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ABSTRACT

Why so Glum? The Meese-Rogoff Methodology Meets the Stock Market*

This paper applies the Meese-Rogoff (1983a) methodology to the stock market. We compare the out-of-sample forecasting accuracy of various time-series and fundamentals-based models of aggregate stock prices. We stick as close as possible to the original Meese-Rogoff sample and methodology. Just as Meese and Rogoff found for the case of exchange rates, we find that a random walk model of stock prices performs as well as any estimated model at one to twelve month horizons, even though we base forecasts on actual future fundamentals of dividends and earnings. Using this metric and for this sample period, aggregate stock prices seem to be as difficult to model empirically as exchange rates.

JEL Classification: F37 and G12
Keywords: aggregate, dividend, earning, exchange, forecast, fundamental, growth, model and rate

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Submitted 12 February 2008

I. Motivation

In their now-classic (1983a, b) papers, Richard Meese and Kenneth Rogoff (hereafter "MR") examined the forecasting performance of a number of then-popular exchange rate models. They found that a random walk "model" of the exchange rate consistently out-forecast the structural models, despite the latter's being given the advantage of using actual future values of market fundamentals. The full reaction to the MR message took years to process, but was eventually devastating for the field of International Finance. Academic modeling of exchange rate determination basically ceased. The area fell into disrepute; indeed, the area is not even represented on many first-rate academic faculties. By academic standards the MR paper had a huge impact and its fallout is still felt whenever exchange rates are intelligently discussed.

In the current paper we ask a simple question: What happens when the MR method is applied to assets other than foreign exchange? We consider aggregate stock market indices in Germany, Japan, the UK and the USA, countries that correspond to the bilateral exchange rates considered by MR. We carry out the same forecasting analysis as MR, over the same sample period, 1973m3 through 1981m6. Just as MR did for foreign exchange rates, we consider a number of time-series and structural models, and use a number of metrics to compare them out of sample with a random walk. Crucially, we follow MR in allowing structural models to forecast asset prices with actual future values of fundamentals (which would ordinarily be unknown). Where MR forecast exchange rates with money, income, and the like, we provide the forecaster with information about the levels and growth rates of earnings, dividends, and interest rates. It turns out that not only is our methodology similar to that of MR; so is our conclusion. Just as MR found with foreign exchange, we find that none of our models with fundamentals perform consistently and substantially better than a simple random walk model of the aggregate stock market.

This paper is intended primarily for the international finance profession. Our intention is to focus on the stock market to demonstrate that foreign exchange prices are broadly as difficult to model as other asset prices of relevance like the stock market. Accordingly, we stick close to the original MR setup. We plan to broaden the paper's sample and methods in a follow-up paper intended for the domestic asset-pricing community.

Consistent with MR, we use each of our competing models to generate forecasts at a number of different forecasting horizons. We examine four large stock markets, and estimate the coefficients of each model with the most up-to-date information available at the time of a given forecast. We follow MR in doing this by adding an observation and re-estimating each of our forecasting models for each forecast period.

The models we use rely on both the level and growth rate of two key fundamental determinants of stock prices: dividends and earnings. In particular, we focus on the well-known "Gordon Growth" model of stock values, using either dividends or earnings as the appropriate fundamental. We also consider a composite model that incorporates the levels and growth rates of both dividends and earnings, as well as the short-term interest rate. We estimate these models with a variety of different estimators, and also consider both forecasts from univariate models and vector autoregressions (VARs). Yet despite our broad-ranging sensitivity checks, we are unable to find a model that consistently outperforms the simple-minded random walk "model."

In section II we present the theoretical framework for our analysis; we then discuss the empirical methodology and data in the following section. Our results follow, and our paper ends with a brief conclusion.

II. Theory

The standard way we think about stock prices is that a firm's value at a point in time (P_t) is based entirely on either the present value of dividends (D) or earnings (N); the two must be equal by the firm's budget constraint. We follow the profession in assuming that stocks give no non-pecuniary returns. A firm's stock price is given by:

$$P_t = PV(D_{t+1}, D_{t+2}, ...) = PV(N_{t+1}, N_{t+2}, ...) \quad (1)$$

where PV() is the present value operator, which can take many forms. For our purposes, we start by assuming

$$PV(X_{t+1}, X_{t+2}, ...) = E_t \sum_{i=1}^{\infty} X_{t+i} \rho^i \quad (2)$$

where E is the expectation operator, and $0 < \rho < 1$ is the non-stochastic discount rate.[1]

Combining equations (1) and (2), we can write:

$$P_t = E_t \sum_{i=1}^{\infty} D_{t+i} \rho^i = E_t \sum_{i=1}^{\infty} N_{t+i} \rho^i . \quad (3)$$

Since price is equal to the present value of either dividends or earnings, it must equal a weighted average of the two. So for any θ,

$$P_t = \theta E_t \sum_{i=1}^{\infty} D_{t+i} \rho^i + (1-\theta) E_t \sum_{i=1}^{\infty} N_{t+i} \rho^i . \quad (4)$$

To take equation (4) to the data, we need to make an assumption about how to form expectations of future values of dividends and earnings. We assume that growth is proportional:

$$X_{t+i+1} = (1 + g_t^x) X_{t+i} + \varepsilon_{t+i+1} \tag{5}$$

where: ε_t is white noise orthogonal to X, and g_t^x is the growth rate of X estimated with data through time t, which is assumed to be constant from t onward. This assumption seems to be broadly consistent with evidence from the asset-pricing literature.[2]

We use these assumptions and equation (5) to get:

$$P_t = \theta D_t \sum_{i=1}^{\infty} (1 + g_t^D)^i \rho^i + (1 - \theta) N_t \sum_{i=1}^{\infty} (1 + g_t^N)^i \rho^i . \tag{6}$$

With a little algebra we collapse the infinite sums to

$$P_t = \frac{\theta D_t (1 + g_t^D)\rho}{1 - (1 + g_t^D)\rho} + \frac{(1 - \theta) N_t (1 + g_t^N)\rho}{1 - (1 + g_t^N)\rho} . \tag{7}$$

Equation (7) is a simple formula that gives stock price as a weighted function of earnings and dividends and their respective growth rates.[3] Versions of equation (7) are commonly known as the "Gordon growth model", after Gordon (1962).

We follow MR, and consider a log-linearized version of (7), with the interest rate added:

$$p_t = \beta_o + \beta_d d_t + \beta_{dg} \ln(1 + g_t^D) + \beta_n n_t + \beta_{ng} \ln(1 + g_t^N) + \beta_i \ln(1 + i_t) + u_t, \qquad (8)$$

where i represents the interest rate, {β} are a set of coefficients of interest, and lower- case letter are natural logs of their upper-case counterparts.[4]

In our forecasting analysis, we consider three "structural" models of stock prices; all are contained within equation (8). The Gordon-growth model for dividends sets $\beta_n = \beta_{ng} = \beta_i = 0$, while the Gordon-growth model for earnings symmetrically sets $\beta_d = \beta_{dg} = \beta_i = 0$. We also consider a composite model without any parametric constraints. We estimate our models with OLS.

III. Methodology and Data

IIIa. Estimating and Forecasting with the Fundamentals-Based Models

We try to stick as closely as possible to MR in estimating our models and using them to produce forecasts. Thus we estimate our models using our monthly data set, beginning in March 1973. We initially estimate our models with OLS using data through the start of the first forecasting period, November 1976 (we choose these dates to match those of MR). Using the estimated coefficients, we then generate forecasts for stock prices at one, three, six, and twelve month horizons. We then add data for December 1976, re-estimate our models, generate new forecasts, and continue in this fashion through the end of the sample period of June 1981.[5]

Our most interesting models rely on "fundamentals" such as earnings and/or dividends. Forecasting future stock prices with these models requires future values of these explanatory variables, and we follow MR in using actual realized values in place of forecasts of explanatory variables.

We compare our models using out-of-sample statistical techniques, and follow MR in using three measures of forecast accuracy. These are: 1) the root mean square forecast error, 2) the mean forecast error, and the 3) mean absolute forecast error. These are defined as follows:

$$MeanError \equiv \sum_{s=0}^{N_k-1}[F(t+s+k) - A(t+s+k)]/N_k \tag{9a}$$

$$MeanAbsoluteError \equiv \sum_{s=0}^{N_k-1}[|F(t+s+k) - A(t+s+k)|]/N_k \tag{9b}$$

$$RootMeanSquareError \equiv \{\sum_{s=0}^{N_k-1}[F(t+s+k) - A(t+s+k)]^2/N_k\}^{1/2} \tag{9c}$$

where: k = 1, 3, 6, 12, and 24 denotes the forecast horizon; N_k is the total number of forecasts in the projection period; A(t) is the actual known value; F(t) is the forecast value; and forecasting begins in period t. Since we follow MR in examining natural logarithms, our statistics are unit-less, approximately percentages, and comparable across markets.[6]

The root mean square error is the most important of these statistical criteria, though we consider the mean absolute error to be of almost equal importance. We are less interested in the mean error, since a very noisy forecast which wildly over- and under-forecasts can have a low average forecast error. However, we follow MR in using it as an auxiliary measure. Moreover, as MR note one can easily compare mean and mean absolute errors to determine whether a particular model habitually over- or under-forecasts.

IIIb. Alternative Models

We follow MR in comparing models with fundamentals to atheoretical univariate and multivariate time-series alternatives.

As a univariate alternative to the random walk prediction of no change, we use the "long AR" technique favored by MR. This is an unconstrained autoregression, where the longest lag included (M) is a function of the sample size (T), M=T/ln(T). Other univariate techniques tend to deliver comparable results.[7]

For our atheoretical multivariate alternative, we follow MR in using an unconstrained vector autoregression (VAR). This consists of a VAR in three variables: the natural logarithms of stock prices, earnings, and dividends. We chose the lag-lengths for the VARs taking into account three different criteria. the final prediction error (FPE), the Hannan and Quinn information criterion (HQIC) and the Schwarz information criterion (SIC).[8] Since more parsimonious VARs typically forecast better in short samples, it is unsurprising to us that we end up with relatively short lag lengths: Germany (2); Japan (2); UK (3); and US (4).[9]

IIIc. The Data Set

Our data set relies on conventional measures of popular stock price indices that cover most of the national stock market. We use the following indices: the CDAX (Germany); the Nikkei 225 (Japan); the FTSE All-Share (UK), and the S&P 500 (USA). We think of these broad measures of national stock markets as being roughly analogous to the necessarily aggregate bilateral exchange rates considered by MR.[10] We combine these prices with Price/Earnings and Dividend Yield ratios to "back out" measures of dividends and earnings. This may well induce measurement error, since we only have indirect measurements of earnings and dividends. This problem is potentially more serious at short horizons, since P/E and D/P

ratios may be updated with a lag. Accordingly, we tend to place more credence on our long-horizon forecasting results, and try to be cautious in our conclusions.[11]

We follow MR and use closing month-end prices rather than temporally-averaged prices. We also follow MR by taking natural logarithms of our key variables. In particular, we transform stock price indices, earnings, and dividends by logs, and consider interest rates in the form of $\ln[1+(i(t)/100)]$ where $i(t)$ is the annualized interest rate in percentage points at time t.[12] Our data have not been seasonally adjusted or adjusted for inflation.

Our data sources are described more fully in appendix I. We have checked all our series with a number of different statistical and ocular filters; we have also checked them with comparable and similar (e.g., monthly average) series from other sources (such as Datastream and Bloomberg), and performed spot checks with the *Financial Times*. Our key raw variables are plotted in three figures: stock price indices are graphed in Figure 1, while dividends and earnings are plotted in Figures 2 and 3 respectively. The trends over this period of time are similar across countries for prices and both fundamentals. The depressing effect of the mid-70s recession is also quite apparent in all the series. The natural logarithm transformation is quite consistent with the upward drift of the series.[13]

Our fundamentals-based models rely on growth rates of both earnings and dividends. We have experimented with a number of different ways of measuring rates of change. In particular, we have looked at annual growth rates over both one- and three-year periods; we have also measured growth rates as both forward- and backward-looking.[14] Since no one measure of growth seems to perform consistently better than the others, we err on the side of giving our forecasters more rather than less information, and use a three-year forward looking growth rate as our default. In appendix II, we present results for all four combinations that we have

considered (estimating growth rates over both one- and three-year horizons, looking either forwards or backwards).

IV. Results

Iva. Benchmark Results

Our key results are presented in Tables 1-3. These present root mean square forecast errors, mean absolute forecast errors, and mean forecast errors from November 1976 through June 1981. In each table, we present results for the random walk benchmark, and five alternative models. These are respectively, a) the univariate long autoregression; b) the vector autoregression; c) the structural Gordon-growth model with earnings; d) the structural Gordon-growth model with dividends; and e) the composite model. Each of these models is compared at three different forecast horizons (one, three, and twelve months) for the key stock market indices of four different countries (Germany, Japan, the United Kingdom, and the United States). Tables 1 and 3 are exact analogues to Tables 1 and 2 of MR (1983a) with one gap; we have no equivalent of forward rates for stock indices.[15,16]

The most striking feature of the tables is how poorly all five alternative models forecast future stock prices, compared with the simple random walk prediction of no change. In terms of our preferred root mean square error metric, the random walk model out-forecasts all four of the models that take advantage of fundamentals, for all four countries, at all horizons. This is true despite the fact that the forecasts of the Gordon-growth and composite models are based on realized future values of earnings, dividends, and interest rates. Moreover, the differences in forecast performance are not small; using fundamentals often results in a substantive deterioration in forecast performance. For instance, at the twelve-month horizon, the random

walk has a RMSE that is almost 50% lower than that of the Gordon-Growth Earning models for Germany; results are even more dramatic for other countries.

In this sample, the only model to beat the random walk model in terms of RMSE is the univariate long autoregression. Even then, it only beats the random walk decisively at the twelve-month horizon for Japan. At other horizons, the much-simpler random walk performs slightly better for Japan. The long AR also out-forecasts the random walk at the one-month horizon for the USA, though only marginally.[17]

The generally dismal performance of fundamentals-based models is also apparent when one looks at mean absolute forecast errors instead of root mean square forecast error. The long autoregression still performs better than the random walk at the twelve-month horizon for Japan, but it also forecasts better at the six-month horizon for Japan, and at twelve months for Germany. The VAR also beats the random walk at the one-month horizon for the UK in terms of MAE.[18]

It seems remarkable that forecasts which take advantage of unknowable future values of fundamentals do not seem to perform systematically better than the mindless prediction of no change. Still, this echoes the celebrated negative results of MR. We emphasize that we are not claiming that stock price indices actually follow a random walk. We are simply following in MR showing that the forecasts from the simplest forecasting model we can imagine – that of no change in an asset price – works approximately as well as more sophisticated forecasting models using unknowable future information on "fundamentals."

IVb. Sensitivity Checks

A more complete set of results is tabulated in Appendix II. These include a number of different perturbations of the models that rely on fundamentals, primarily using backward

(instead of just forward) looking growth rates of fundamentals for one- (as well as three-) year horizons. We provide tabulations of: a) root mean square forecast error; b) mean absolute forecast error; and c) mean error forecast statistics, at five different forecast horizons: a) one; b) three; c) six; d) twelve; and e) twenty-four months. We also tabulate the comparable figures for the random walk models to facilitate comparisons. In Tables 4a through 4c, we provide statistics for the random walk model inclusive of a freely-estimated drift term. In Tables 5a and 5b, we show robustness with respect to the sample period. In Table 5a, we show the results of changing the start of the forecast period from November 1976 to November 1978, while in Table 5b we change the end of the forecast period from June 1981 to November 1980.[19] We choose these dates to match those of MR. (We extend the sample closer to the present – and well beyond the Meese-Rogoff sample period – in Tables 5c and 5d, with similar results.) Finally, in Table 6, we use three different estimators. In Table 6a we use a GLS with a first-order (Prais-Winsten) correction for serial correlation. In Table 6b, we use one-year lags for instrumental variables.[20] In Table 6c, we use least-absolute errors instead of OLS as our estimator. In Table 6d, we add a comprehensive set of seasonal dummies.

In their second paper MR (1983b) eschewed coefficient estimation altogether and checked the out of sample forecasting ability of their models against that of a random walk model using a grid-search technique. We have found essentially the same results ourselves with comparable a grid-search technique; the results are in Table 7.

MR also performed a number of experiments that we consider to be unimportant in our context. These include: a) the Granger-Newbold technique for combining forecasts; b) estimation in first-differences; and c) more univariate models. One could also add more sophisticated estimation strategies (e.g., using GMM) or forecasting metrics (e.g., Diebold-

Mariano), both of which have advanced greatly since the time of the original MR research. We see no reason why any of these perturbations should deliver better results than MR, who uniformly found that considerations like these typically did little to affect the key conclusions.

We note in passing that our analysis is linked to two ongoing research programs. Engel and West (2005) consider the case where discount rates are high and fundamentals are I(1); see also Engel, Mark and West (2007). They show that in the limit asset prices will move like random walks in the sense that (p 486) "the change in the time t asst price will be uncorrelated with information known at time t-1." We agree with all of this. However, such *ex ante* forecasting ability is not the issue of concern to us, since we follow the MR methodology in giving the forecaster information on actual future fundamentals, dated t+1 or greater. Further, we do not make assumptions above regarding either the persistence in fundamentals or the discount rate. Rossi (2005) shows that persistence in disturbances may drive MR results, because of asymptotic estimation (Hurwicz) bias. However, we assume away this issue above; adding this very real estimation problem back into our setup is likely to make the MR methodology even more troublesome.

V. Conclusion

Naïve "random walk" models of no change seem to forecast future stock prices just as well as more sophisticated models based on a variety of fundamentals such as earnings and dividends. Crucially, this is true even giving a hypothetical modeler the advantage of actual future information on "fundamentals," which are unobservable in practice. In this sense, domestic financial prices of great interest (stock market indices) are just as difficult to forecast as

international financial prices (exchange rates). International finance seems to be no worse at modeling important asset prices than domestic finance, at least over the MR sample period.

Table 1: Root Mean Square Forecast Errors

Stock Market	Horizon	Random Walk	Univ. Long AR	VAR	Gordon Earnings	Gordon Dividends	Composite
Germany	**1 mon**	2.68	2.86	3.09	8.05	6.59	5.30
	6 mon	6.13	8.41	10.86	10.45	13.65	8.36
	12 mon	8.65	9.11	19.31	12.97	24.24	12.41
Japan	**1 mon**	2.70	2.75	3.53	16.93	11.27	9.99
	6 mon	6.03	6.09	13.18	21.84	14.98	14.23
	12 mon	10.93	8.19	24.44	27.85	20.03	19.03
UK	**1 mon**	5.51	5.85	5.59	27.44	15.16	13.49
	6 mon	12.95	22.20	12.96	41.60	20.05	19.13
	12 mon	18.09	37.02	19.31	58.12	21.94	24.68
USA	**1 mon**	4.14	4.06	4.64	12.53	10.43	13.26
	6 mon	8.68	10.40	10.25	17.18	14.01	25.11
	12 mon	12.59	15.32	14.80	24.32	18.71	40.73

Percentage terms. Three-year forward-looking growth rates for structural models.

Table 2: Mean Absolute Forecast Errors

Stock Market	Horizon	Random Walk	Univ. Long AR	VAR	Gordon Earnings	Gordon Dividends	Composite
Germany	**1 mon**	2.13	2.42	2.45	6.81	5.24	4.20
	6 mon	5.24	6.55	9.14	9.96	9.60	6.54
	12 mon	7.61	7.22	15.82	10.88	16.57	9.63
Japan	**1 mon**	2.02	2.16	2.84	16.34	10.00	8.65
	6 mon	5.22	4.84	11.99	21.52	13.89	12.45
	12 mon	10.19	6.05	22.78	27.67	19.13	16.95
UK	**1 mon**	4.51	4.61	4.22	23.42	12.26	10.81
	6 mon	10.64	20.28	11.16	34.90	15.82	14.94
	12 mon	15.36	36.27	16.81	48.69	18.39	19.82
USA	**1 mon**	3.25	3.25	3.69	10.94	8.19	10.53
	6 mon	6.96	8.24	8.78	15.57	10.99	20.51
	12 mon	10.38	13.09	12.41	22.51	14.84	35.06

Percentage terms. Three-year forward-looking growth rates for structural models.

Table 3: Mean Forecast Errors

Stock Market	Horizon	Random Walk	Univ. Long AR	VAR	Gordon Earnings	Gordon Dividends	Composite
Germany	**1 mon**	.52	.75	-1.20	4.24	2.48	1.67
	6 mon	2.33	2.74	-7.64	5.31	6.70	2.77
	12 mon	4.18	2.10	-13.84	6.52	13.39	4.26
Japan	**1 mon**	1.01	.93	2.55	16.34	10.00	7.99
	6 mon	4.96	2.88	11.99	21.52	13.89	11.91
	12 mon	10.08	4.07	22.78	27.67	19.13	16.89
UK	**1 mon**	1.66	2.62	-.05	22.70	6.67	7.56
	6 mon	7.88	20.28	-5.19	34.31	7.22	12.89
	12 mon	14.05	36.27	-14.16	48.69	6.00	18.82
USA	**1 mon**	.46	1.52	.20	10.73	7.27	9.46
	6 mon	3.19	8.00	2.45	15.46	10.22	20.42
	12 mon	7.51	13.09	5.75	22.51	14.78	35.06

Percentage terms. Three-year forward-looking growth rates for structural models.

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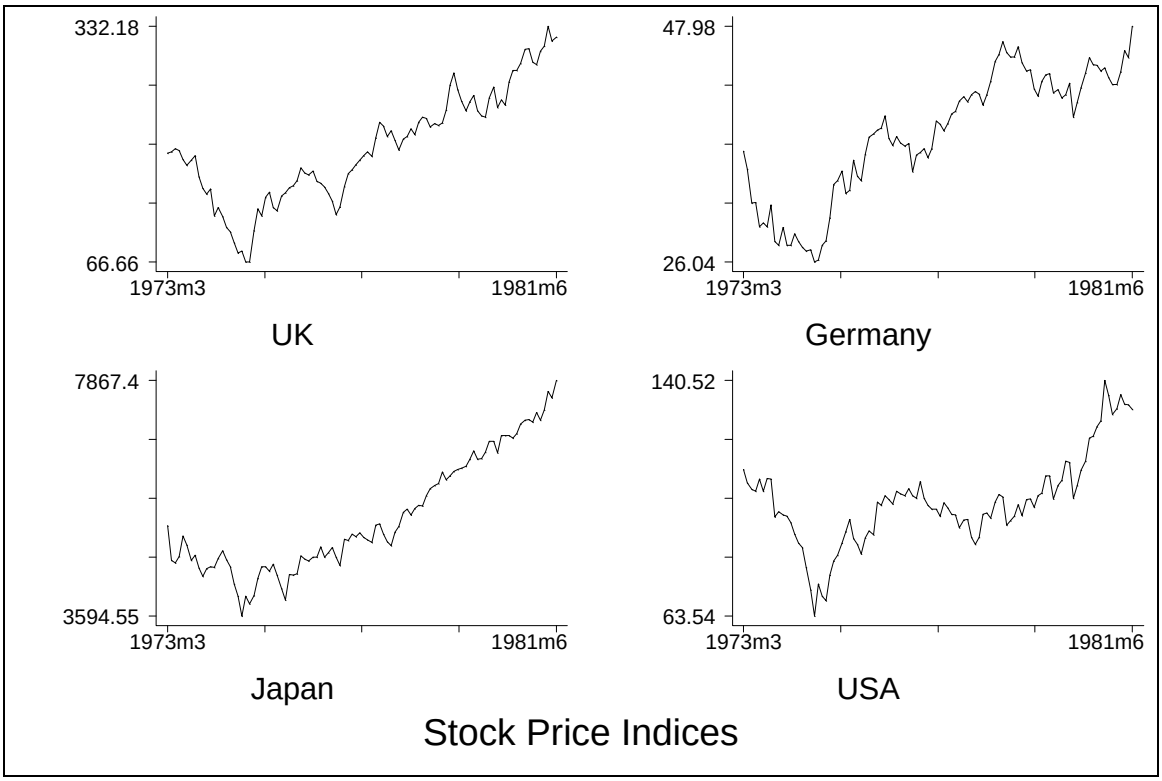

Figure 1: Raw Stock Price Indices

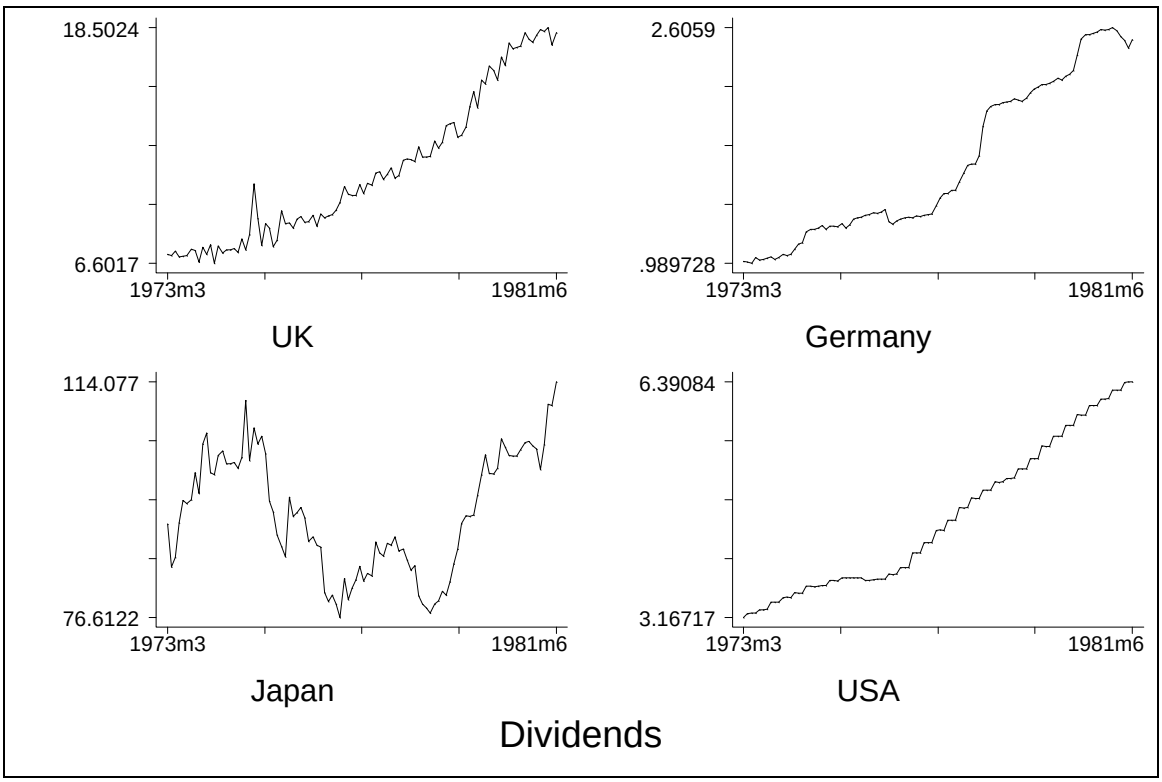

Figure 2: Dividends Extracted from Dividend/Price Ratios

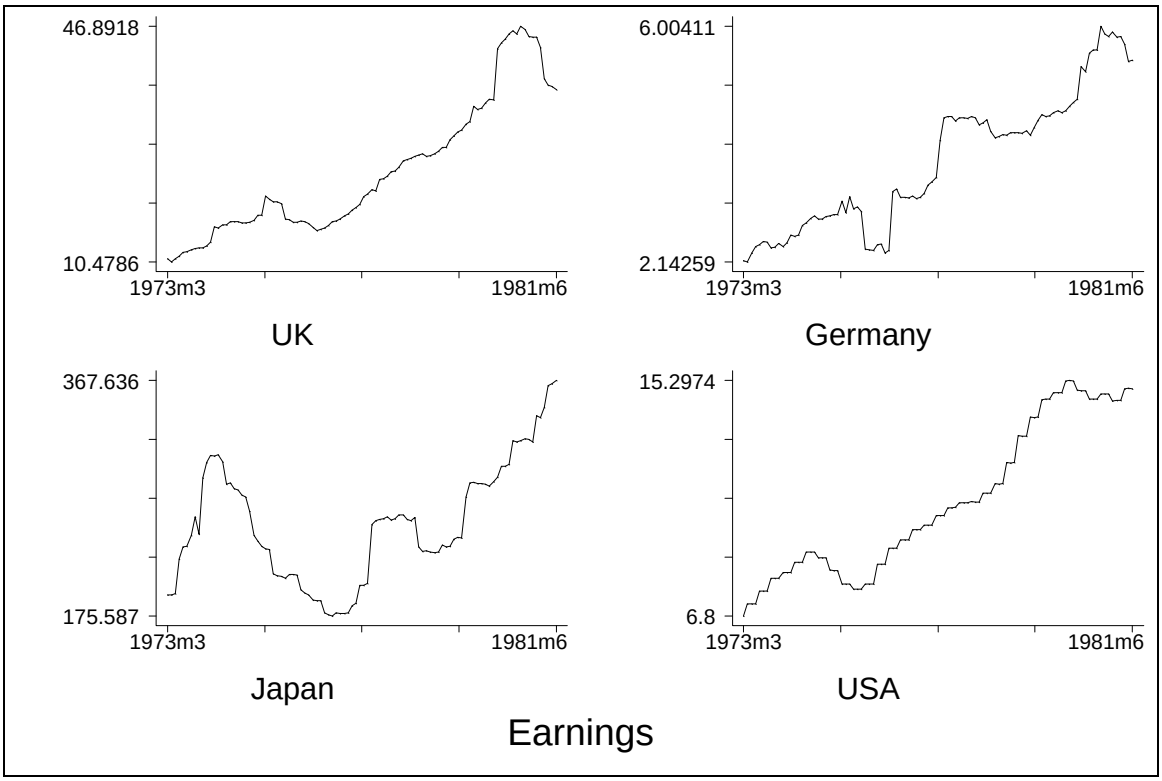

Figure 3: Earnings Extracted from Price/Earnings Ratios

Appendix I: Data Sources

- Stock Price Indices for Germany, Japan, and UK are taken from Datastream (URL: http://www.datastream.net) and Global Financial data set (GFD, URL: http://www.globalfinancialdata.com/).
    - "The CDAX includes the shares of all domestic companies listed in Prime Standard and General Standard. The index represents the German equity market in its entirety, i.e. all companies listed on FWB Frankfurter Wertpapierbörse (Frankfurt Stock Exchange)."[21]
    - "The Nikkei Stock Average is Japan's most widely watched index of stock market activity and has been calculated continuously since September 7, 1950… The 225 components of the Nikkei Stock Average are among the most actively traded issues on the first section of the TSE."[22]
    - "FTSE All-Share Index: Representing 98-99% of the UK market capitalisation, FTSE All-Share is the aggregation of the FTSE 100, FTSE 250 and FTSE Small Cap Indices."[23]
    - "S&P 500: Widely regarded as the best single gauge of the U.S. equities market, this world-renowned index includes 500 leading companies in leading industries of the U.S. economy."[24]
- American Data for the S&P 500 stock price index, earnings and dividends are taken from Robert Shiller's website (URL: http://www.econ.yale.edu/~shiller/data/ie_data.htm).
- Price/Earnings and Dividend/Price Ratios for Germany, Japan, and UK are taken from the GFD.[25]
- Interest Rates for Germany, the UK, and the USA are 1-month Euro-interest rates taken from the BIS data set, mnemonic "JDBA." The Japanese interest rate starts too late to be useable, and has been replaced by the call-money interest rate taken from the IFS data set, IFS line 60b.

Appendix II: Stock Market Results

Appendix II, Table 1a: Root Mean Square Forecast Errors (percentages)

		Random Walk	Univ AR	VAR
	Horizon			
Germany	1 mon	2.68	2.86	3.09
	3 mon	4.59	5.67	6.40
	6 mon	6.13	8.41	10.86
	12 mon	8.65	9.11	19.31
	24 mon	10.19	5.28	39.76
Japan	1 mon	2.70	2.75	3.53
	3 mon	4.37	4.61	7.72
	6 mon	6.03	6.09	13.18
	12 mon	10.93	8.19	24.44
	24 mon	21.74	11.59	37.51
UK	1 mon	5.51	5.85	5.59
	3 mon	9.84	13.31	10.09
	6 mon	12.95	22.20	12.96
	12 mon	18.09	37.02	19.31
	24 mon	26.82	25.91	35.73
USA	1 mon	4.14	4.06	4.64
	3 mon	6.40	6.75	7.25
	6 mon	8.68	10.40	10.25
	12 mon	12.59	15.32	14.80
	24 mon	19.73	16.22	18.31

Appendix II, Table 1b: Mean Absolute Forecast Errors (percentages)

		Random Walk	Univ AR	VAR
	Horizon			
Germany	1 mon	2.13	2.42	2.45
	3 mon	3.72	4.61	5.44
	6 mon	5.24	6.55	9.14
	12 mon	7.61	7.22	15.82
	24 mon	7.32	4.24	35.03
Japan	1 mon	2.02	2.16	2.84
	3 mon	3.46	3.61	6.76
	6 mon	5.22	4.84	11.99
	12 mon	10.19	6.05	22.78
	24 mon	21.50	9.42	36.33
UK	1 mon	4.51	4.61	4.22
	3 mon	7.97	11.25	8.22
	6 mon	10.64	20.28	11.16
	12 mon	15.36	36.27	16.81
	24 mon	24.68	24.63	30.78
USA	1 mon	3.25	3.25	3.69
	3 mon	5.35	5.32	5.96
	6 mon	6.96	8.24	8.78
	12 mon	10.38	13.09	12.41
	24 mon	16.64	13.65	14.40

Appendix II, Table 1c: Mean Forecast Errors (percentages)

		Random Walk	Univ AR	VAR
	Horizon			
Germany	1 mon	.52	.75	-1.20
	3 mon	1.38	1.86	-3.82
	6 mon	2.33	2.74	-7.64
	12 mon	4.18	2.10	-13.84
	24 mon	5.09	-.79	-30.39
Japan	1 mon	1.01	.93	2.55
	3 mon	2.66	2.41	6.74
	6 mon	4.96	2.88	11.99
	12 mon	10.08	4.07	22.78
	24 mon	21.50	6.43	36.33
UK	1 mon	1.66	2.62	-.05
	3 mon	4.40	9.75	-1.10
	6 mon	7.88	20.28	-5.19
	12 mon	14.05	36.27	-14.16
	24 mon	24.68	24.63	-28.33
USA	1 mon	.46	1.52	.20
	3 mon	1.37	3.90	.88
	6 mon	3.19	8.00	2.45
	12 mon	7.51	13.09	5.75
	24 mon	15.12	13.65	7.49

Appendix II, Table 2a: Gordon Earnings: Root Mean Square Forecast Errors (percentages)

		Random Walk	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon					
Germany	1 mon	2.68	7.64	9.61	7.80	8.05
	3 mon	4.59	7.73	11.26	9.04	8.99
	6 mon	6.13	6.48	13.61	10.79	10.45
	12 mon	8.65	8.36	17.46	12.71	12.97
	24 mon	10.19	9.52	18.61	11.70	14.97
Japan	1 mon	2.70	21.02	20.31	12.06	16.93
	3 mon	4.37	22.93	22.14	13.24	18.89
	6 mon	6.03	25.87	24.95	14.98	21.84
	12 mon	10.93	31.99	30.41	18.53	27.85
	24 mon	21.74	44.70	39.03	28.02	39.66
UK	1 mon	5.51	24.61	24.14	22.58	27.44
	3 mon	9.84	28.40	28.63	26.91	32.93
	6 mon	12.95	33.29	35.31	32.88	41.60
	12 mon	18.09	37.59	48.59	40.29	58.12
	24 mon	26.82	47.85	80.06	52.67	96.26
USA	1 mon	4.14	12.53	11.14	13.26	12.53
	3 mon	6.40	13.78	12.43	14.83	14.13
	6 mon	8.68	15.91	14.65	17.30	17.18
	12 mon	12.59	19.59	19.40	21.79	24.32
	24 mon	19.73	26.97	30.03	26.56	42.68

Appendix II, Table 2b: Gordon Earnings: Mean Absolute Forecast Errors (percentages)

		Random Walk	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon					
Germany	1 mon	2.13	5.65	8.04	6.78	6.81
	3 mon	3.72	5.78	9.33	7.93	7.61
	6 mon	5.24	5.94	10.84	9.44	9.96
	12 mon	7.61	7.53	12.99	10.66	10.88
	24 mon	7.32	8.56	16.28	8.29	11.51
Japan	1 mon	2.02	18.91	17.76	11.07	16.34
	3 mon	3.46	20.94	19.79	12.32	18.41
	6 mon	5.22	24.08	22.98	14.17	21.52
	12 mon	10.19	30.71	29.11	17.97	27.67
	24 mon	21.50	44.18	38.74	27.90	39.59
UK	1 mon	4.51	17.75	17.84	19.40	23.42
	3 mon	7.97	20.21	21.10	22.83	27.94
	6 mon	10.64	23.26	26.47	27.44	34.90
	12 mon	15.36	26.27	40.14	33.72	48.69
	24 mon	24.68	38.05	74.25	47.59	89.65
USA	1 mon	3.25	10.05	9.24	10.84	10.94
	3 mon	5.35	11.00	10.48	12.35	12.57
	6 mon	6.96	12.68	12.78	14.99	15.57
	12 mon	10.38	16.15	18.00	20.13	22.51
	24 mon	16.64	25.02	29.50	22.56	41.93

Appendix II, Table 2c: Gordon Earnings: Mean Forecast Errors (percentages)

		Random Walk	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon					
Germany	1 mon	.52	-.96	7.31	2.54	4.24
	3 mon	1.38	-1.73	8.53	3.16	4.65
	6 mon	2.33	-3.12	10.17	3.95	5.31
	12 mon	4.18	-4.64	12.68	4.32	6.52
	24 mon	5.09	-8.50	16.28	3.75	8.92
Japan	1 mon	1.01	18.91	17.71	11.07	16.34
	3 mon	2.66	20.94	19.79	12.32	18.41
	6 mon	4.96	24.08	22.98	14.17	21.52
	12 mon	10.08	30.71	29.11	17.97	27.67
	24 mon	21.50	44.18	38.74	27.90	39.59
UK	1 mon	1.66	15.41	16.25	17.07	22.70
	3 mon	4.40	17.63	19.62	20.14	27.21
	6 mon	7.88	20.55	26.04	24.41	34.31
	12 mon	14.05	24.07	40.04	31.04	48.69
	24 mon	24.68	36.06	74.25	47.59	89.65
USA	1 mon	.46	9.67	8.46	5.84	10.73
	3 mon	1.37	10.70	9.61	6.21	12.38
	6 mon	3.19	12.52	11.87	6.97	15.46
	12 mon	7.51	16.15	17.39	8.62	22.51
	24 mon	15.12	25.02	29.50	16.12	41.93

Appendix II, Table 3a: Gordon Dividends: Root Mean Square Forecast Errors (percentages)

		Random Walk	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon					
Germany	1 mon	2.68	10.65	10.22	6.73	6.59
	3 mon	4.59	13.01	12.80	7.66	9.01
	6 mon	6.13	16.44	15.92	8.92	13.65
	12 mon	8.65	23.48	19.02	11.45	24.24
	24 mon	10.19	35.39	26.05	17.59	35.53
Japan	1 mon	2.70	24.08	24.54	18.17	11.27
	3 mon	4.37	26.37	26.56	20.15	12.73
	6 mon	6.03	29.62	29.52	23.13	14.98
	12 mon	10.93	35.05	35.09	29.12	20.03
	24 mon	21.74	42.27	43.10	40.18	31.82
UK	1 mon	5.51	12.60	14.10	14.14	15.16
	3 mon	9.84	14.41	16.23	16.21	17.42
	6 mon	12.95	16.43	18.76	18.56	20.05
	12 mon	18.09	17.96	22.17	21.37	21.94
	24 mon	26.82	24.55	28.81	29.21	24.78
USA	1 mon	4.14	10.55	8.05	12.96	10.43
	3 mon	6.40	11.31	9.69	14.58	11.51
	6 mon	8.68	12.87	11.78	17.23	14.01
	12 mon	12.59	14.52	15.01	22.50	18.71
	24 mon	19.73	19.03	13.79	33.08	30.17

Appendix II, Table 3b: Gordon Dividends: Mean Absolute Forecast Errors (percentages)

		Random Walk	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon					
Germany	1 mon	2.13	9.06	8.00	5.50	5.24
	3 mon	3.72	10.75	9.81	6.33	6.84
	6 mon	5.24	13.16	11.78	7.69	9.60
	12 mon	7.61	19.77	14.45	10.54	16.57
	24 mon	7.32	32.48	19.36	16.16	26.72
Japan	1 mon	2.02	19.76	21.38	16.48	10.00
	3 mon	3.46	21.80	23.44	18.51	11.54
	6 mon	5.22	24.70	26.44	21.50	13.89
	12 mon	10.19	30.24	32.26	27.33	19.13
	24 mon	21.50	39.62	41.62	38.62	31.37
UK	1 mon	4.51	9.89	11.46	11.88	12.26
	3 mon	7.97	11.11	13.08	13.49	13.96
	6 mon	10.64	12.49	14.92	15.23	15.82
	12 mon	15.36	13.95	17.15	17.21	18.39
	24 mon	24.68	16.38	19.26	19.27	18.96
USA	1 mon	3.25	8.25	7.00	11.02	8.19
	3 mon	5.35	8.92	8.46	12.55	9.12
	6 mon	6.96	9.96	10.13	15.21	10.99
	12 mon	10.38	11.52	12.10	20.59	14.84
	24 mon	16.64	16.84	11.33	32.22	25.95

Appendix II, Table 3c: Gordon Dividends: Mean Forecast Errors (percentages)

		Random Walk	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon					
Germany	1 mon	.52	-5.68	2.31	-3.64	2.48
	3 mon	1.38	-6.75	3.21	-4.51	3.92
	6 mon	2.33	-8.61	4.35	-5.93	6.70
	12 mon	4.18	-14.14	5.15	-9.45	13.39
	24 mon	5.09	-31.70	8.11	-16.16	25.06
Japan	1 mon	1.01	19.56	21.38	16.48	10.00
	3 mon	2.66	21.62	23.44	18.51	11.54
	6 mon	4.96	24.60	26.44	21.50	13.89
	12 mon	10.08	30.23	32.26	27.33	19.13
	24 mon	21.50	39.62	41.62	38.62	31.37
UK	1 mon	1.66	6.26	8.01	8.61	6.67
	3 mon	4.40	7.04	9.08	9.70	7.11
	6 mon	7.88	7.77	10.24	10.81	7.22
	12 mon	14.05	8.45	12.00	12.27	6.00
	24 mon	24.68	13.94	18.90	18.72	7.99
USA	1 mon	.46	6.98	-3.23	10.87	7.27
	3 mon	1.37	7.62	-4.18	12.48	8.25
	6 mon	3.19	8.82	-5.33	15.21	10.22
	12 mon	7.51	11.07	-7.51	20.59	14.78
	24 mon	15.12	16.84	-10.66	32.33	25.95

Appendix II, Table 4a: Composite "Model": Dividends, Earnings, their Growth Rates, and the Interest Rate: Root Mean Square Forecast Errors (percentages)

		Random Walk	Random Walk with Drift	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon						
Germany	1 mon	2.68	2.65	5.71	7.47	6.11	5.30
	3 mon	4.59	4.49	7.17	10.22	7.20	6.70
	6 mon	6.13	5.93	8.80	13.24	8.53	8.36
	12 mon	8.65	8.35	11.18	12.52	10.89	12.41
	24 mon	10.19	12.27	10.82	21.22	13.30	18.33
Japan	1 mon	2.70	2.62	14.94	17.17	10.61	9.99
	3 mon	4.37	3.95	17.88	19.82	13.13	11.79
	6 mon	6.03	4.72	22.11	23.39	16.89	14.23
	12 mon	10.93	8.08	28.47	29.34	23.59	19.03
	24 mon	21.74	16.65	38.02	37.61	31.48	28.51
UK	1 mon	5.51	5.58	19.98	20.28	19.47	13.49
	3 mon	9.84	10.01	24.24	25.15	24.23	16.03
	6 mon	12.95	13.22	30.60	32.83	31.90	19.13
	12 mon	18.09	18.24	40.03	49.05	45.14	24.68
	24 mon	26.82	27.82	62.11	87.40	72.77	40.61
USA	1 mon	4.14	4.16	11.47	8.93	10.82	13.26
	3 mon	6.40	6.46	14.35	11.22	13.22	17.92
	6 mon	8.68	8.81	18.53	14.02	17.06	25.11
	12 mon	12.59	12.94	25.48	19.63	24.84	40.73
	24 mon	19.73	22.30	38.44	25.11	37.01	67.87

Appendix II, Table 4b: Composite: Dividends, Earnings, their Growth Rates, and the Interest Rate: Mean Absolute Forecast Errors (percentages)

		Random Walk	Random Walk with Drift	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon						
Germany	1 mon	2.13	2.09	4.46	5.79	4.43	4.20
	3 mon	3.72	3.70	5.62	7.80	5.33	5.35
	6 mon	5.24	5.10	7.00	10.01	6.32	6.54
	12 mon	7.61	6.71	9.55	8.75	7.56	9.63
	24 mon	7.32	10.79	10.02	15.46	10.08	13.66
Japan	1 mon	2.02	1.94	12.11	13.33	9.14	8.65
	3 mon	3.46	2.94	14.97	15.93	11.19	10.27
	6 mon	5.22	3.80	19.19	19.60	14.19	12.45
	12 mon	10.19	6.69	26.34	26.79	20.49	16.95
	24 mon	21.50	15.56	37.54	37.02	30.37	27.24
UK	1 mon	4.51	4.54	17.90	16.08	17.18	10.81
	3 mon	7.97	8.04	21.49	19.63	21.45	12.85
	6 mon	10.64	10.31	26.73	25.31	28.63	14.94
	12 mon	15.36	14.51	35.45	40.47	42.70	19.82
	24 mon	24.68	22.39	56.50	79.76	71.14	35.11
USA	1 mon	3.25	3.28	9.13	7.25	8.54	10.53
	3 mon	5.35	5.40	11.90	9.10	10.87	14.35
	6 mon	6.96	7.01	16.16	11.41	14.38	20.51
	12 mon	10.38	11.01	22.77	16.91	20.99	35.06
	24 mon	16.64	19.29	32.99	20.53	28.32	64.09

Appendix II, Table 4c: Composite: Dividends, Earnings, their Growth Rates, and the Interest Rate: Mean Forecast Errors (percentages)

		Random Walk	Random Walk with Drift	Growth: 1-yr bkd	Growth: 3-yr bkd	Growth: 1-yr fwd	Growth: 3-yr fwd
	Horizon						
Germany	1 mon	.52	.98	1.70	3.31	3.21	1.67
	3 mon	1.38	.10	2.00	4.50	4.11	2.08
	6 mon	2.33	-.26	2.09	6.09	5.30	2.77
	12 mon	4.18	-1.08	.79	6.97	6.95	4.26
	24 mon	5.09	-6.07	-6.22	6.15	9.81	6.14
Japan	1 mon	1.01	.68	11.82	12.79	8.71	7.99
	3 mon	2.66	1.67	14.71	15.28	10.75	9.58
	6 mon	4.96	3.05	19.19	19.19	13.92	11.91
	12 mon	10.08	6.48	26.34	26.55	20.36	16.89
	24 mon	21.50	15.56	37.54	37.02	30.37	27.24
UK	1 mon	1.66	1.43	14.41	12.51	17.18	7.56
	3 mon	4.40	3.76	17.45	15.74	21.45	9.69
	6 mon	7.88	6.71	22.46	22.36	28.63	12.89
	12 mon	14.05	12.19	31.46	37.85	42.70	18.82
	24 mon	24.68	22.39	3.95	78.48	71.36	34.86
USA	1 mon	.46	.47	6.96	2.62	6.19	9.46
	3 mon	1.37	1.42	8.55	3.44	7.63	13.34
	6 mon	3.19	3.41	10.80	5.18	10.05	20.42
	12 mon	7.51	8.39	14.72	8.66	15.38	35.06
	24 mon	15.12	17.96	25.71	19.08	28.00	64.09

Appendix II, Table 5a: Changing Forecast Start Date from 1976m11 to 1978m11: Root Mean Square Forecast Errors (in percentage terms; 3-yr fwd Growth rates)

		Random Walk	Gordon Earnings	Gordon Dividends	Composite
	Horizon				
Germany	1 mon	2.90	5.73	3.79	4.98
	3 mon	4.68	5.34	4.01	5.76
	6 mon	5.59	5.19	4.36	6.60
	12 mon	6.70	6.31	5.00	7.81
	24 mon	6.92	5.94	3.90	6.76
Japan	1 mon	2.14	19.55	13.82	12.54
	3 mon	3.21	21.40	15.61	14.85
	6 mon	5.19	24.34	18.50	18.28
	12 mon	9.21	29.89	24.36	24.84
	24 mon	18.63	41.64	38.80	33.14
UK	1 mon	5.31	17.86	9.98	9.22
	3 mon	9.79	19.39	11.79	10.46
	6 mon	11.05	18.56	13.69	10.76
	12 mon	17.52	19.60	16.13	11.88
	24 mon	24.11	39.78	9.26	11.19
USA	1 mon	4.29	15.12	9.87	16.33
	3 mon	6.68	17.38	11.39	21.64
	6 mon	9.81	21.04	13.82	29.40
	12 mon	16.66	28.25	18.68	42.83
	24 mon	30.38	42.53	31.11	42.31

Appendix II, Table 5b: Changing Forecast End Date from 1981m6 to 1980m11: Root Mean Square Forecast Errors (in percentage terms; 3-yr fwd Growth rates)

		Random Walk	Gordon Earnings	Gordon Dividends	Composite
	Horizon				
Germany	1 mon	2.59	8.37	7.00	4.75
	3 mon	4.47	9.37	9.62	6.26
	6 mon	6.28	10.97	14.70	8.16
	12 mon	8.86	13.74	26.08	12.78
	24 mon	10.85	16.61	40.14	20.40
Japan	1 mon	2.68	16.82	9.74	9.06
	3 mon	4.40	18.80	11.17	10.73
	6 mon	6.02	21.72	13.38	13.07
	12 mon	11.13	27.58	18.45	18.13
	24 mon	22.53	39.04	29.49	27.19
UK	1 mon	5.66	28.44	16.08	14.21
	3 mon	10.26	34.46	18.55	17.00
	6 mon	13.69	44.01	21.48	20.46
	12 mon	17.24	62.63	23.75	26.78
	24 mon	27.86	107.07	27.57	45.63
USA	1 mon	4.30	11.10	10.10	13.77
	3 mon	6.65	12.73	11.04	18.30
	6 mon	8.70	15.96	13.41	25.69
	12 mon	10.74	23.89	18.09	42.60
	24 mon	16.28	43.37	30.20	74.30

Appendix II, Table 5c: Forecasting from 1989m3 to 2001m12:
Root Mean Square Forecast Errors (in percentage terms; 3-yr fwd Growth rates)

		Random Walk	Gordon Earnings	Gordon Dividends	Composite
	Horizon				
Germany	1 mon	5.52	46.15	27.01	22.14
	3 mon	10.18	49.24	28.62	24.45
	6 mon	14.68	53.35	30.97	27.81
	12 mon	21.26	59.08	34.98	34.16
	24 mon	29.96	65.91	40.17	43.45
Japan	1 mon	6.84	69.91	35.01	30.38
	3 mon	11.42	71.74	36.47	33.34
	6 mon	16.08	74.03	38.44	36.82
	12 mon	22.84	78.07	41.99	41.52
	24 mon	27.46	84.92	48.28	41.65
UK	1 mon	4.18	27.28	26.18	23.17
	3 mon	7.28	27.97	27.00	24.69
	6 mon	9.69	28.97	28.23	27.03
	12 mon	13.86	30.83	30.71	31.69
	24 mon	21.94	34.23	35.84	39.23
USA	1 mon	4.23	32.77	39.59	22.86
	3 mon	7.27	34.32	41.08	24.56
	6 mon	10.50	36.43	43.25	26.99
	12 mon	17.28	39.93	47.42	31.72
	24 mon	30.99	44.82	55.58	41.76

Estimation begins in 1973m3

Appendix II, Table 5d: Forecasting from 1989m3 to 2001m12:
Root Mean Square Forecast Errors (in percentage terms; 3-yr fwd Growth rates)

		Random Walk	Gordon Earnings	Gordon Dividends	Composite
	Horizon				
Germany	1 mon	5.52	46.67	17.36	16.45
	3 mon	10.18	50.83	18.60	19.20
	6 mon	14.68	56.22	20.38	23.33
	12 mon	21.26	62.97	23.28	34.33
	24 mon	29.96	68.81	26.20	50.77
Japan	1 mon	6.84	52.33	27.64	29.38
	3 mon	11.42	55.69	28.88	33.21
	6 mon	16.08	60.13	30.22	37.57
	12 mon	22.84	68.32	33.06	44.35
	24 mon	27.46	80.41	37.97	45.72
UK	1 mon	4.18	20.54	26.02	17.09
	3 mon	7.28	21.18	26.94	18.40
	6 mon	9.69	22.08	28.32	20.24
	12 mon	13.86	23.57	31.19	23.40
	24 mon	21.94	25.22	36.66	28.17
USA	1 mon	4.23	30.39	25.05	21.22
	3 mon	7.27	32.54	26.43	23.21
	6 mon	10.50	35.64	28.45	26.06
	12 mon	17.28	41.17	32.34	31.25
	24 mon	30.99	50.04	39.93	40.34

Estimation begins in 1980m1

Appendix II, Table 6a: GLS instead of OLS: Root Mean Square Forecast Errors
(in percentage terms; 3-yr fwd Growth rates)

		Random Walk	Gordon Earnings	Gordon Dividends	Composite
	Horizon				
Germany	1 mon	2.68	20.76	3.64	3.99
	3 mon	4.59	21.97	4.77	5.23
	6 mon	6.13	23.60	5.60	6.42
	12 mon	8.65	25.90	7.59	7.71
	24 mon	10.19	27.52	13.93	11.62
Japan	1 mon	2.70	17.01	15.35	16.37
	3 mon	4.37	18.52	16.36	17.67
	6 mon	6.03	20.70	17.95	19.60
	12 mon	10.93	25.36	21.42	24.04
	24 mon	21.74	35.77	26.53	33.05
UK	1 mon	5.51	29.14	12.49	20.84
	3 mon	9.84	31.93	14.29	23.27
	6 mon	12.95	35.13	16.13	25.90
	12 mon	18.09	38.68	17.65	28.02
	24 mon	26.82	46.12	19.97	32.45
USA	1 mon	4.14	13.29	12.66	16.46
	3 mon	6.40	14.74	14.47	19.58
	6 mon	8.68	17.30	17.44	24.53
	12 mon	12.59	24.37	24.35	35.51
	24 mon	19.73	38.73	40.10	56.81

Appendix II, Table 6b: IV instead of OLS: Root Mean Square Forecast Errors
(in percentage terms; 1-yr fwd Growth rates)

		Random Walk	Gordon Earnings	Gordon Dividends	Composite
	Horizon				
Germany	1 mon	2.68	13.98	11.22	31.13
	3 mon	4.59	16.15	13.60	43.93
	6 mon	6.13	17.90	17.25	58.36
	12 mon	8.65	18.59	24.07	96.93
	24 mon	10.19	21.95	38.07	112
Japan	1 mon	2.70	1843.	452.	410
	3 mon	4.37	2162.	453.	308
	6 mon	6.03	2388.	671.	299
	12 mon	10.93	30.83	725.	761
	24 mon	21.74	25.84	203.	629
UK	1 mon	5.51	16.82	11.76	990
	3 mon	9.84	18.91	13.59	1153
	6 mon	12.95	22.23	15.59	1513
	12 mon	18.09	27.60	17.80	2128
	24 mon	26.82	33.27	22.80	1535
USA	1 mon	4.14	20.66	12.94	120
	3 mon	6.40	22.49	14.68	610
	6 mon	8.68	25.94	17.48	143
	12 mon	12.59	32.83	22.99	916
	24 mon	19.73	55.39	34.64	8435

12-month lags of (log-) earnings/dividends/interest rates used for current values.

Appendix II, Table 6c: LAD instead of OLS: Root Mean Square Forecast Errors
(in percentage terms; 3-yr fwd Growth rates)

		Random Walk	Gordon Earnings	Gordon Dividends	Composite
	Horizon				
Germany	1 mon	2.68	8.05	5.18	5.77
	3 mon	4.59	8.99	7.05	7.27
	6 mon	6.13	10.45	11.52	9.09
	12 mon	8.65	12.97	23.75	12.68
	24 mon	10.19	14.97	36.69	22.19
Japan	1 mon	2.70	16.93	10.07	10.13
	3 mon	4.37	18.89	10.94	11.36
	6 mon	6.03	21.84	12.40	13.08
	12 mon	10.93	27.85	16.26	17.68
	24 mon	21.74	39.66	26.66	26.03
UK	1 mon	5.51	27.44	12.03	10.92
	3 mon	9.84	32.93	14.94	12.75
	6 mon	12.95	41.60	18.17	15.73
	12 mon	18.09	58.12	21.01	20.46
	24 mon	26.82	96.26	27.44	34.50
USA	1 mon	4.14	12.53	12.31	13.41
	3 mon	6.40	14.13	13.87	17.83
	6 mon	8.68	17.18	17.71	25.00
	12 mon	12.59	24.32	24.81	39.35
	24 mon	19.73	42.68	41.40	65.00

Appendix II, Table 6d: OLS with seasonal dummies: Root Mean Square Forecast Errors
(in percentage terms; 3-yr fwd Growth rates)

		Random Walk	Gordon Earnings	Gordon Dividends	Composite
	Horizon				
Germany	1 mon	2.68	8.91	7.87	5.89
	3 mon	4.59	9.54	10.05	7.26
	6 mon	6.13	10.77	13.99	8.65
	12 mon	8.65	12.12	23.62	12.36
	24 mon	10.19	13.86	35.19	20.32
Japan	1 mon	2.70	18.03	12.27	10.61
	3 mon	4.37	19.53	13.56	12.20
	6 mon	6.03	21.91	15.67	14.50
	12 mon	10.93	26.16	19.86	18.85
	24 mon	21.74	37.83	32.22	28.13
UK	1 mon	5.51	30.56	16.90	15.38
	3 mon	9.84	35.48	18.14	17.95
	6 mon	12.95	43.40	20.72	19.90
	12 mon	18.09	56.87	20.69	18.84
	24 mon	26.82	96.06	23.10	19.62
USA	1 mon	4.14	13.64	11.82	14.59
	3 mon	6.40	14.82	12.07	19.33
	6 mon	8.68	17.50	14.30	26.08
	12 mon	12.59	23.58	18.47	39.83
	24 mon	19.73	41.17	29.56	66.00

Appendix II, Table 7: Shortest Forecast Horizon (in months) for Which at Least *x* Percent of Each Model's Parameter Grid Improves on the Random Walk Model in MAE/RMSE When Realized Values of the Explanatory Variables are Used
(3-yr fwd Growth rates)

	Stock Market	Germany		Japan		UK		US	
Model	Threshold	MAE	RMSE	MAE	RMSE	MAE	RMSE	MAE	RMSE
Gordon Earnings	0-1%	-	-	24	24	12	12	36	36
	10	-	-	24	24	18	18	-	-
	25	-	-	24	24	24	30	-	-
	50	-	-	24	30	-	-	-	-
Gordon Dividends	0-1%	-	-	36	-	6	6	18	18
	10	-	-	-	-	6	6	18	18
	25	-	-	-	-	12	6	30	24
	50	-	-	-	-	12	12	-	-

Grid-size=49. Parameters for grid were .7-1.3 in increments of .1, for each coefficient.
Forecasting horizons used: 1, 3, 6, 12, 18, 24, 30, 36.

Appendix III: Meese-Rogoff Results

Appendix III, Table A1a: Meese-Rogoff (1983a) Table 1:
Root Mean Square Forecast Errors (in percentage terms)

		Random Walk	Forward Rate	Univ AR	VAR	Frenkel-Bilson	Dornbusch-Frankel	Hooper-Morton
	Horizon							
$/mark	1 mon	3.72	3.20	3.51	5.40	3.17	3.65	3.50
	6 mon	8.71	9.03	12.40	11.83	9.64	12.03	9.95
	12 mon	12.98	12.60	22.53	15.06	16.12	18.87	15.69
$/yen	1 mon	3.68	3.72	4.46	7.76	4.11	4.40	4.20
	6 mon	11.58	11.93	22.04	18.90	13.38	13.94	11.94
	12 mon	18.31	18.95	52.18	22.98	18.55	20.41	19.20
$/pound	1 mon	2.56	2.67	2.79	5.56	2.82	2.90	3.03
	6 mon	6.45	7.23	7.27	12.97	8.90	8.88	9.08
	12 mon	9.96	11.62	13.35	21.28	14.62	13.66	14.57
EER	1 mon	1.99	N.A.	2.72	4.10	2.40	2.50	2.74
	6 mon	6.09	N.A.	6.82	8.91	7.07	6.49	7.11
	12 mon	8.65	14.24	11.14	10.96	11.40	9.80	10.35

Appendix III, Table A1b: Meese-Rogoff (1983a) Table 2:
Mean Forecast Errors (in percentage terms)

		Random Walk	Forward Rate	Univ AR	VAR	Frenkel-Bilson	Dornbusch-Frankel	Hooper-Morton
	Horizon							
$/mark	1 mon	0.04	0.35	0.26	-1.12	0.37	-0.17	0.07
	6 mon	-0.92	1.31	1.99	-3.31	1.23	-0.59	0.17
	12 mon	-3.93	0.29	5.20	-5.22	0.55	-3.06	-1.52
$/yen	1 mon	-0.46	-0.06	-0.15	-2.64	1.36	-1.46	-0.18
	6 mon	-3.32	-1.26	-3.17	-7.51	-8.00	-8.53	-1.81
	12 mon	-6.48	-2.62	-8.91	-10.45	-14.05	-14.82	-2.38
$/pound	1 mon	-0.31	-0.38	-0.12	-3.72	-0.48	-0.37	-0.52
	6 mon	-3.09	-4.05	-1.32	-9.45	-5.55	-4.53	-5.30
	12 mon	-7.75	-9.55	-4.17	-18.54	-13.21	-12.07	-11.69
EER	1 mon	-0.03	N.A.	0.06	0.89	0.63	0.54	0.68
	6 mon	0.77	N.A.	1.61	3.91	3.86	2.79	3.52
	12 mon	3.18	7.66	6.44	7.11	7.69	5.30	5.78

Appendix III, Table A2a: Meese-Rogoff (1983b) Table 3.7: Shortest Forecast Horizon (in months) for Which at Least *x* Percent of Each Model's Parameter Grid Improves on the Random Walk Model in MAE/RMSE When Realized Values of the Explanatory Variables are Used

	FX rate	$/DM		$/Pound		$/yen	
Model	Threshold/Metric	MAE	RMSE	MAE	RMSE	MAE	RMSE
Frenkel-	0-1%	24	30	18	24	12	12
Bilson	10	30	30	18	24	18	18
	25	30	30	24	30	24	24
	50	36	36	30	36	36	30
Dornbusch-	0-1%	12	18	18	18	12	12
Frankel	10	18	18	24	24	12	12
	25	30	30	30	36	12	12
	50	-	-	-	-	24	18
Hooper-	0-1%	12	18	18	18	12	12
Morton	10	18	18	24	24	12	12
	25	30	30	30	36	12	18
	50	-	-	-	-	24	18

Appendix III, Table A2b: Meese-Rogoff (1983b) Table 3.8: Comparing the Random Walk and the Structural Models (with their best representative parameter configuration) When Realized Values of the Explanatory Variables are Used (in percentage terms)

	FX rate	$/DM		$/Pound		$/yen	
Model	Threshold/Metric	MAE	RMSE	MAE	RMSE	MAE	RMSE
Random	1	2.4	3.2	2.0	2.5	2.1	3.0
Walk	3	4.8	6.2	3.2	5.1	4.2	5.7
	12	9.4	10.9	9.8	11.5	10.6	13.8
	36	18.1	21.0	23.4	25.4	19.4	23.3
Frenkel-	1	9.1	11.4	4.2	6.1	4.5	6.4
Bilson	3	11.5	14.2	8.7	11.1	7.9	11.5
	12	12.2	15.2	13.5	16.6	9.7	13.3
	36	12.6	17.0	15.5	18.8	10.2	14.5
Dornbusch-	1	5.5	6.9	8.1	10.0	4.4	8.4
Frankel	3	8.1	9.7	8.6	10.5	7.4	9.4
	12	8.8	10.8	10.4	12.3	7.0	8.5
	36	8.2	10.5	8.3	10.0	8.8	10.2
Hooper-	1	8.3	10.4	4.0	10.0	4.9	6.7
Morton	3	8.8	11.0	8.5	10.5	8.3	10.9
	12	9.2	11.6	10.0	12.0	8.8	11.7
	36	9.3	11.6	10.5	12.5	9.3	12.2

Endnotes

[1] We follow MR in developing a model of the nominal price of stock. With suitable assumptions, this can be derived from a model of real asset prices.

[2] Fama and French (2001, p4) state "Confirming Campbell (1991), Cochrane (1994), and Campbell and Shiller (1998), we find that dividend and earnings growth rates for 1950-2000 are largely unpredictable." Also see Cochrane (2001, p 404). We have not directly attempted to test (5) ourselves; this might be a topic for future research.

[3] The growth rates for dividends and earnings must be similar over the long run, which may raise estimation issues.

[4] Equation (8) does not follow strictly from equation (7), which is a risk neutral pricing equation that does not involve interest rates. Equation (8) is a generalization that allows for the possibility that there is some portfolio substitution in stock pricing, so that when interest rates change, the stock market can react.

[5] We are simultaneously pursuing the grid-search technique of MR (1983b).

[6] To compare the out-of-sample statistics formally, one would need to take account of the temporal dependence of the forecast errors, since forecasts of over one month overlap each other. As it turns out, this is not a major issue in our sample, since the random walk model often dominates the forecasting models we consider.

[7] In Tables 4a-4c, we tabulate results for one of the extensions we considered, the random walk "model" with an estimated intercept.

[8] We choose our lag-length after we estimate the VARs over the sample, 1973m3 through 1981m6. After we choose the VAR lag-length for a particular country, we then keep it constant for all forecast periods.

[9] For Germany, the FPE is minimized at two lags, while both the HQIC and the SIC indicate one lag. We are wary of including only a single lag, and thus we err on the side of (minor) potential over-parameterization. In the case of Japan, the FPE, HQIC, and SIC all point to two lags. Both HQIC and SIC indicate three lags for the UK, while the FPE indicates four lags. Finally, four lags are indicated for the American data by both HQIC and SIC, while the FPE indicates nineteen lags. One could also use the Akaike information criteria, though this is well-known to indicate much longer lag lengths. One could also use standard Bayesian techniques to reduce the over-parameterized VARs, even without resorting to more structural techniques.

[10] They also match the P/E and D/P ratios we use closely. This match is exact in the case of Japan, the UK and the USA. In the case of Germany, the GFD description is "Monthly data from the Bundesamt begin … in January 1956. The current index is an aggregate of dividends (including stock dividends) divided by the aggregate market value (end of period) of all quoted shares and do not include the effect of the withholding tax. The data from 1953 through 1995 were calculated by the Statistisches Bundesamt."

[11] In future work we also plan to tackle this problem by examining data from individual firms.

[12] Thus a 5% interest rate is measured as $\ln(1+.05) \approx .05$.

[13] This is above and beyond ensuring positivity, and, more importantly, our goal of keeping our technique as compatible as possible with that of MR.

[14] To be precise, we measure a one-year backward-looking growth rate at time t as $[\ln(x_t)-\ln(x_{t-12})]$, while an annualized three-year forward-looking growth rate at time t is measured as $[\ln(x_{t+36})-\ln(x_t)]/3$

[15] For comparison, Appendix III, Tables A1a and A1b are transcribed versions of Meese and Rogoff (1983a), Tables 1 and 2 respectively. These contain RMSE and ME for the data and models that MR consider, formatted analogously.

[16] Stock index futures do exist for some of our indices. For instance, the Chicago Mercantile exchange trades a futures contract for the S&P 500, though trading only began in 1982; http://www.cme.com/trading/prd/equity/index.html. Likewise, the Osaka Securities Exchange has traded a Nikkei 225 stock index future since 1988; http://en.wikipedia.org/wiki/Osaka_Securities_Exchange. We have been unable to find evidence that either the FTSE All-share or CDAX is traded as a futures contract.

[17] As MR found with exchange rates, the random walk may perform as well as other forecasting models, but it does not perform well in any absolute sense; the RMSE at even the one-month horizons exceed 2% for all the countries we consider.

[18] Unsurprisingly, these positive results are also reflected in superior mean forecast errors; these also show that there are some cases where the British and American VARs – and the Gordon-growth for the UK – out-forecast the random walk. We are less concerned with these outcomes for the reasons spelled out above, given that they perform worse in terms of root mean square and mean absolute error.

[19] Note that the number of forecasts in Table 5a is small, especially at the longer horizons; for instance, there are only eight 24-month forecasts available.

[20] We use one-year lags of the (log-) levels of dividends, earnings, and interest rates; we do not instrument for the growth rates at all. We realize this is lame, and are open to suggestions for superior instrumental variables, mostly to account for the potential measurement error.

[21] http://deutsche-boerse.com/dbag/dispatch/en/isg/gdb_navigation/market_data_analytics/20_indices/24_all_share_indices/20_CDAX?module=InOverview_Index&foldertype=_Index&lang=de&wp=DE0008469602&wplist=DE0008469602&active=overview

[22] http://www.nni.nikkei.co.jp/FR/SERV/nikkei_indexes/nifaq225.html

[23] http://www.ftse.com/Indices/UK_Indices/index.jsp

[24] http://www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices_500/2,3,2,2,0,0,0,0,0,0,0,0,0,0,0,0,0.html

[25] The GFD notes on these ratios "Dividend yields and P/E ratios are generally based upon large cap stocks in each country representing about 75% of the capitalization of that country. Since dividends and earnings are reported quarterly or annually, and at a lag, while prices change daily, the yields are based upon historical data. Dividend data are based upon the dividends reported for the trailing twelve months and do not include any forecast dividends. Fourth quarter dividends and earnings, for example, are generally not reported until February and only at this point are fourth quarter dividends and earnings included in the calculations. Hence, January dividend yields are based upon dividends through the third quarter of the previous year, but prices of the stocks in January. Earnings data are generally based upon trailing twelve-month as reported earnings."