a (short-term) TAA tool.

The evidence discussed below assembles the largest cross-section of countries and the longest time series available to test both the Fed model and the relationship between marketwide *P*/*E* ratios and interest rates. It therefore offers a comprehensive view of the validity of this model and this relationship.

3. The evidence

As the discussion above 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 reveals that this is largely not the case.

3.1. 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 some of the results discussed in this section are based on the widely used Morgan Stanley Capital International (MSCI) indices.

Unfortunately, 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 on forward earnings is therefore complemented with that on *trailing* earnings, broad benchmark indices of stocks, and 10-year government bond yields, all of them available in Global Financial Data.[15]

Panel A of Table 2 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 June 2005. This panel 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. Fig. 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.

[15] 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.

Table 2
Preliminary analysis

	E/P (%)	Y (%)	Rho	$E/(P–Y)$ (%)	DM	Beginning
Panel A						
Australia	7.7	8.1	0.89	−0.4	−1.88	December 1987
Austria	6.9	6.1	−0.52	0.8	4.76	September 1988
Belgium	8.3	6.5	0.50	1.8	9.66	December 1987
Canada	6.9	7.4	0.67	−0.5	−2.93	December 1987
Denmark	6.5	6.9	0.39	−0.4	−2.60	December 1987
Finland	6.6	7.5	0.21	−0.9	−2.59	January 1988
France	7.0	6.5	0.73	0.5	2.32	December 1987
Germany	6.2	5.9	0.24	0.2	1.38	December 1987
Ireland	8.3	6.5	0.70	1.8	9.39	May 1990
Italy	6.1	8.4	0.26	−2.3	−7.74	December 1987
Japan	3.2	3.3	−0.50	−0.1	−0.86	December 1987
Netherlands	7.9	6.0	0.63	1.8	9.93	December 1987
New Zealand	8.8	8.1	0.88	0.7	2.73	January 1988
Norway	9.1	7.5	0.57	1.6	6.76	December 1987
Portugal	7.6	7.4	0.84	0.1	0.32	July 91
Spain	7.8	8.2	0.72	−0.4	−1.51	December 1987
Sweden	6.8	7.8	0.67	−0.9	−3.76	December 1987
Switzerland	7.1	4.1	0.64	3.1	18.79	December 1987
UK	7.2	7.4	0.89	−0.1	−0.62	December 1987
USA	6.6	6.3	0.74	0.3	1.98	December 1987
Panel B						
Australia	6.9	9.4	0.69	−2.5	−12.77	July 1969
Austria	4.2	6.6	−0.67	−2.5	−15.24	October 1981
Belgium	7.6	8.1	0.60	−0.5	−3.03	July 1969
Canada	6.5	7.8	0.46	−1.3	−8.10	January 1956
Denmark	8.7	10.6	0.73	−1.9	−5.73	July 1969
Finland	5.8	7.5	0.25	−1.7	−5.61	January 1988
France	6.9	8.8	0.52	−1.9	−7.52	September 1971
Germany	7.1	7.0	0.44	0.1	0.92	July 1969
Ireland	7.0	6.5	0.21	0.5	2.85	May 1990
Italy	5.0	9.3	0.03	−4.3	−15.88	April 1984
Japan	4.6	6.2	0.63	−1.7	−9.67	January 1956
Netherlands	11.0	7.2	0.72	3.8	12.38	July 1969
New Zealand	7.2	8.1	0.65	−0.8	−3.12	January 1988
Norway	8.1	8.5	0.51	−0.3	−1.40	July 1969
Portugal	6.0	8.9	0.09	−2.9	−9.02	January 1988
Spain	7.1	10.3	0.76	−3.2	−11.58	December 1979
Sweden	8.6	9.0	0.44	−0.3	−1.43	July 1969
Switzerland	7.4	4.5	0.58	2.9	21.32	July 1969
UK	7.9	9.0	0.75	−1.1	−5.76	April 1962
USA	7.4	4.6	0.10	2.8	30.96	January 1871

This table shows monthly 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 June 2005. E/P and Y represent averages over each country's whole sample period. E, P, and E/P are based on MSCI indices and forward earnings in panel A and on benchmark stock market indices and trailing earnings in panel B, all of them in local currency. Yield data for Finland based on 5-year government bond yields in both panels; yield data for Japan based on 7-year government bond yields in panel B. DM is the test statistic for a difference-in-means test; the asymptotic critical value at the 5% level of significance is ±1.96.

Panel B of Table 2 shows the same 20 countries and magnitudes reported on panel A but in this case referring to the longer data set based on trailing earnings, broad indices of stocks, and 10-year government bond yields from Global Financial Data. Fig. A5 in the appendix shows graphs depicting trailing earnings yields and bond yields for all countries over their own sample period.

As panel A shows, the correlation between forward 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.[16]

Panel A 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 (at the 5% significance level) that these magnitudes are significantly different in 14 countries of the 20 considered.

Panel B shows that the correlations between trailing earnings yields and bond yields are in some countries higher and in some countries lower than those reported in panel A. The largest differences in correlations between the two panels 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). Panel B also shows the difference between the mean trailing 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.

Finally, 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.

3.2. The worse (I): 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, 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.

Table 3 reports four valuation gaps that respond to the expressions

$$\mathrm{VG1} = \left(\frac{1}{T}\right)\sum_{t}\left\{\left(\frac{E}{P}\right)_t - Y_t\right\} \tag{4}$$

$$\mathrm{VG2} = \left(\frac{1}{T}\right)\sum_{t}\left\{\frac{(E/P)_t - Y_t}{Y_t}\right\} \tag{5}$$

[16] 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 not stationary, which renders correlation analysis largely meaningless.

Table 3
Valuation gaps

	VG1 (%)	VG2 (%)	VG3 (%)	VG4 (%)
Panel A				
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
Panel B				
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

This table shows four monthly valuation gaps based on forward earnings (panel A) and trailing earnings (panel B). VG1, VG2, VG3, and VG4 follow from expressions (4), (5), (6), and (7), respectively.

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

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

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%.[17] 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 in Table 3.

In panel A, 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.

Panel B shows that VG1 and VG2 generally show substantially larger valuation gaps between trailing earnings yields and bond yields than those reported in panel A. VG4 is larger in panel B than in panel A in 14 of the 20 countries, notably in the US (going from 18.3% to 110.8%). The evidence in this table quite clearly indicates, 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.

3.3. The worse (II): unit roots and cointegration

The correlations between earnings yields and bond yields reported in Fig. 1 seem to suggest that the Fed model is a fairly 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 then to determine whether these variables have a unit root. The second and third columns of Table 4 report the test statistics of augmented Dickey–Fuller (ADF) tests for a unit root in $\ln(P/E)$ and $\ln(1/Y)$. In panel A, 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 are not stationary and, therefore, correlation analysis is largely meaningless. For this reason, it is simply misleading to justify the plausibility of the Fed model by highlighting a high correlation between earnings yields and bond yields.

[17] 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 $(12–10\%)/10 = 20\%$.

Table 4
Unit roots and cointegration

	ln(*P*/*E*)	ln(1/*Y*)	Δln(*P*/*E*)	Δln(1/*Y*)	FM	Coint
Panel A						
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
Panel B						
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

This table shows the results of tests for a unit root and cointegration using monthly data. Panel A shows results for forward *P*/*E*s and panel B for trailing *P*/*E*s The second through sixth columns show test statistics of augmented Dickey–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*). N/A indicates that ln(*P*/*E*) and ln(1/*Y*) have different orders of integration.

Table 5
Hypothesis testing

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

This table shows the results of the regression $\ln(P/E)_t = \lambda_0 + \lambda_1 \ln(1/Y)_t + \varepsilon_t$, where ε_t is an error term, for Ireland and New Zealand based on monthly data and forward P/Es. 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.

The fourth and fifth columns of Table 4 report the test statistics of ADF tests on the first difference of $\ln(P/E)$ and $\ln(1/Y)$. In panel A, 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.[18] 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 $\mathrm{FM} = \ln(P/E) - \ln(1/Y)$ is stationary around a 0 mean. The sixth column of Table 4 shows the test statistics of ADF tests for a unit root on FM. In panel A, 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 Table 4 shows the test statistics of Engle–Granger cointegration tests between P/E ratios and inverse bond yields. In panel A, at 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 $\ln(P/E)_t = \lambda_0 + \lambda_1 \ln(1/Y)_t + \varepsilon_t$, 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. Table 5 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.

The evidence in panel B is not more supporting of the Fed model than that in panel A. ADF tests on $\ln(P/E)$ and $\ln(1/Y)$ 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 unit-root hypothesis for the first difference of $\ln(P/E)$ and $\ln(1/Y)$ is rejected for both variables in all countries, indicating that both variables become stationary after differencing.

The sixth column of panel B show that the FM variable has a unit root (and is therefore nonstationary) in all countries. The last column of the same panel shows the test statistics of

[18] 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.

Engle–Granger cointegration tests between *P*/*E* ratios and inverse bond yields; at the 5% level of significance, these numbers confirm that these two variables are cointegrated in *no* country of the 20 considered.

In short, then, despite the rather high correlations displayed in Fig. 1, 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 (New Zealand) when the analysis is based on forward earnings, and in no country when the analysis is based on trailing earnings.

3.4. The ugly: 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

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

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.[19] 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

$$\ln(R_{t+60}) = \gamma_0 + \gamma_1 \ln\left(\frac{P}{E}\right)_t + v_t, \tag{9}$$

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 Table 6. Panel A1 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.

[19] In all countries nominal stock returns are calculated using total return indices (which include both capital gains and dividends), and inflation rates using consumer price indices.

Table 6
Forecasting real stock returns

Panel A	Panel A1: Fed model					Panel A2: *P/E* ratios				
	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
Panel B	**Panel B1: Fed model**					**Panel B2: *P/E* ratios**				
	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

This table shows the results of the regressions $\ln(R_{t+60}) = \beta_0 + \beta_1\{\ln(P/E)_t - \ln(1/Y)_t\} + u_t$ in panels A1 and B1 and $\ln(R_{t+60}) = \gamma_0 + \gamma_1 \ln(P/E)_t + v_t$ in panels A2 and B2, where u_t and v_t are error terms. Panel A shows results for forward *P/E*s and panel B for trailing *P/E*s. All regressions run with monthly data from the beginning of each country's sample period (indicated in Table 2) through June 2000. Last 5-year real return for all countries estimated over the June 2000 to June 2005 period. Nominal returns based on MSCI indices in panel A and on benchmark stock indices in panel B. Inflation rates based on consumer price indices. Significance is based on the Newey–West heteroskedasticity/autocorrelation-consistent covariance matrix.

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 outperformed by the forecasting ability of the *P*/*E* ratio. In fact, Panel A2 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.[20]

The evidence based on trailing earnings reported on panel B points in the same direction. Panel B1 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.

Panel B2 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.

3.5. Some further thoughts

The evidence in the previous section indicates that, as a predictor of real stock returns, the Fed model is outperformed by the *P*/*E* ratio in every country when the analysis is based on trailing earnings, and in all but two countries when it is based on forward earnings. Curiously, one of these two countries is the US, which begs the question of why this might be the case.

Fama (1981) suggests that the post-1953 US data shows a negative correlation between real stock returns and inflation, and argues that this may be due to a proxy effect; that is, the fact that stock returns are determined by forecasts of real variables, plus the fact that inflation and real activity are negatively correlated. This second relationship, in turn, could be explained by the fact that most of the variation in real money demanded that follows from changes in real activity is accommodated through offsetting variations in inflation rather than through nominal money growth. In other words, if the Fed responds to an increase in inflationary expectations by increasing interest rates, investors may expect the economy to cool down and earnings growth to slow, to which they react by pushing down stock prices thus raising earnings yields.[21]

This argument may offer a possible explanation of why the model has some explanatory power in the US, and it is consistent with Modigliani and Cohn (1979), Asness (2003), and Feinman (2005), all of whom argue that US investors suffer from money illusion. However, it does not quite explain why US investors suffer from *more* money illusion than investors from other countries.

[20] 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.

[21] An anonymous referee suggested both this argument and its relationship to Fama's (1981) article.

Still, the bulk of the evidence discussed above casts some serious doubts on the overall empirical merits of the Fed model. Earnings yields and bond yields are more correlated in some markets than in others, but even high correlations do not help the model given that nonstationary variables render correlation analysis meaningless. Empirical validations of the Fed model supported by high correlations are, essentially, flawed.

The equality between earnings yields and bond yields is rejected in 14 markets when the analysis is based on forward earnings, and in 17 when it is based on trailing earnings. Furthermore, the valuation gaps between earnings yields and bond yields are far larger than those that could be reasonable expected from an accurate forecasting framework, even if the Fed model is considered as providing only a fair value range.

Finally, cointegration analysis shows that earnings yields and bond yields do not move together over the long term. The restrictions imposed by the Fed model on these variables are fulfilled in just one country out of 20 when the analysis is based on forward earnings, and in no country when it is based on trailing earnings. This evidence thus indicates that there seems to be no mechanism attracting earnings yields and bond yields toward each other over the long term.

4. 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*.[22] 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 discussed in this article, following from the largest cross-section of countries and the longest time series available, however, lends little or no support to this 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 and meet the restrictions imposed by the Fed Model. Finally, *P*/*E* ratios by themselves outperform the Fed model as a 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 Fig. A5 says much about the very weak (if any) relationship between these variables.

However, many 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

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

conventional wisdom? After much reflection, Modigliani and Cohn (1979) conclude that it is; most practitioners, they claim, are unable to see through the veil of inflation.

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."[23] Perhaps this is the reason why the so-called Fed model was never officially endorsed by the Fed.

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Appendix A

See Figs. A1–A5.

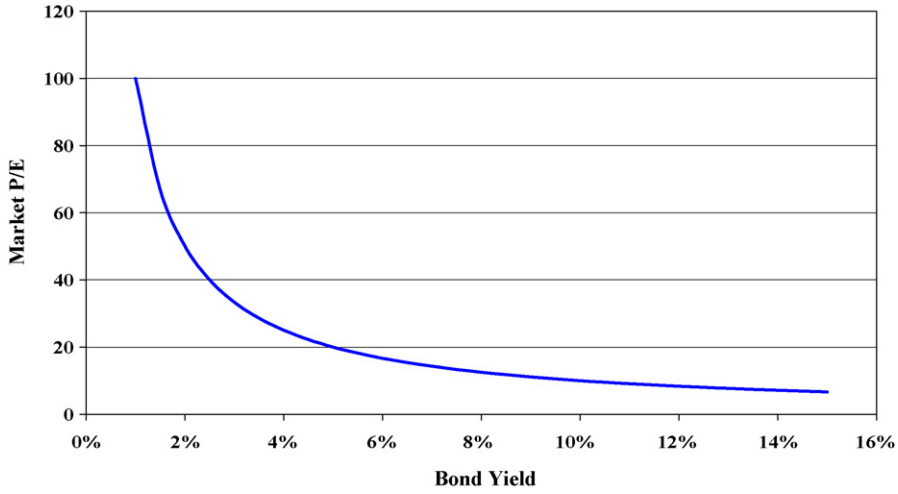

Fig. A1. The Fed model and the Market's P/E. This figure shows the equilibrium P/E of the stock market according to the Fed model, calculated as $P/E = 1/Y$.

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

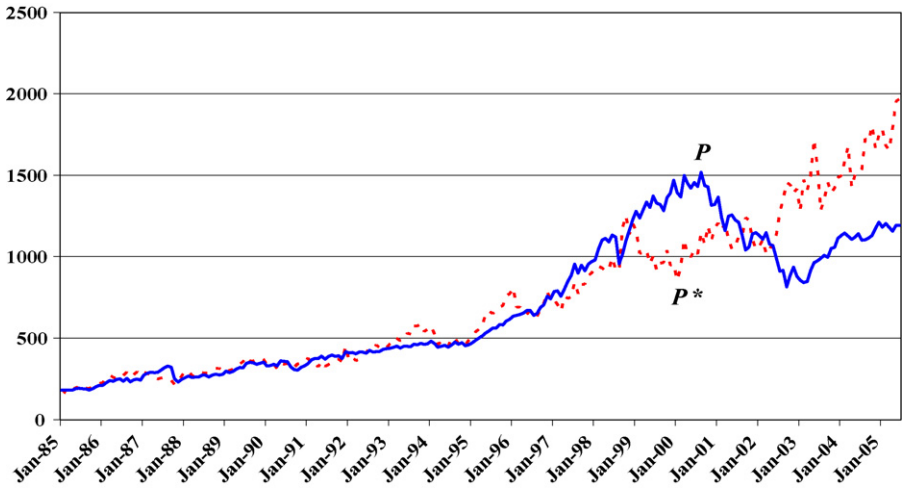

Fig. A2. S&P500, P and P^*, January 1985 to June 2005. This figure shows the value of the S&P500 (P) and its equilibrium value according to the Fed model (P^*), calculated as $P^* = E/Y$, where E denotes forward earnings and Y denotes the yield on 10-year bonds.

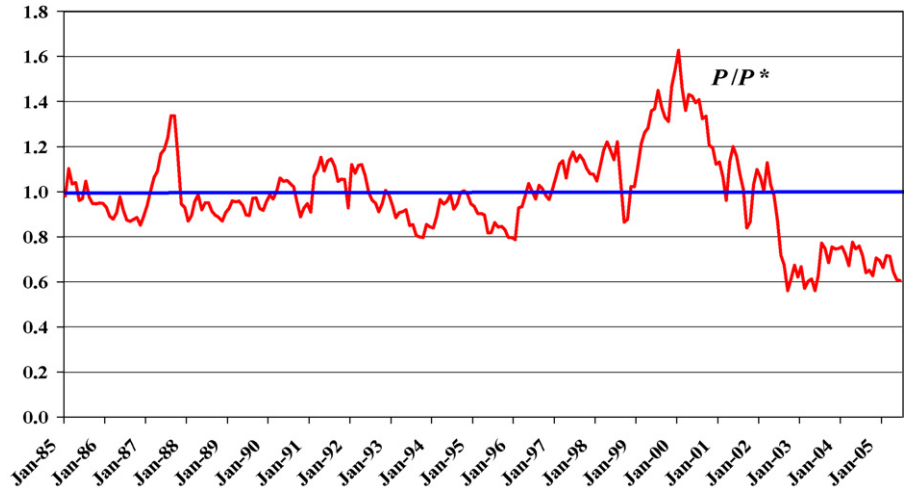

Fig. A3. S&P500, P/P^*, January 1985 to June 2005. This figure shows the ratio P/P^*, where P denotes the value of the S&P500 and P^* its equilibrium value according to the Fed model, calculated as $P^* = E/Y$, where E denotes forward earnings and Y denotes the yield on 10-year bonds.

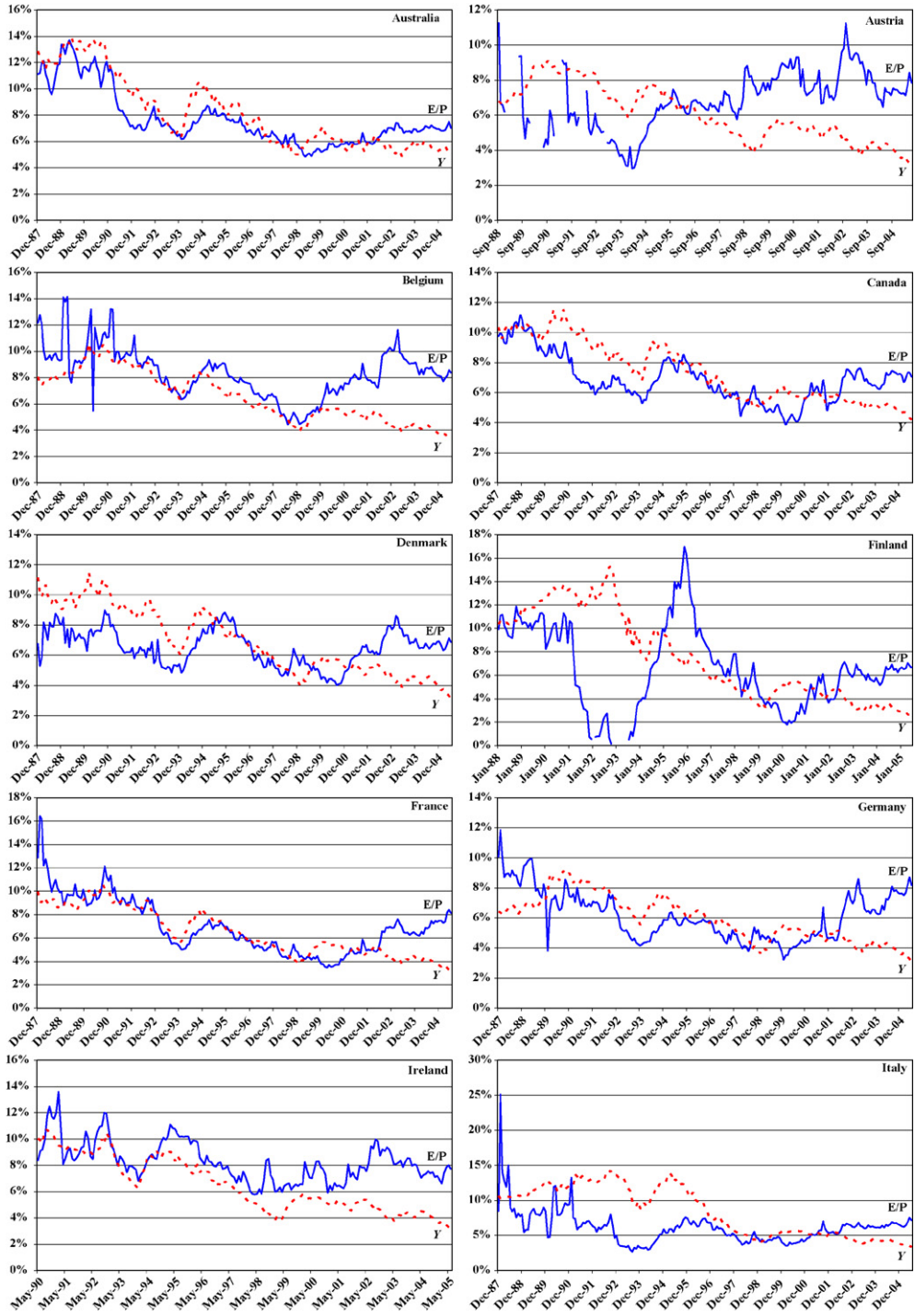

Fig. A4. Forward earnings yields and bond yields.

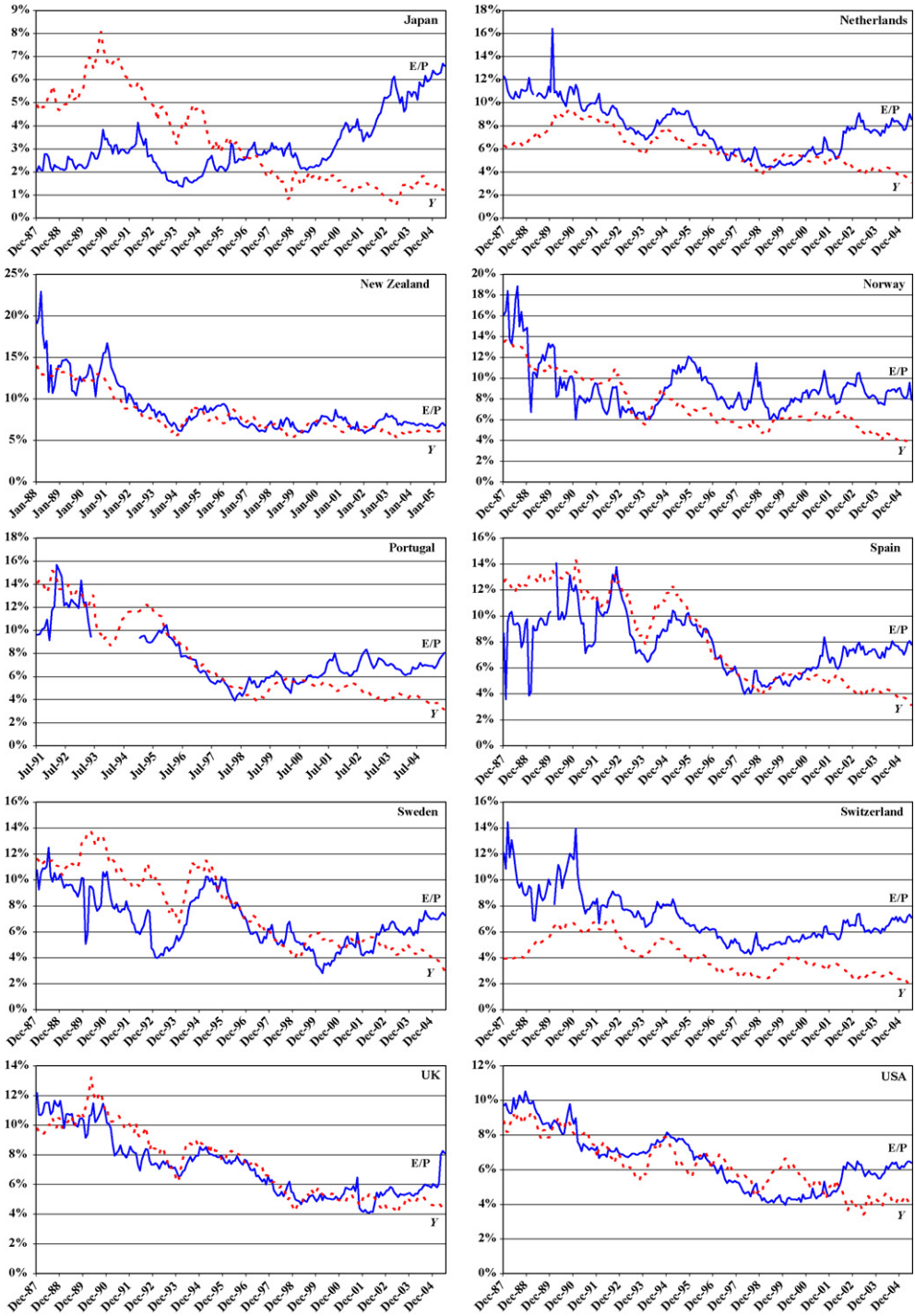

Fig. A4. (*Continued*).

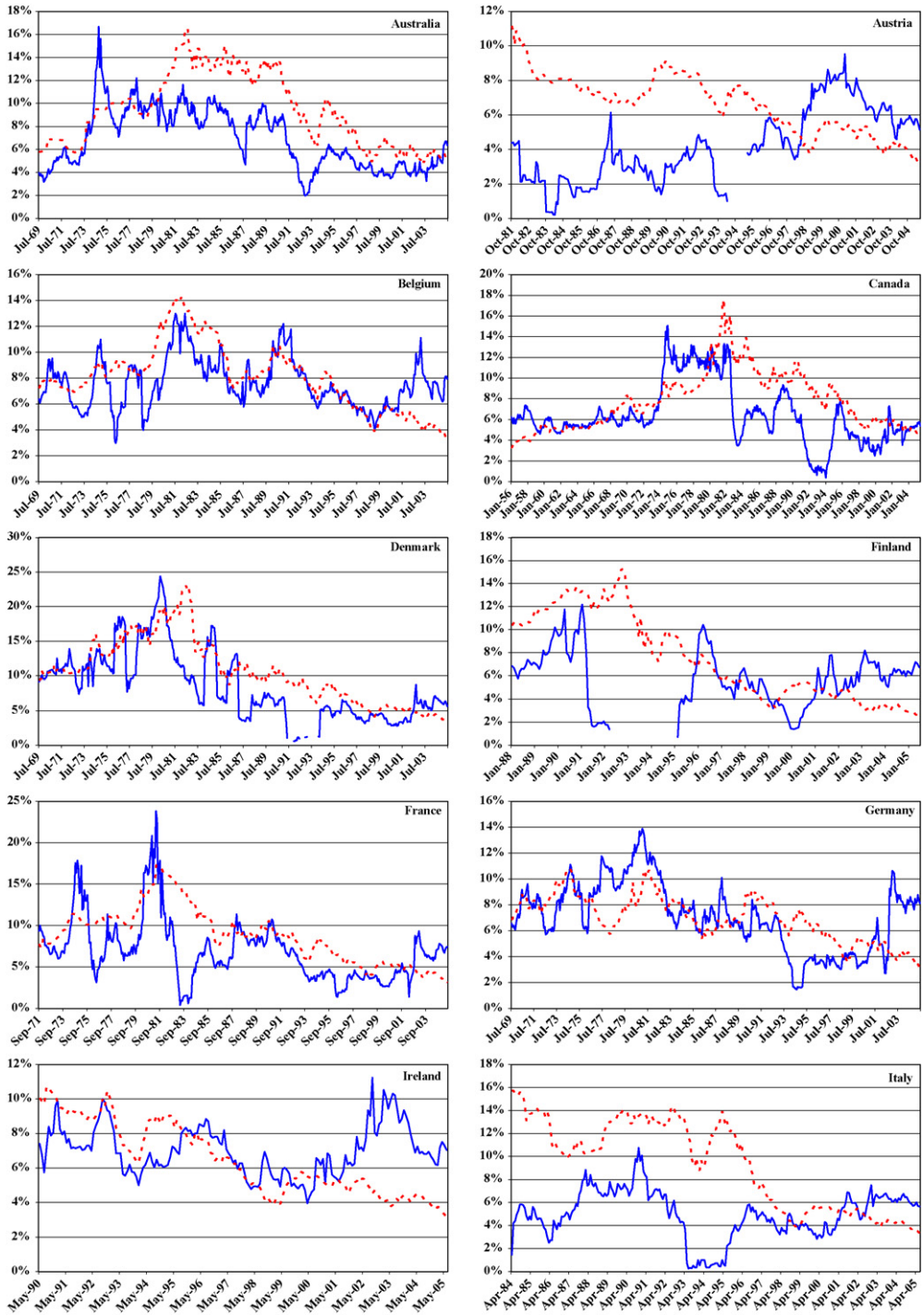

Fig. A5. Trailing earnings yields and bond yields.

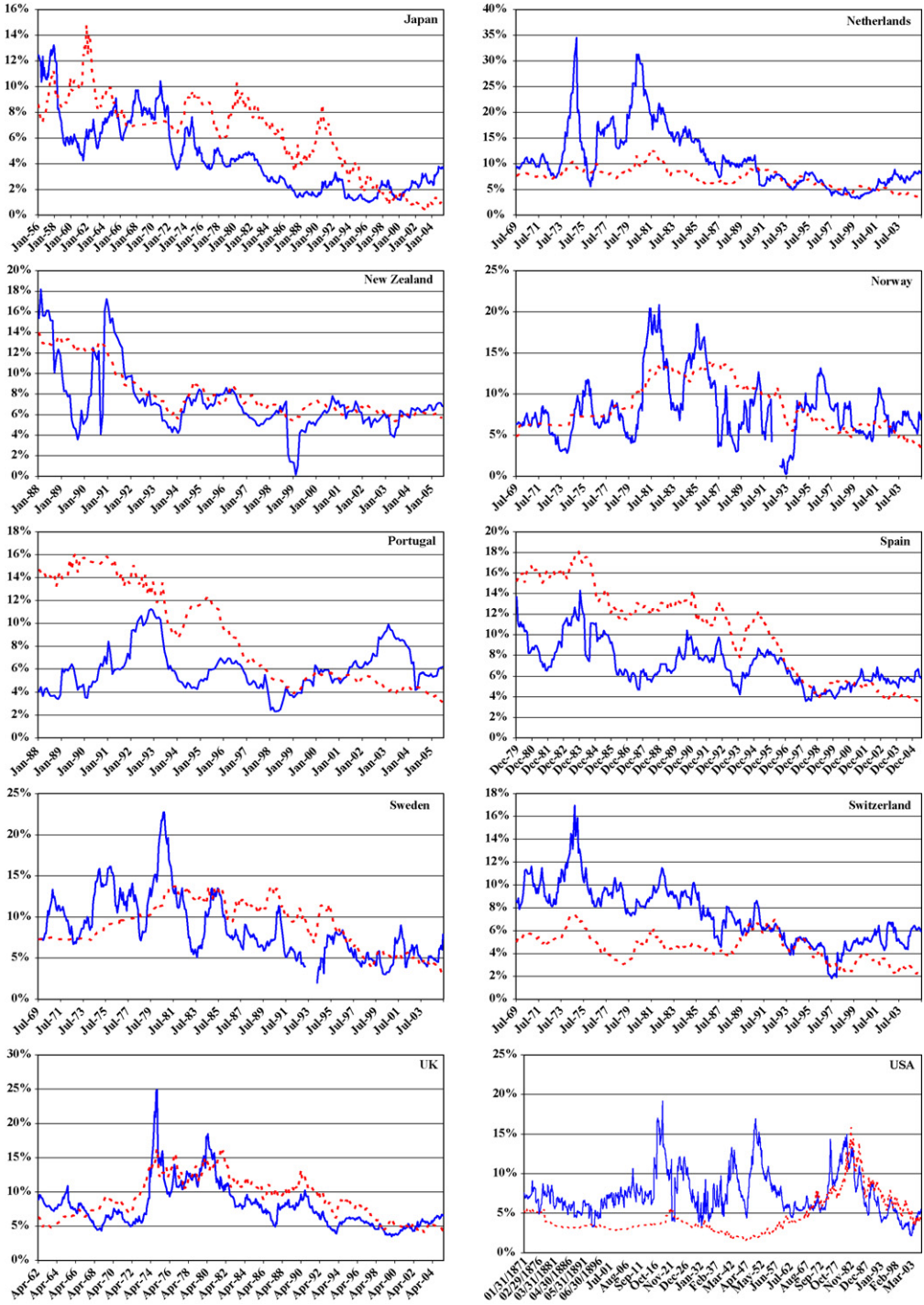

Fig. A5. (*Continued*).

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