Price-to-Earnings Ratio and Expected Earnings Growth Rate in Global Equity Markets

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Abstract

This paper documents the empirical relationship between price-to-earnings ratios and analyst expected earnings growth rate, in global equity markets. We propose a theoretical framework that links the price-to-earnings multiple of a stock to its expected earnings growth rate, the discounting factor, and the factor risk premiums. Exploiting a universe of over 15,000 stocks, taken from 42 countries, we establish that analyst determined expected earnings growth is a crucial determinant of price-to-earnings ratios in the cross-section of individual stocks. Our cross-sectional regression results hold, even after controlling for dispersions in business risks, firm size, and cash-flow volatility. A large fraction of the dynamic variation in the P/E valuation ratio is due to changes in the expected earnings growth rate. Our principal empirical findings are consistent with asset pricing theory.

1 Introduction

How equity should be valued, in theory, is the cornerstone of economics and finance. Even though elaborate equity valuation models are continually being developed, how the investment professional views equity valuation for practical purposes is often detached from academic model building. For instance, it is traditionally perceived that the price-to-earnings ratio of a stock (the P/E) is perhaps the single most important investment benchmark: it mirrors the price investors are willing to pay for each dollar the firm expects to earn. As a shortcut for tedious discounted cash-flow analysis, and due to its ease of comparison, across time and stocks, both within and outside of a sector, the P/E has guided security analysis and stock selection for as long as stock markets have been in existence (see the classic Graham and Dodd (1934) and Malkiel (1973)). Moreover, as the fraction of firms paying cash dividends has fallen substantially in recent decades (Fama and French (2000)), it is not surprising that the P/E is assuming an even more fundamental role as an indictor of value (relative to, say, the price-to-dividend ratio). Given the pre-eminence of this financial ratio, it then makes sense to comprehend, empirically and theoretically, the interplay of forces that determine the P/E of individual stocks (the book-to-market is another crucial ratio, but that warrants a separate paper altogether). Our central question is: Are stocks with superior growth opportunities compensated with higher P/E valuation standards, both in the cross-section of stocks and in the time-series?[1]

We ask the above central question in four distinct ways. First, we investigate the cross-sectional relationship between the P/E valuation ratio and the expected earnings growth rate, using a collection of global capital markets. Since these stock markets are largely segmented through accounting rules, differential tax treatment of dividends and capital gains, legal protection to shareholders, and the nature of analyst earnings expectation,

[1]The topic of financial ratios has been a fertile area of research in financial economics and in accounting. A partial list includes Ang and Liu (1999), Bakshi and Chen (1998), Ball (1978), Basu (1977), Barsky and Delong (1993), Beaver and Morse (1978), Berk, Green, and Naik (1999), Campbell and Shiller (1988,1998), Chowdhry and Titman (1998), Daniel and Titman (1997), Fama and French (1992,1995), Ferson and Harvey (1993,1997), French and Poterba (1991), Hodrick, Ng and Sengmueller (1999), Kothari and Shanken (1997), Lakonishok, Shleifer and Vishny (1994), Lee, Myers, and Swaminathan (1999), Malkiel (1963), Ou and Penman (1989), Penman (1996), and Robichek and Bogue (1971). Understanding financial ratios has become an increasingly important goal, as recent empirical approaches have revealed that they have forecasting ability in predictive (return) regressions and stocks in a certain ratio class exhibit superior investment performance. When we expand on our analytical and empirical characterizations, the incremental contribution of this paper will be stated more directly.

they provide independent laboratories for our analysis. Second, we determine if a positive relationship between the P/E and the expected earnings growth rate persists, even after we account for cross-sectional differences in business risk, firm size, and the volatility of cash-flows. Third, we assess the time-series dependence of the P/E on the expected earnings growth rate, using a set of country indices and size/sector sorted portfolios. Finally, in the spirit of French and Poterba (1991), we document country patterns in the price-to-earnings ratios. The focal point of this exercise is to reconcile differences in long-run valuation behaviors.

To impose discipline on our empirical inquiry, we build an entire class of models to describe the price-to-earnings ratio. Without any explicit parameterization, this framework links the P/E of the stock to the expected earnings growth rate, the spot interest rate, and the factor risk premium for earnings. We establish that the P/E ratio has an intuitive discounted cash-flow interpretation: it is the discounted (martingale) expectation of a dollar payoff over the entire time-continuum. This random discount factor is affine in three components: the interest rate, the factor risk premium for earnings, and the anticipated earnings growth rate. Thus, as favored by Fama and French (1995), this candidate value-measure does compress risk, discounting, and future cash-flow behavior, all in a single identifiable entity. In essence, our analytical characterizations show that a higher anticipated earnings growth rate should bid the stock's P/E upwards in the cross-section (i.e., growth will pare the discounting factor for glamour stocks), and with the passage of time. Moreover, a trending interest rate environment should dampen the dynamic-path of the P/E. According to our model, holding other factors constant, the countries with lower interest rates should demand loftier valuation multiples.

By appealing to a sample of over 15,000 individual stocks compiled from 42 stock markets, we are able to evaluate the dynamic and cross-sectional validity of the asset pricing model. Taken from Institutional Brokers Estimate System (hereby, IBES), the overall sample has 2.01 million observations on equity price and analyst earnings forecasts. Our principal conclusions are easily summarized:

- The relationship between analyst earnings expectation and the P/E ratio is strong in the cross-section of international stocks. The cross-sectional regression of a stock's P/E onto a constant and expected earnings growth yielded slope coefficients that are positive with large t-statistics;

- When we controlled for disparities in business risk, as measured by sector membership, the cross-sectional results are similarly conclusive. In general, stocks in the health (finance) sector display the greatest (least) P/E sensitivity to earnings growth;

- The documented results are valid, even after adjusting for firm size and the volatility of cash-flows. As one would intuitively expect, small firms are relatively more sensitive to downward revisions in growth expectations. The explanatory power of expected earnings growth rate is never subsumed by size or cash-flow volatility;

- Expected earnings growth rate and interest rates are indeed the critical features that explain dynamic fluctuations in the P/E. Our empirical modeling of the problem suggests that earnings growth is of a higher-order importance. In the US, as much as 63% of the time-variation in the P/E ratio can be explained through expected earnings growth rate alone. When combined with nominal interest rate, only 8% of the P/E movement remains unexplained;

- The price investors are willing to pay per unit of earnings has a country-specific and a region-specific character to it. Our regression evidence indicates that structural differences in interest rates, accounting standards, and legal systems, are largely responsible for long-run departures in the P/E across countries.

The accumulated evidence on price-to-earnings ratio and earnings growth is robust over sub-samples, and to alternative test designs. Specifically in our time-series analysis, we constructed the P/E of a portfolio as the ratio of the average price to average earnings (instead of average of the individual P/E ratios). When we performed regression analysis again, the overall conclusions were essentially the same. We were able to reproduce most of our core findings after we discarded outliers, screened out small capitalization firms, and adopted more sophisticated heteroscedasticity adjustments.

The next section proposes a generic share valuation model and uncovers the dynamic and cross-sectional properties of the P/E ratio. Section 3 presents data and expounds on methodology. We devote Section 4 to studying the cross-sectional link between the P/E and expected earnings growth rate (with risk controls). In Section 5, we examine time-variations in the P/E ratios. We analyze long-run cross-country valuation patterns in Section 6. Conclusions are offered in the final Section 7.

2 A Model of Price-to-Earnings Ratio

Our intent is to present a theoretical framework for understanding variations in the price-to-earnings ratio, both in the stock cross-section and in the time-series. This modeling approach formalizes the set of testable implications for the later empirical analysis. To achieve this initial goal, consider a model where the stock price is Markov in earnings/cash-flows $E(t)$, its expected growth rate $G(t)$, and the nominal (spot) interest rate $R(t)$. The idea is to develop the general properties of the price-to-earnings ratio, where the equity price, denoted P(t), can be broadly written as P[E,G,R]. Adopt the assumption that each variable follows a Markov Ito process, under the objective probability measure. Hypothesize

$$
\begin{aligned}
\frac{dE(t)}{E(t)} &= G(t)\,dt + \sigma_e[G(t)]\,dW_e(t), \qquad\qquad E(0) > 0, &(1)\\
dG(t) &= \mu_g[G(t)]\,dt + \sigma_g[G(t)]\,dW_g(t), &(2)\\
dR(t) &= \mu_r[R(t)]\,dt + \sigma_r[R(t)]\,dW_r(t), &(3)
\end{aligned}
$$

where, for simplicity, the growth rate of cash-flows and the change in interest rate are modeled as an autonomous process. In the stochastic differential equations (1)-(3), W_e, W_g and W_r each represent a standard Brownian motion; and $\mu_g[G]$ ($\mu_r[R]$) and $\sigma_g[G]$ ($\sigma_r[R]$) are, respectively, the drift and diffusion rates governing the expected earnings growth rate (the nominal interest rate). Define $\rho_{g,r} \equiv \text{Cov}_t\,(W_g(t), W_r(t))$, $\rho_{e,g} \equiv \text{Cov}_t\,(W_e(t), W_g(t))$, and $\rho_{e,r} \equiv \text{Cov}_t\,(W_e(t), W_r(t))$. Because $G(t)$ and $\sigma_e[G]$ are independent of the path of $E(t)$, the earnings process, we postulated, is in the family of proportional stochastic processes.

Faced with a decision on how to treat dividends and earnings, we assume, as in Fama and French (1995), that the instantaneous dividend-flow, D, on the stock is related to the earnings stream, as in:

$$D(t) = y(t)\,E(t) \tag{4}$$

for some stochastic pay-out policy, y. Since pay-out is confined between 0 and 1 by construction, we presume y is in the family of beta distributions with density: $\frac{1}{B(a,b)}\,y^{a-1}\,(1-y)^{b-1}$, where $\bar{B}(a,b) \equiv \int_0^1 y^{a-1}(1-y)^{b-1}dy$ is the beta function with $a > 0$ and $b > 0$. As will be apparent in a moment, a stochastic pay-out policy is a convenient tool to create a wedge between price-to-earnings ratios and price-to-dividend ratios (Campbell and Shiller (1988, 1998)). Let the pay-out policy be independent and identically distributed, and orthogonal to every risk source. The mean payout ratio is accordingly $\frac{a}{a+b}$, for all t.[2]

The nature of risk compensation remains to be specified. For a generic pricing kernel, $m(t)$, posit that the factor risk premium for earnings and expected earnings growth rate (interest rate) risk are at most a function of $G(t)$ (R(t)). More exactly, let $\lambda_e[G] \equiv -\text{Cov}_t\left(\frac{dE(t)}{E(t)}, \frac{dm(t)}{m(t)}\right)/dt$, $\lambda_g[G] \equiv -\text{Cov}_t\left(dG(t), \frac{dm(t)}{m(t)}\right)/dt$, and $\lambda_r[R] \equiv -\text{Cov}_t\left(dR(t), \frac{dm(t)}{m(t)}\right)/dt$. This formulation nests a large class of possible risk adjustments. Applying Ito's rule, and using standard steps, the partial differential equation for the stock price becomes:

$$\begin{aligned}
&\frac{1}{2}\,\sigma_e^2[G]\,E^2\,\frac{\partial^2 P}{\partial E^2} + (G(t) - \lambda_e[G])\;E\,\frac{\partial P}{\partial E} + \frac{1}{2}\,\sigma_r^2[R]\,\frac{\partial^2 P}{\partial R^2} + (\mu_r[R] - \lambda_r[R])\,\frac{\partial P}{\partial R} \\
&+\frac{1}{2}\,\sigma_g^2[G]\,\frac{\partial^2 P}{\partial G^2} + (\mu_g[G] - \lambda_g[G])\;\frac{\partial P}{\partial G} + \rho_{e,g}\,\sigma_e[G]\,\sigma_g[G]\,E\,\frac{\partial^2 P}{\partial E \partial G} \\
&+\rho_{e,r}\,\sigma_e[G]\,\sigma_r[R]\,E\,\frac{\partial^2 P}{\partial E \partial R} + \rho_{g,r}\,\sigma_g[G]\,\sigma_r[R]\,\frac{\partial^2 P}{\partial G \partial R} - RP + \frac{a\,E}{a+b} = 0
\end{aligned} \tag{5}$$

subject to $0 \leq P(t) < \infty$, for all t. The following proposition provides foundations for the empirical predictions.

Proposition 1 *Suppose the process for the level of earnings, the expected earnings growth rate, and the nominal interest rate are as generically described in (1)-(3). Then, the P/E of stock n (indexed by $n = 1, \cdots, N$) can be characterized as follows (with $R(t) + \lambda_{e,n}(t) - G_n(t) > 0$, for all t):*

$$\frac{P_n(t)}{E_n(t)} = \frac{a_n}{a_n + b_n} \int_0^\infty \mathcal{E}_t^* \left\{ \exp\left(-\int_t^{t+\tau} [R(u) + \lambda_{e,n}(u) - G_n(u)]\, du \right) \right\} d\tau \tag{6}$$

which is the expected discounted value of unity cash-flows, forever. The discounting factor is explicitly modified for (i) stock-specific earnings risk, and (ii) the expected earnings growth

[2]Some clarification is needed regarding the economic reasonableness of assumptions (1) and (4). First, negative earnings are inadmissible in proportional economies. As firms do occasionally experience negative earnings, the class of earning processes proposed in (1) are admittedly far from ideal. Nonetheless, the reader may observe that if negative earnings are ever permitted here, the dividend policy, and hence the stock price, will become theoretically negative from (4) - both counterfactual (unless the payout ratio is negative). In the next section, we demonstrate that only a small portion of the stock universe has negative current earnings. Viewed from another perspective, when the earnings of individual stocks are consolidated into country-specific or sector-specific earning indices, the earnings series so aggregated will be positive in general. As our chief concern is with the normative aspects of the P/E value measure, and with its broad empirical testing, we refrain from developing a full-blown theory of the stock and the P/E under negative current earnings. We will revisit this point in our empirical implementation.

rate. Here, the expectation, $\mathcal{E}_t^*\{.\}$, is taken under the martingale pricing density (presumed to exist), and according to the transformed stochastic system (16)-(17).

Even though not yet solved in closed-form, equation (6) provides the central intuition that P/E proxies the market's assessment of discounted cash-flows, albeit with altered discounting. Unlike existing models, it suggests an analogy between the P/E of a stock and the (risk-free) consol bond price: each entity sharing a similar integral representation in the Lebesgue continuum of time-variate τ. In essence, the proposition characterizes, to a first-order, how the P/E of a stock responds to fluctuations in the nominal interest rate, the factor risk premium for earnings, and the expected earnings growth rate. Proposition 1 suggests a few hypotheses about the P/E ratio.

1. Stocks with superior earnings growth potential merit greater P/E multiples, in the stock cross-section (holding constant the risk premium for earnings). The higher the risk compensation for earnings risk, the lower the P/E tends to be in the cross-section;

2. When a stock's expected earnings growth rate, $G_n(t)$, goes up, the P/E multiple should go up in accordance with (6). When the nominal interest rate increases, it should dynamically lower the P/E of all stocks (although differentially). Alternatively, a tractable variant is that the inverse of R is positively related to the P/E.

The first set of hypotheses is concerned with the behavior of the P/E in the stock cross-section; the second set imposes dynamic restrictions on the P/E movements. Naturally, one is tempted to ask: How general are these predictions? Insofar as expected earnings growth rate is concerned, our economic theorizing should be verifiable in more expanded (or watered-down) renditions of the model. This assertion hinges on the fact that a higher expected earnings growth decreases the random variable $\int_t^{t+\tau}(R(u)+\lambda_e(u)-G(u))\,du$, for a fixed time-path of the realizations of $R(u)$ and $\lambda_e(u)$. However, common sense does suggest that it is far too extreme to expect the P/E to decline every time the interest rate goes up in value. For example, it is certainly possible for a rise in interest rates to enhance current and future profitability of the stock. But proposition 1 argues that the negative effect of discounting always overwhelms any positive influence interest rates may have on the cash-flow stream. An answer to this seemingly paradoxical finding may lie in the working of assumption (2): the expected earnings growth rate is locally independent of the current interest rate. Even when this complex assumption is incorporated into (2) and the P/E is analytically derived, its implications for P/E are still ambiguous. Mired by this theoretical outcome, we pose the interest rate sensitivity of the P/E as a question to be settled through empirics.

All reasonably parameterized equity valuation models may make similar predictions about the P/E ratio. To appreciate this point, relax assumptions (1)-(3) so that the resulting conditional expectation can be solved in closed-form. Specifically in the traditional Gordon model, the earnings process admits a geometric Brownian motion representation with $G(t) = G$, $\lambda_e[G] = \lambda_e$ and $R(t) = R$, all constants. Since $\int_t^{t+\tau}(R+\lambda_e-G)\,du = (R+\lambda_e-G)\,\tau$, we, thus, have (by an integration step and (6))

$$\frac{P_n(t)}{E_n(t)} = \frac{a_n}{a_n + b_n}\left(\frac{1}{\mu_n - G_n}\right) \qquad n = 1, \cdots, N, \tag{7}$$

where the expected rate of return, μ (>G), is denoted by: $\mu_n \equiv R + \lambda_{e,n}$, for all n. Guided by such a connection, many studies (some of the papers are listed in footnote 1) have inferred variations in the P/E, as due to variations in the expected return and/or expected earnings growth. However, if one relies on a more general stochastic environment, it is often impossible to analytically decompose the P/E of a stock into its expected stock return, and earnings growth components (see the valuation models of Abel (1988), Ang and Liu (1999), Bakshi and Chen (1998), Berk, Green, and Naik (1999), Campbell and Shiller (1988), and Lee, Myers, and Swaminathan (1999)). Due to this reason, we will abstain from estimating the relative importance of expected stock return and expected earnings growth rate in explaining variations in the P/E - either in the cross-section or the time-series. Instead, we focus on testing properties common to a wide class of equity valuation models (in the presence of risk controls).

In the empirical section, we will also outline ways to control for cross-sectional variations in earnings risk (granted the risk compensation is unobservable). As a practical matter, note that the price-to-dividend ratio and the price-to-earnings ratio are not completely recoverable from one another (i.e, $P(t)/D(t) = \frac{1}{y(t)}\,P(t)/E(t)$ for all t). With this said, we investigate the basic implications of proposition 1 from distinct perspectives.

3 Data Description

Maintained by IBES International, the database contains information on a wide variety of financial variables. Specifically, the raw database has coverage, from 48 national stock markets, on individual stock prices, analyst expectation of current year earnings and next year earnings, and the number of shares outstanding. Overall, the data universe includes 5991 stocks in the United States, and 11,031 stocks in the rest of the world. The individual stock sample begins in January of 1976 for the US; in January of 1985 for Canada; and in January of 1987 for most other industrialized capital markets. The sample ends in July 1998, with about 2.01 million observations. This database possesses the advantage that it assigns each stock to one of 11 different economic sectors (i.e., basic industries, capital goods, and so on). This consideration is critical as price-to-earnings multiples, and expected earnings growth rates, do vary systematically across sectors. Finally, this database does not suffer from the kind of survivorship biases that many other databases are known to do.

In any investigation structured around a topic such as ours, stocks with negative current earnings (and thus negative P/E) are difficult to conceptualize theoretically and characterize empirically. In other words, it is unclear how to treat such observations in the construction of country-wide (or, sector/size specific) P/E's and projected earnings growth rates. Indeed as noted elsewhere, when the P/E is negative, this measure loses much of its theoretical and empirical attractiveness. Even if a coherent theory of the P/E under negative earnings is ever developed to our satisfaction, it still presents a difficulty: How should the expected earnings growth rate be formulated in these cases? To see this point, take the case of IBM in October 1993. The consensus analyst earnings forecast for the current year is -$0.21 and the next year forecast is $1.03. While one can no doubt observe that the change in earnings is expected to be positive $1.24, we are not yet aware of ways to compute the expected earnings growth. Pitfalls of a similar nature emerge when current (next) year earnings is -$6.08 (-$0.26), which GM had in January of 1992.

Before rushing to exclude all such observations, we, nonetheless, conducted a simple experiment. From the stock history of each of the 42 stock markets, we computed, the percentage of observations, as a fraction of the total, that have negative earnings.[3] Then

[3]Out of the original 48 countries, we deleted, for lack of sufficient number of stocks (or price histories) Hungry, Israel, Slovakia, and Venezuela. Furthermore, Peru and Russia each experienced a hyperinflationary episode. Due to the resulting price-level uncertainty, IBES converted each individual stock price and their

compiling the occurrence rate across all stocks within a country, we report, in Table 1, this consolidated statistic. With few exceptions, the fraction of stocks with negative earnings is generally not too large. For instance, this fraction is less than 5% for 21 countries, and between 5%-10% for 15 countries.

Because of the problems we (and others) have identified, we followed the lead of Fama and French (1995), Lakonishok, Shleifer and Vishny (1994), and La Porta (1996) and omitted all observations with negative earnings from consideration. For the empirical work, the following definitions are adopted:

- E(t): constitutes current year (consensus) analyst earnings forecast, FY1, at date t;
- $P(t)/E(t)$: the (forward) P/E of the stock. It is the ratio of monthly stock price to FY1 earnings;
- $G(t)$: surrogates the expected earnings growth rate. We compute it as the ratio of next year earnings projection, denoted FY2, to the current year earnings projection, FY1, minus one (only when FY1>0);
- $R_k(t)$: the nominal interest rate in country k, as captured by the long-term government bond yield (when unavailable, some reasonable proxy is utilized). The source of this input is mostly International Financial Statistics.

In the IBES universe of stocks, representative country-level and sector-level stock price and earnings growth rate indexes are not reported. As a consequence, these indices must be constructed from individual stocks. For this reason, we follow standard logic and compute, for all stocks in a country, a matched vector of price-to-earnings ratio and the expected earnings growth rate – one for each date t. We then equally-weight the entries in each vector to arrive at the country P/E ratio and the G. In so doing, a few exclusionary filters were imposed. First, if the equity price, FY1, or FY2, were missing for a stock, it was jointly dropped from the P/E and the G vector. Second, if the P/E exceeded 1,000; or if the G exceeded 1500% or declined below -1500%, those stocks were dropped as well. While

forecasted earnings, respectively, from the local currency directly into the US dollar. To ensure consistency within the country sample, these two countries were also dropped. Thus, only the empirical results for 42 countries are reported in Table 1, and thereafter. Among these, by precedent, 19 countries were identified to have developed stock markets and 23 countries to have emerging stock markets.

rare, the latter screen was adopted to prevent a few extremes from controlling the analysis. Each filter guarantees that the P/E of the index incorporates earnings growth for the same set of stocks. To address any remaining influential observations problem, we later use ratios of the aggregates, rather than average of the ratios.

Repeating the same sequence of steps for each country, we report, for illustration, in Table 1, the number of stocks comprising each country index (in June of 1988, 1990, 1992, 1994, 1996, and 1998). The scope and the depth of the coverage maintained in this database is apparent. In the present context, observe that the P/E is *not* computed as the ratio of the monthly stock price to its trailing (or recent actual) earnings, but rather to its forward earnings. This forward P/E measure will be the focal object throughout.

4 Expectation and Price-to-Earnings in the Cross-section

How does P/E relate to expected earnings growth rate in the cross-section of individual stocks? For expositional clarity, this question is addressed in several parts. At the outset, we present regression evidence from around the world. Next, we design empirical tests that incorporate a role for (i) business related risks, (ii) firm size, as measured by its market capitalization, and (iii) the volatility of the earnings stream. Our objective is to study whether including risk premium proxies can distort the link between price-to-earnings ratio and expected earnings growth rate. Some of the proxies may lack rigorous asset pricing underpinnings but they provide a set of plausible controls.

4.1 A Systematic Picture from the Country Universe

Consider the regression specification

$$P_n(t)/E_n(t) = \alpha(t) + \beta(t)\, G_n(t) + \epsilon_n(t) \qquad n = 1, \cdots, N_t,\ t = 1, \cdots, T, \qquad (8)$$

which parsimoniously links the price-to-earnings ratio of a stock to the expected earnings growth rate. Note that this empirical specification suppresses cross-sectional variations in the factor risk premiums. The primary testable implication is: $\beta > 0$. Intuitively, this hypothesis states that a stock with higher growth prospects will be rewarded with a higher P/E multiple, in the stock cross-section. The coefficient α represents the expected P/E multiple of a stock, with zero earnings growth. We can, thus, expect α to be positive.

The estimation steps embedded in the empirical specification (8) are relatively straightforward. Take the stocks in the US as an example. Starting in January 1976, we cross-sectionally regress price-to-earnings multiple onto a constant and expected earnings growth rate (via ordinary least squares), using the entire stock collection N_t. Proceeding to the next month, a new cross-sectional regression is performed. This procedure is followed each month, yielding a time-series of $\{\alpha(t) : t = 1, \cdots, T\}$ and $\{\beta(t) : t = 1, \cdots, T\}$. We then calculate the average intercept and the average slope coefficient, as suggested in Fama and McBeth (1973). For statistical inference we rely, in part, on the t-statistic, which is merely the average regression coefficient scaled by its (time-series) standard error. Repeating this procedure for each country and pooling the resulting regression coefficients, we present the results from the country universe in Table 2.

This line of investigation establishes a number of key findings. First, the coefficient β is positive and statistically significant in almost all of the countries. For the set of developed countries, the P/E growth sensitivity, β, ranges from a low of 0.12 (in New Zealand), to a high of 0.64 (in Japan). Amongst our cohort of developed markets, the lowest t-statistic is 7.58. Therefore, the hypothesis that β is zero can be rejected throughout. In the emerging markets, the counterpart magnitude ranges between 0.02 and 0.33 – with a minimum t value of 1.84 (the only one below 2). Along another dimension, note that the magnitude of β is economically plausible: if the expected earnings growth rate of US stocks were to rise by 1%, it can cause their P/E to jump by as much as 14 basis points (on average). As we predicted, α is positive and statistically significant in the cross-section.

Second, the documented relationship between P/E and G is structurally stable, as seen from the counting indicator, 1_β. Among all available months, this variable measures the proportion of months with $\beta < 0$. As reported, the occurrence rate of negative β is 1.1% for US (i.e., 3 months out of 271 months), 1.44% for Japan, and 0% for the UK. The strength of the association is similarly strong in the emerging markets (with the possible exception of Mexico, Turkey, and South Africa, who have 1_β in excess of 10%).

Third, the part of the cross-sectional variation that can be explained by expected earnings growth is reasonable. Observe that the reported R^2 is the average R^2 over all the monthly regressions. The goodness-of-fit statistic is 28.32% for US, 21.20% for Japan, 34.29% for UK, 35.85% for Germany, and 47.93% for France. The magnitude of the R^2's from emerging markets are generally smaller compared to those from developed markets, and vary between 8.48% to 34.61%.

Finally, is the evidence equally compelling at the individual (cross-sectional) regression level? To address this issue, we constructed the $1_{t>2}$ statistic. In essence, this statistic measures the relative frequency of $t(\beta) > 2$. For our monthly regressions, this statistic corresponds to slope coefficients, β, that are not only positive, but also statistically significant. Shown in Table 2, it is assuring that this statistic is rather large for most countries. Specifically, $1_{t>2}$ exceeds 60% for 40 stock markets. In the US, $1_{t>2}$ equals 97.42% with a minimum monthly t-statistic of 18.32 (not shown).

To confirm the above elementary findings, we also performed diagnostic checks from three separate angles. We initially divided each country sample into several sub-samples, and studied the time-stability of β. During the recent 1992:01–1998:07 sample, for instance, we obtained an average β of 0.19, 0.17, and 0.34, respectively for US, UK, and Germany (all statistically significant). These numbers closely resemble its Table 2 counterparts. Next, we conducted empirical tests that took the impact of influential observations into consideration. Here we trimmed the cross-sectional data to exclude observations in the top and bottom 5% of the P/E and G distributions (each month). When the cross-sectional regressions were repeated, the overall findings were quantitatively similar to those we have presented. In yet another test, we incorporated more realistic forms of heteroscedasticity (say, proportional to the P/E itself) into (8), and still found our conclusions to be robust. To summarize, price-to-earnings ratios impound analyst expectations about future cash-flows in markets around the world.

4.2 Controlling for Business Risks

One possible concern with the country regression results just presented is the lack of sufficient controls for dispersions in the earnings risk premium. To resolve this issue, we slightly modify our empirical approach. For this exercise, we classify, each month, the available stock universe, eleven-way according to their line of business. Sharing similar cash-flow characteristics, the sector stocks are positively correlated in general (see, among others, Liew and Vassalou (1999) and Moskowitz and Grinblatt (1999)). Hence, one should expect sector stocks to covary more closely with the generic pricing kernel, than their non-sector counterparts. To make empirical approach more manageable, we restrict attention to the stock markets of US, UK, and Japan (which incidentally have the deepest cross-section). This finer stock partition produced a set of 33 cross-sections, one for each month. Then putting specification (8) to test, we cross-sectionally regress the P/E of sector stocks onto a constant and expected earnings growth rate.

The regression coefficients are pooled by sector, and the respective averages are displayed in Table 3. Two central messages are evident. First, the slope coefficients β are consistently positive and significant, even after controlling for sector-specific risks. Depending on the nature of the sector, earnings growth can have a differential impact on the price-to-earnings ratio. For instance, in the growth starved utility sector, even a small change in the expected earnings growth rate can bring about a large change in the P/E. In general, stocks in the health, the energy, and the utility, sector possess the greatest growth sensitivities. Second, the P/E-growth relation continues to strong, as detected by the magnitude of 1_β (the largest 1_β is 5.75% for US transport sector). The regression goodness-of-fit statistics are comparable, or even higher relative to those shown in Table 2.

Inspection of the sector characteristics uncovers another regularity: the sectors with relatively higher P/E are the same ones that analysts expect to grow faster. The converse relationship exists for sectors with stunted growth opportunities. A standard F-test of whether the mean P/E ratio is the same across sectors is overwhelmingly rejected. However, the P/E of stocks in any given sector can still exhibit sharp variance across national stock markets. According to Table 3, country influences can effectively swamp out sector influences on the price-to-earnings ratio. Apart from this insight, the set of evidence presented in Table 2 and 3 are mutually consistent.

4.3 Controlling for the Impact of Size

We now refine the basic approach to study a role for size. More formally, we adopted the cross-sectional specification below:

$$P_n(t)/E_n(t) = \alpha(t) + \beta(t)\, G_n(t) + \gamma(t)\, \ln[\mathrm{Size}_n(t)] + \epsilon_n(t) \qquad n = 1, \cdots, N_t,\ t = 1, \cdots, T, \tag{9}$$

where Size_n denotes the market capitalization of stock n (i.e., the market price multiplied by the number of shares outstanding). Berk (1995) and Fama and French (1992) have articulated that size is inversely related to the riskiness of the firm. Guided by their reasoning and proposition 1, $\gamma > 0$. That is, holding other factors constant, smaller firms are more risky and therefore command lower P/E valuations.

To implement this cross-sectional regression, we assigned stocks into ten groups, by their market capitalization (Decile 1 stocks have the lowest size, and Decile 10 have the largest size). Each month, and for each size decile, we run regression (9) with size as an additional explanatory variable. The findings from this investigation are shown in Table 4. We continue to maintain focus on the stock markets of US, UK, and Japan.

Even in the presence of size controls, price-to-earnings ratio and expected earnings growth are positively associated. In each of the 30 cross-sectional regressions, β shows essentially the same order of magnitude as its Table 2 and 3 benchmarks. One possible point of departure is that the growth sensitivity is generally increasing with size: the lowest (highest) capitalization US stocks have an average β of 0.11 (0.23). Seldom is the growth sensitivity negative, as illustrated by the low values of 1_β. Most of the monthly t-statistics are also greater than 2 (see the $1_{t(\beta)>2}$ statistic). The second point to note is that although the coefficient on (log of) size is positive on average for US and UK, it often switches sign in the cross-sectional regression. Moreover, in the monthly regressions, $t(\gamma) > 2$ only occasionally. This is evident from the low magnitudes of $1_{t(\gamma)>2}$ across the dimensions of size deciles and countries. In general, the role of size is weakest in Japan.

Between the expected earnings growth rate and size, the former is almost always the more important variable than the latter. For example, the adjusted R^2 from the multiple regression (9) are virtually indistinguishable from the univariate regression with expected earnings growth rate alone. To be more precise, for US stocks with lowest capitalization, the R^2 from the multiple (univariate) regression is 43.31% (42.43%).

The decile characteristics portray a similar qualitative picture. Displaying a hump-shaped pattern, P/E and size do not interact in any obvious fashion. Consider the US. The average P/E of the stocks in Decile 1 (with average size of 0.24 Billion) is 18.12 which does not greatly differ from 18.65, the average P/E of stocks in Decile 10 (with average size 122.46 Billion). However, expected earnings growth rate and size are inversely related. We also extended our regression analysis to screen out firms with market value less than 500 million. In large part, this evidence does not contradict the numbers displayed in Table 4. Overall, our evidence indicates that the documented relationships are not an artifact of the size effect.

4.4 Controlling for the Impact of Cash-Flow Volatility

This sub-section controls for cross-sectional variations in cash-flow volatilities across stocks. In this thought experiment, US stocks are rank-ordered into one of five different groups based on the volatility of their FY1 earnings. Under our classification scheme, Group 1 contains stocks with the lowest volatility, and Group 5 contains stocks with the opposite volatility characteristic. Define cash-flow volatility, VOL[$E(t)$], as the standard deviation of the prior six month FY1 earnings:

$$\mathrm{VOL}[E_n(t)] = \mathrm{Std}[E_n(t), \cdots, E_n(t-5)] \qquad n = 1, \cdots, N. \tag{10}$$

Only the months of June and December are used to avoid any variable overlaps in the regressions. For all quintile stocks, we study the impact of cash-flow volatility via

$$P_n(t)/E_n(t) = \alpha(t) + \beta(t)\, G_n(t) + \theta(t)\, \mathrm{Vol}[E_n(t)] + \epsilon_n(t) \qquad n = 1, \cdots, N_t,\ t = 1, \cdots, T, \tag{11}$$

with Vol[$E_n(t)$], as defined in (10). In principle, stocks with lower cash-flow volatility are less risky. As a result, such stocks should have more elevated P/E valuations. Therefore, we expect $\theta < 0$. From the cross-sectional regressions performed at each time-point, we get 43 estimates each for α, β, and θ (and their t-statistics).

Now shift focus to Table 5, which summarizes our empirical results. First, the growth sensitivity coefficient, β, is always significant across the volatility quintiles. The order of the magnitude parallels those in Table 3 and Table 4, and range between 0.09-0.30. Second, with one possible exception, higher cash-flow volatility in the cross-section translates into a lower P/E ratio. The coefficient θ is statistically significant. Moving from low volatility to high volatility quintiles, the response coefficient becomes less negative. This asymmetry is intuitive as, for a stock that normally exhibits small cash-flow volatility, even a small increase in volatility could generate a significant decrease in the P/E ratio. The adjusted R^2's of these regressions range from 25.72% to 36.71%, which broadly agree with our earlier controls. However, the expected earnings growth rate is still the predominant explanatory factor. All univariate regressions that use earnings volatility as the sole regressor have marginal R^2's (less than 1% for 4 quintiles).

By and large, the reported results are consistent with the displayed portfolio profiles. That is, the P/E and expected earnings growth are both monotonically declining in cash-flow volatility. The average P/E ranges from 27.27 for the lowest volatility quintile, down to 10.96 for the highest volatility quintile. Similarly, the average expected earnings growth rate ranges from 68.03 down to 16.74 along the volatility spectrum.

We also back-tested (11) with volatility measures constructed over longer horizons (i.e., each December), and arrived at the same inference: one can count on expected earnings growth rate to increase price-to-earnings ratios. In sum, the cross-sectional predictions of the asset pricing model are supported in a broad spectrum of international stocks.

5 Exploring the Time-Series Behavior of the P/E

Our central purpose is to now investigate dynamic variations in the price-to-earnings ratios. For reasons of tractability, we appealed to the econometric specification below:

$$P_k(t)/E_k(t) = \Delta_0 + \Delta_g G_k(t) + \Delta_r \frac{1}{R_k(t)} + \epsilon_k(t), \tag{12}$$

$$\epsilon_k(t) = \rho\, \epsilon_k(t-1) + \eta_k(t), \qquad t = 1, \cdots, T, \tag{13}$$

where η_k has zero mean and variance σ_k^2 ($k = 1, \cdots, K$). We settled on the specification with auto-correlated regression residuals, as an ordinary least squares estimation consistently delivered low Durbin-Watson statistics (Greene (1997), Chapter 13). Observe that $G_k(t)$, and $R_k(t)$ are, respectively, the monthly expected earnings growth and the monthly interest rate for country k, as constructed in Section 3. To be consistent with the predictions of our asset pricing theory, we maintain $\Delta_g > 0$ and $\Delta_r > 0$. The model (12)-(13) is estimated using the two-stage least squares methodology of Cochrane-Orcutt (i.e, we minimized $\frac{1}{2\sigma^2}\sum_{t=2}^{T}(\epsilon(t) - \rho\,\epsilon(t-1))^2$, with $\epsilon(t)$ defined in (12)-(13)).

To fix ideas, Panels A and B of Table 6 provide an overview of our time-series estimations, separately for developed and emerging markets. The commonality of the findings across countries is striking. It is clear that a higher expected earnings growth rate will cause the country price-to-earnings multiple to rise in response (Malkiel (1963)). The coefficient varies between 0.08 and 0.25 for developed countries. With the exception of Japan, all the coefficients are statistically significant. Ceteris paribus, a 1% change in earnings growth expectation will induce a 21 (24) basis point change in the P/E of US (UK) stocks. A parallel pattern is evident from emerging stock markets, with 13 (out of 23) countries showing positive and significant Δ_g. When Δ_g is negative, it is not statistically significant.

The second noteworthy result is that a higher interest rate lowers the country P/E. But the pattern is not as clear-cut as that from earnings growth rate: Δ_r is positive with t-statistic in excess of two, for only nine developed and two emerging stock markets. Surprisingly, Δ_r shows a statistically significant negative sign for two developed markets and one emerging market. The regression analysis seems to suggest that, in the emerging stock markets, movements in P/E can be removed from changes in nominal interest rates.

The dynamic fit of the model is reasonable with 22 countries showing adjusted R^2's (from the OLS estimation) higher than 30%. For the developed markets, 12 countries display a higher R^2 in the univariate regression involving the expected earnings growth rate, compared to the one with inverse interest (see the columns marked "Constrained" $\Delta_r \equiv 0$ and $\Delta_g \equiv 0$). In the US, the adjusted R^2 is 62.79% with G alone, and 41.43 with 1/R alone; in the multiple regression the combined explanatory power of the two variables is 91.58%. Whether expected earnings growth rate or inverse interest have a higher R^2 varies across emerging markets, with no clear pattern. Lastly, the auto-correlation coefficient, ρ, is persistently positive with large t-statistics. The Durbin Watson statistics (hereby DW) are all in the neighborhood of two, which imply a less severe model mis-specification.

Analyzing the results from sectors and size deciles, somewhat consistent conclusions emerge. Reported in Table 7 are the time-series estimations from the US (we have omitted UK and Japan to save space). We can note that Δ_g and Δ_r are positive, and mostly significant across sectors and size deciles. Stocks in the utility and health sector suggest that small downward revisions in G can cause the P/E to decline substantially. Across the size deciles, the P/E's respond quite differently to growth opportunities and to interest rate movements. The minimum explanatory R^2 of the regressions is 60.68%.

Because the aggregate P/E (G) is calculated as the average of the ratio of individual stock prices (FY2) to their FY1 earnings, the presence of influential observations can impart a bias to the time-series regressions. To accommodate this possibility, we performed one final diagnostic check by taking the P/E to be the ratio of average monthly stock price to average FY1 earnings. Aggregate G is analogously average FY2 divided by average FY1, minus one. We refer to this construction as "Ratio of the Average." Then re-running the time-series regressions, we obtained a matched comparison for the 1992:01-1998:07 subsample period (omitting Δ_0, and $\epsilon(t)$):

1. **DEC 1** $P/E = 0.12\,G + 0.60\,\frac{1}{R}$, R^2=51.42%, ρ=0.69 **Average of the Ratio**
   $P/E = 0.10\,G + 0.37\,\frac{1}{R}$, R^2=39.95%, ρ=0.71 **Ratio of the Average**

2. **DEC 10** $P/E = 0.33\,G + 0.98\,\frac{1}{R}$, R^2=47.21%, ρ=0.77 **Average of the Ratio**
   $P/E = 0.13\,G + 0.63\,\frac{1}{R}$, R^2=53.64%, ρ=0.66 **Ratio of the Average**

We observe that regression estimates and fits largely mimic one another. Hence, the proxy problem at the aggregate level may not be that severe. When we used the median instead of the average, the outcome was not too different. Our conclusions on the time-series relation between the P/E and its economic determinants are robust.[4]

6 Reconciling Cross-Country P/E Patterns

The thrust of this section is two-fold. First, we document long-run cross-country patterns in the aggregate P/E ratio. Next, we research whether international divergences in the P/E can be empirically reconciled. Consider Table 8, which displays cross-country disparities in (i) the P/E ratio, (ii) the expected earnings growth rate, and (iii) the nominal interest rate. A few observations are clear-cut. First, there is wide variation in the amount that investors are paying for a unit of earnings. Take the G-7 group of countries as the basis. Over their respective samples, the average P/E is 17.19 in the US; 23.72 in Canada; 20.03 in France; 21.74 in Italy; 16.44 in UK; 29.92 in Germany, and 64.83 in Japan. The variation in the P/E's is similarly pronounced for emerging capital markets. Even though structurally alike in several respects, the aggregate P/E of 43.39 in Taiwan contrasts starkly the corresponding P/E of 11.75 in Hong Kong. What combination of factors can drive the wedge between the P/E in Hong Kong and Taiwan? Why do some emerging stock markets warrant superior

[4]We also tried an alternative time-series specification that included anticipated depreciation of a country's currency. This additional variable is based on a theoretical model we developed in an earlier version of this paper. According to our parameterization, a depreciating exchange rate (benchmarked to the dollar) will erode the P/E of export oriented stocks and the converse for import oriented stocks. This thesis is not inconsistent with the view that the depreciation of the Yen against the US dollar will depress the US P/E, potentially to the benefit of its Japanese partners. Thus, we can address more directly such questions as: Can one attribute the decline in the Japanese P/E to the appreciation of the Yen/dollar exchange rate (French and Poterba (1991))? How large is this exposure quantitatively? When we used interest rate differential as a proxy for expected depreciation (as parity conditions suggest), the sign of the exposure was contrary to our theoretical predictions (in 28 out of 42 countries). The explanatory R^2's were also relatively low. To make our investigation less spread out, we have excluded this extended analysis from the main body of the paper.

P/E's, while others lag behind forever? What causes the fundamental ratio in Japan to differ from the rest of the world? These findings are puzzling.

Although this sort of approach based on average P/E and G is commonplace, it can surely mask time-variation in each of the entities. To investigate this issue, we scrutinized country-specific numbers in the June of 1988, 1993, and 1998. We also divided global stock markets into three different geographical regions: (1) Asia/Pacific, (2) Europe, and (3) Latin America (e.g., Jorion and Goetzmann (1999), and Roll (1992)). While not reported in a table, some findings are useful. First, they substantiate a radical decline in the Japanese P/E. In just over a decade, the Japanese P/E has fallen from 84.25 (in June 1988) to 34.31 (in June 1998), more in-line with OECD standards (e.g., French and Poterba (1991)). Second, the price that a unit of earnings commands is smaller in the emerging markets, than in developed markets. Among various geographical regions, the aggregate P/E's are highest in Asia followed, in turn, by Europe and Latin America.

To understand the above patterns, we first executed the cross-sectional regression

$$\ln(P_k/E_k) \quad = \quad \alpha + \beta_g\, G_k + \beta_r\, \frac{1}{R_k} + \epsilon_k, \qquad\qquad k = 1, \cdots, K, \qquad (14)$$

where, for each country k, P_k/E_k, G_k, and R_k denote the *yearly* values, respectively, for price-to-earnings, expected earnings growth, and the nominal interest rate. To construct the yearly number, we time-averaged the monthly observations. As our regression results are representative of the overall pattern, only estimations for select years are shown. A number of points can be made based on Table 9. First, the nominal interest rate is almost always of a first-order importance in explaining divergences in the P/E ratio. This is especially true across developed capital markets. In fact, the coefficient β_r is persistently positive and statistically significant. The bulk of the cross-country variations in the P/E can be attributable to nominal interest rates. For instance, the adjusted R^2 from the full regression (14) are almost identical to the one with $\beta_g \equiv 0$. Second, in contrast to our earlier findings from individual stocks, the expected growth rate has a negligible impact in the cross-country regressions. The coefficient β_g is significant only once, and often switches sign. For developed markets, the time-averaged β_g (β_r) is 0.04 (1.72) with a t-statistic of 0.64 (7.46). Finally, the regression fit is worse for emerging markets. In brief, cross-country disparities in the price-to-earnings ratios are ascribable, at least partially, to divergences in the nominal interest rate.

Although earnings growth is a dimensionless quantity, it is still measured in the local currency. Therefore, in our cross-sectional regression (14), one may argue that the country earnings growth rate needs to be inflation-adjusted or denominated in dollar terms. To pursue this aspect of the problem, we performed a univariate regression with $G_k - R_k$ as the explanatory variable. While not reported here to conserve space, the slope coefficient ranged between -0.01 and 0.01 with all t-statistics less than 2. The maximum R^2 (which occurred in the 1998 cross-section) is 10.76%. In essence, earnings growth, even when adjusted for inflation differences across countries, is not significant. For this reason, inflation-induced biases were not explicitly accounted.

Second, can cross-country P/E patterns arise as a result of long-lived differences in accounting standards and/or the composition of their legal systems? Indeed, French and Poterba (1991, p.361) generate evidence that if Japan adopted US accounting standards, its P/E would be reduced by about 40%. In the accounting literature, among others, Alford, Jones, Leftwich, and Zmijewski (1993) have contrasted the information content and the timeliness of accounting earnings in several countries. Using a sample of US and Canadian firms, Bandyopadhyay, Hanna, and Richardson (1994) demonstrate that GAAP differences can exert a substantial impact on reported earnings. To take into account such factors, we introduce measures of (i) quality of accounting standards (denoted ACCTN_k) and (ii) integrity of the legal environment (denoted LEGAL_k), from La Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998, Table 5). The former is complied from International Accounting and Auditing Trends (from 1990), and the later from Business International Corporation (averaged between 1980-1983).

To isolate the contribution of each long-lived variable, we performed two regressions using the 1990 cross-section (suppressing the constant and ϵ_k)

$$\ln(P_k/E_k) = 0.004[0.43]\, G_k + 0.07[2.77]\, \frac{1}{R_k} - 1.51[-1.92]\ln(\mathrm{ACCTN}_k), \qquad R^2 = 24.14\%$$

$$\ln(P_k/E_k) = -0.004[-0.54]\, G_k + 0.10[3.44]\, \frac{1}{R_k} - 0.71[-2.28]\ \ln(\mathrm{LEGAL}_k), \quad R^2 = 27.27\%.$$

On balance, this exercise yields three empirical findings. First, the coefficient on ACCTN_k and LEGAL_k are negative, and significant (i.e., t-statistic of -1.92 and 2.28 as shown in square brackets). Thus, the more improved the legal environment or the quality of its accounting standards, lower is that country's P/E (or equivalently higher earnings-yields).

Second, the individual contribution of ACCTN and LEGAL to the overall fit of the regression is potentially large; the R^2 with expected earnings growth and interest rate is about 14%. Third, the (inverse) interest rate sensitivity remains positive and statistically significant. In particular, interest rates do not subsume the explanatory ability of ACCTN or LEGAL, and the reverse. In summary, accounting/legal channels have interesting implications for asset prices. We defer a thorough theoretical examination to a future research project.

7 Conclusions

Grounded in conceptual and empirical characterizations, this article has taken a look at several different, but equally important issues confronting financial economists. Theoretically, it is shown that the price-to-earnings ratio has an appealing discounted cash-flow interpretation. Empirically, we document that the price-to-earnings ratio is determined by earnings growth expectation in the cross-section of international stocks. It is argued that these results are true even when we adjust for cross-sectional differences in business risks, firm size, and the volatility of cash-flows. To a large extent, our empirical investigation shows that time-variations in the country P/E (and size/sector sorted portfolios) are related to variations in expected earnings growth rate and nominal interest rate. The nominal interest rate appears to be a more fundamental attribute in reconciling cross-country divergences in the price-to-earnings ratio. Our exercise suggests that accounting standards and legal factors also show promise in understanding cross-country valuation patterns.

A number of prospective research avenues are deserving in their own right. First, since the P/E multiple exemplifies risk, interest rate, and earnings growth, empirically gauging how well it predicts aggregate economic activity and bond market variables is of broad relevance. Second, analyst earnings expectation naturally surrogates future firm profitability. Thus, scholars endeavoring to trace the forecasting ability of book-to-market and price-to-earnings ratio can now see how this variable correlates with the ex-ante expectation of growth. Finally, the time-series properties of individual price-to-earnings, earnings growth, and interest rates can be studied in an international arena, and in the vector-autoregression framework of Campbell and Shiller (1988), Lamont (1999), and Vuolteenaho (1999). They are all left to follow-up work.

Appendix

Proof of Proposition 1

Our objective is to show that the P/E possesses the probabilistic solution asserted in (6). Because dividends are homogeneous of degree one in earnings from (4), guess that the stock price can be written as: $P(t) = E(t)\,V(t)$, where the P/E ratio, $V[G,R]$, is independent of $E(t)$. Substituting into (5) and simplifying the resulting expression, we have the valuation equation of the P/E ratio

$$\begin{aligned} &\frac{1}{2}\,\sigma_r^2[R]\,\frac{\partial^2 V}{\partial R^2} + \left(\mu_r[R] - \lambda_r[R] + \rho_{e,r}\,\sigma_e[G]\,\sigma_r[R]\right)\frac{\partial V}{\partial R} + \frac{1}{2}\,\sigma_g^2[G]\,\frac{\partial^2 V}{\partial G^2} \\ &+ \left(\mu_g[G] - \lambda_g[G] + \rho_{e,g}\,\sigma_e[G]\,\sigma_g[G]\right)\frac{\partial V}{\partial G} + \rho_{g,r}\,\sigma_g[G]\,\sigma_r[R]\,\frac{\partial^2 V}{\partial G \partial R} \\ &- \left(R + \lambda_e[G] - G\right)V + \frac{a}{a+b} = 0 \end{aligned} \tag{15}$$

with $0 \leq V(t) < \infty$. Provided the regularity conditions for the Feynman-Kac theorem to hold are satisfied, and the expectation is taken according to the stochastic system

$$dG(t) = \left(\mu_g[G] - \lambda_g[G] + \rho_{e,g}\,\sigma_e[G]\,\sigma_g[G]\right)dt + \sigma_g[G]\,dW_g(t), \tag{16}$$

$$dR(t) = \left(\mu_r[R] - \lambda_r[R] + \rho_{e,r}\,\sigma_e[G]\,\sigma_r[R]\right)dt + \sigma_r[G]\,dW_r(t), \tag{17}$$

we get the equivalent solution presented in proposition 1. $\Box$

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Table 1: The Stock Universe

Three criteria were applied to construct the stock universe. First, if stock price, FY1, or FY2 were missing in any month, that stock was dropped. Second, only stocks with analyst earnings growth expectation between -1500% and 1500% and those with P/E less than 1000 are retained. Finally, all stocks with negative FY1 are eliminated. For each country sample, we report the start date, the number of monthly (time-series) observations, T, the average number of stocks per month, N, and the number of stocks in June of selected years. "Percent Negative" represents the fraction of stocks that have negative FY1 earnings. The source of our data is IBES. For each country, the last observation is in July, 1998. For ease of presentation, the stock markets are divided into "Developed" (19 countries) and "Emerging" (23 countries).

Country	Start Date	T	Percent Negative	Number of Stocks Each June in: 1988	1990	1992	1994	1996	1998	N
Austria	8701	139	6.33	34	36	71	69	79	74	56
Australia	8701	139	3.63	225	165	156	205	307	311	217
Belgium	8701	139	5.25	53	44	48	59	70	85	58
UK	8701	139	3.81	975	894	878	945	963	1176	949
Canada	8501	163	9.00	371	345	269	348	405	560	338
Switzerland	8701	139	4.93	127	158	152	142	151	151	146
Germany	8701	139	5.31	150	164	341	311	304	395	262
Denmark	8701	139	11.41	81	156	152	97	136	119	116
Spain	8701	139	9.41	57	152	108	91	100	122	100
Finland	8801	127	17.72	16	18	25	62	91	88	49
France	8701	139	6.24	178	252	304	265	359	379	295
Ireland	8702	138	4.00	35	50	54	54	48	52	47
Italy	8701	139	9.35	95	85	156	130	128	151	110
Japan	8701	139	6.61	948	1042	2017	1992	2463	2793	1763
Netherlands	8701	139	4.69	67	99	150	138	157	170	131
Norway	8701	139	11.48	20	30	33	48	102	118	49
New Zealand	8701	139	1.39	12	50	56	69	82	68	54
Sweden	8701	139	10.67	21	29	47	108	186	217	86
US	7601	271	7.08	2680	2708	2921	3792	4394	4660	2416
Argentina	9208	72	8.94				46	45	44	43
Chile	9210	70	1.26				80	104	68	78
China	9308	60	2.37				56	75	97	76
Colombia	9407	49	1.37					18	18	19
Czech	9506	38	3.93					61	47	52
Greece	9308	60	6.76				75	164	127	120
Hong Kong	8701	139	1.50	112	140	173	207	217	222	167
Indonesia	9101	91	1.59			81	124	115	73	104
India	9301	67	2.38				146	327	174	216
Korea	8805	123	7.95	19	24	20	549	523	141	258
Sri Lanka	9301	67	3.38				97	60	58	65
Mexico	9206	74	9.21				75	75	90	73
Malaysia	8701	139	2.48	65	118	203	209	218	238	162
Philippines	9001	103	4.65		21	29	55	84	83	57
Pakistan	9301	67	5.18				70	66	58	61
Poland	9507	37	0.84					56	62	59
Portugal	9104	88	13.01			42	40	45	53	46
Singapore	8701	139	3.05	54	98	117	148	161	178	119
Thailand	8709	131	7.78	22	94	216	320	373	68	205
Turkey	9112	80	3.81			21	35	72	237	99
Taiwan	9101	91	4.88		47	87	216	166	235	179
Brazil	9208	72	14.29				134	141	137	124
South Africa	8702	138	2.65	186	72	173	193	268	315	193

Table 2: Basic Cross-sectional Regression, by Country

We report the results of regressing P/E onto a constant and expected earnings growth rate using the entire stock cross-section: $P_n(t)/E_n(t) = \alpha(t) + \beta(t)\, G_n(t) + \epsilon_n(t)$, $n = 1, \cdots, N$, $t = 1, \cdots, T$, by country. Thus, we obtain a time-series of $\{\alpha(t) : t = 1, \cdots, T\}$ and $\{\beta(t) : t = 1, \cdots, T\}$ (one for each country). Following a standard procedure (i.e., Fama and McBeth (1973)), we report the average intercept, the average slope coefficient, and the average R^2 (in %) of each regression. Each t-statistic (i.e., t(α) and t(β)) is computed as the average coefficient divided by its standard error. Among all slope-coefficients, 1_β reflects the proportion with negative β. $1_{t>2}$ is a counting indicator for the event $t(\beta) > 2$. The average number of stocks used in the regression is represented by N.

	Intercept		**Expected Earnings Growth, G**					
Country	α	t(α)	β	t(β)	1_β (%)	$1_{t>2}$ (%)	R^2	N
Austria	18.84	43.87	0.23	10.51	7.91	69.78	39.46	56
Australia	12.33	56.46	0.15	22.01	1.44	95.68	38.13	217
Belgium	15.92	56.74	0.15	19.47	6.47	64.75	28.52	58
United Kingdom	11.78	67.31	0.16	30.90	0.00	99.28	34.29	949
Canada	14.39	44.52	0.17	27.03	1.23	98.16	37.20	338
Switzerland	14.55	61.37	0.19	20.03	3.60	91.37	40.56	146
Germany	22.17	58.41	0.36	24.75	0.72	97.84	35.85	262
Denmark	16.57	42.29	0.17	27.37	0.00	90.65	41.90	116
Spain	15.29	35.91	0.14	9.83	8.63	72.66	30.16	100
Finland	12.01	36.78	0.12	17.97	3.17	84.13	39.98	49
France	13.01	43.28	0.22	21.23	0.00	97.84	47.93	295
Ireland	10.42	46.48	0.14	16.67	2.90	80.43	33.22	47
Italy	16.70	47.93	0.19	14.45	4.32	76.98	25.68	110
Japan	53.76	49.97	0.64	19.24	1.44	96.40	21.20	1763
Netherlands	10.75	46.29	0.19	18.35	1.44	97.84	52.68	131
Norway	10.64	26.36	0.16	15.64	3.60	89.21	52.82	49
New Zealand	10.53	31.79	0.12	9.23	10.95	69.78	36.65	54
Sweden	14.09	31.60	0.16	7.58	10.07	71.22	32.00	86
US	11.27	61.19	0.14	42.95	1.11	97.42	28.32	2416
Argentina	12.41	24.75	0.10	8.02	2.78	80.56	34.45	43
Chile	13.65	34.49	0.16	14.91	0.00	88.57	34.50	78
China	12.74	13.86	0.19	3.63	8.33	61.67	21.87	76
Columbia	10.37	26.46	0.09	7.66	8.16	36.73	18.96	19
Czech Republic	13.25	30.63	0.13	6.42	2.63	76.32	23.69	52
Greece	17.69	18.08	0.21	8.19	8.33	63.33	14.64	120
Hong Kong	9.74	19.56	0.08	5.71	5.04	83.45	19.46	167
Indonesia	11.48	26.73	0.11	10.59	8.79	72.53	14.19	104
India	15.46	15.27	0.14	8.80	4.48	77.61	9.92	216
Korea	14.10	6.93	0.24	7.24	8.26	68.29	23.36	258
Sri Lanka	10.57	30.17	0.13	12.96	1.49	71.64	23.74	65
Mexico	13.48	35.95	0.07	6.05	10.81	75.68	29.85	73
Malaysia	18.73	36.40	0.33	17.51	1.44	94.24	30.86	162
Philippines	12.74	19.99	0.19	9.90	1.94	78.64	30.69	57
Pakistan	10.52	25.82	0.06	9.31	1.49	70.15	16.37	61
Poland	9.95	28.76	0.11	8.16	0.00	75.68	18.97	59
Portugal	16.03	22.19	0.17	10.47	7.95	81.82	34.61	46
Singapore	19.38	43.46	0.26	16.60	0.72	93.53	28.62	119
Thailand	15.19	38.96	0.26	12.27	4.62	74.05	20.13	205
Turkey	12.30	11.08	0.02	1.84	35.00	31.25	8.48	99
Taiwan	34.86	22.68	0.30	9.97	9.89	74.73	16.28	179
Brazil	10.13	21.29	0.09	11.53	0.00	87.50	33.26	124
South Africa	12.15	31.57	0.13	6.80	19.84	65.08	22.95	193

Table 3: Cross-sectional Regressions of P/E on Expected Earnings Growth Rate, by Sectors

At each date t, the available stock universe is classified into 11 different economic sectors. Then we regress P/E onto a constant and expected earnings growth rate using the cross-section of sector stocks: $P_n(t)/E_n(t) = \alpha(t)+\beta(t)\, G_n(t)+ \epsilon_n(t)$, $n = 1, \cdots, N$, $t = 1, \cdots, T$. Thus, we obtain a time-series of $\{\alpha(t) : t = 1, \cdots, T\}$ and $\{\beta(t) : t = 1, \cdots, T\}$, one for each sector. We report the average intercept, the average slope coefficient, and the average R^2 of each sector regression. Each t-statistic is computed as the average coefficient divided by its standard error. Among all slope-coefficients, 1_β reflects the proportion with negative β. As before, $1_{t>2}$ is a counting indicator for the event $t(\beta) > 2$. We also report the average P/E and average G for each sector. The average number of stocks used in the regression is represented by N. Only the results for US, UK and Japan are shown. The sample period is 1976:01-1998:07 (1987:01-1998:07) for US (UK and Japan).

	Intercept		**Expected Earnings Growth**					**Sector Characteristics**		
Country/Sector	α	t(α)	β	t(β)	1_β (%)	$1_{t>2}$ (%)	R^2	P/E	G	N
US-Finance	9.19	53.22	0.10	25.80	1.50	92.62	27.14	11.73	22.13	439
US-Health	13.80	34.76	0.24	26.31	2.23	90.41	36.58	25.59	43.34	173
US-Con. ND	11.14	57.72	0.11	20.39	4.06	86.35	31.03	14.89	28.50	158
US-Con. SER	11.87	47.77	0.15	27.73	1.11	94.46	33.90	17.52	32.60	364
US-Con. DUR	10.13	45.93	0.11	22.60	3.70	90.77	38.11	15.05	37.27	125
US-Energy	13.71	36.24	0.20	20.66	1.11	83.76	35.62	24.55	48.50	130
US-Transport	10.65	38.27	0.10	11.16	5.75	83.03	41.99	16.20	41.47	64
US-Technology	13.55	58.14	0.14	36.24	0.74	94.46	43.14	22.64	52.83	310
US-Basic Indus.	10.69	48.59	0.13	30.34	0.37	95.57	40.98	16.99	39.06	221
US-Capital Goods	11.16	64.24	0.11	32.49	1.48	91.51	39.10	16.61	37.33	264
US-Utilities	9.35	50.28	0.18	21.00	1.50	90.41	40.36	12.06	12.85	171
UK-Finance	15.42	50.46	0.10	10.73	12.23	71.94	24.46	18.71	25.29	129
UK-Health	12.37	32.49	0.20	11.53	8.66	58.99	34.90	19.01	29.31	26
UK-Con. ND	11.86	72.28	0.09	10.33	4.31	80.58	27.79	14.24	22.99	108
UK-Con. SER	11.50	53.45	0.18	24.99	0.00	99.28	39.12	16.87	26.93	230
UK-Con. DUR	10.41	34.40	0.10	7.07	8.73	69.78	42.47	14.28	28.87	24
UK-Energy	16.76	34.10	0.19	14.60	8.52	71.22	36.94	27.42	49.17	20
UK-Transport	11.83	37.99	0.09	7.06	12.28	43.88	31.84	13.48	19.87	16
UK-Technology	12.54	36.56	0.14	12.89	0.72	89.21	43.36	18.79	39.55	62
UK-Basic Indus.	11.60	51.88	0.11	14.33	4.31	89.93	36.40	14.77	24.91	103
UK-Capital Goods	10.80	44.82	0.13	20.28	0.00	100.00	47.33	15.38	28.96	217
UK-Utilities	9.02	20.98	0.30	17.32	2.22	80.58	37.62	13.89	15.72	15
Japan-Finance	45.55	43.64	0.45	10.92	7.19	68.35	20.61	54.58	20.57	109
Japan-Health	50.06	27.30	0.89	10.02	12.23	71.22	36.98	64.00	13.13	48
Japan-Con. ND	60.16	41.22	0.66	14.12	5.03	82.73	20.70	69.97	15.42	211
Japan-Con. SER	49.12	39.56	0.63	15.15	2.87	82.73	17.91	59.98	17.83	340
Japan-Con. DUR	47.30	32.94	0.39	12.64	13.33	61.15	21.14	54.55	14.50	73
Japan-Energy	54.65	33.94	0.66	8.12	12.90	43.17	25.60	60.46	8.35	21
Japan-Transport	95.04	30.98	1.11	10.34	6.40	70.50	21.94	18.52	16.28	67
Japan-Technology	47.06	43.04	0.70	14.53	5.03	89.93	37.04	66.85	25.33	119
Japan-Basic Indus .	56.90	41.64	0.69	13.97	4.31	83.45	26.21	70.31	18.22	235
Japan-Capital	48.42	45.66	0.70	22.37	0.71	99.28	30.18	61.04	18.01	520
Japan-Utilities	51.09	46.83	0.71	6.95	10.92	41.01	23.90	57.00	4.57	21

Table 5: Cross-sectional Regressions of P/E on Expected Earnings Growth Rate and Cash-Flow Volatility

We assign each stock to one of five different groups based on the volatility of their cash-flows. The volatility measure is: $\mathrm{Vol}[E_n(t)] \equiv \mathrm{Std}[E_n(t), \cdots, E_n(t-5)]$, which represents the standard deviation of prior six month FY1 earnings. The procedure is followed once every June and December to avoid a sorting design with overlapping observations. These portfolios are respectively labeled as P1 through P5 (ordered from lowest to highest volatility). Using each stock quintile, we run the cross-sectional regression

$$P_n(t)/E_n(t) = \alpha(t) + \beta(t)\, G_n(t) + \theta(t)\, \mathrm{Vol}[E_n(t)] + \epsilon_n(t), \qquad n = 1, \cdots, N,\ t = 1, \cdots, T.$$

As in previous tables, we report the average coefficients, the t-statistics (in parenthesis), and the portfolio characteristics. Two numbers are recorded for R^2: First, we report R^2 from the multivariate regression. Second, we report R^2 from the univariate regression with VOL[E] alone (shown in curly brackets). Among all slope-coefficients, 1_β (1_θ) reflects the proportion with negative β (θ). We also display $1_{t(\beta)>2}$ ($1_{t(\theta)<-2}$), which is a counting indicator for the event $t(\beta) > 2$ ($t(\theta) < -2$). Only US stocks are considered in this investigation. The sample period is June 1977 through June 1998 (T=43), with N=478.

	Cross-sectional Regression						Characteristics		
Quintile	α	β	θ	1_β [$1_{t(\beta)>2}$]	1_θ [$1_{t(\theta)<-2}$]	R^2 $\{\beta \equiv 0\}$	P/E	G	Vol[E]
P1 (lowest Vol[E])	29.05 (8.17)	0.30 (1.91)	-50.35 (-9.42)	0.00 [97.67]	97.67 [79.07]	30.02 {5.46}	27.27	68.03	0.27
P2	16.07 (15.25)	0.11 (16.73)	-5.98 (-5.71)	0.00 [100.0]	83.72 [23.26]	33.94 {0.54}	16.67	37.36	0.63
P3	14.24 (17.65)	0.09 (14.49)	-2.70 (-5.52)	2.33 [93.02]	79.07 [16.28]	31.77 {0.24}	14.08	28.15	1.04
P4	12.40 (25.23)	0.09 (13.77)	-1.29 (-6.55)	0.00 [100.0]	86.05 [25.58]	25.72 {0.50}	12.32	20.70	1.62
P5 (highest Vol[E])	9.04 (22.39)	0.12 (14.50)	-0.01 (-0.69)	0.00 [97.67]	37.21 [2.33]	36.71 {0.41}	10.96	16.74	5.02

Table 7: Time-Series Regressions for Sector and Size Portfolios

For the time-series specification with serially-correlated errors

$$P(t)/E(t) = \Delta_0 + \Delta_g\, G(t) + \Delta_r\, \frac{1}{R(t)} + \epsilon(t),$$
$$\epsilon(t) = \rho\, \epsilon(t-1) + \eta(t),$$

the reported results are based on the Cochrane-Orcutt methodology (see Greene (1997), Chapter 13). For each size decile and economic sector, the P/E (G) represents the average monthly price-to-earnings ratio (the expected earnings growth rate) across all relevant stocks. We report the regression coeffiecients, the t-statistics, and the adjusted R^2 (from the OLS estimation). DW is the Durbin-Watson statistic. The source of the US nominal interest rate, R, is the Federal Reserve Board. Since results from UK and Japan are virtually similar to those shown below, we focus on US stocks. The sample period for the sector regressions is 1976:01-1998:07, and the sample period for the decile regressions is 1984:09-1998:07. The number of months in each regression is given by T.

	Intercept		**Expected Earnings Growth**		**Inverse Interest**		**Serial Corr.**				
Sector/Size	Δ_0	t(Δ_0)	Δ_g	t(Δ_g)	Δ_r	t(Δ_r)	ρ	t(ρ)	R^2	DW	T
US-Finance	5.24	2.82	0.10	10.19	0.40	3.91	0.97	54.67	70.93	2.12	271
US-Health	1.92	0.58	0.32	12.36	0.73	2.74	0.80	20.34	77.12	2.20	271
US-Con. ND	7.98	3.13	0.10	7.63	0.37	2.46	0.96	54.04	83.30	2.04	271
US-Con. SER	7.61	2.46	0.17	9.02	0.46	2.70	0.97	57.21	86.65	1.89	271
US-Con. DUR	1.16	0.56	0.10	10.86	0.80	5.16	0.91	34.78	68.82	2.04	271
US-Energy	1.04	0.34	0.18	8.76	1.16	4.71	0.73	17.26	64.58	2.22	271
US-Transport	-0.73	-0.28	0.09	8.27	1.02	5.08	0.80	21.41	60.68	2.27	271
US-Technology	8.37	2.09	0.16	7.09	0.45	1.60	0.94	41.11	64.45	1.77	271
US-Basic Indus.	9.04	3.07	0.13	9.93	0.20	1.03	0.95	48.28	76.21	2.22	271
US-Capital Goods	7.11	3.28	0.12	9.84	0.36	2.55	0.95	49.45	85.78	1.85	271
US-Utilities	7.45	3.17	0.20	10.94	0.24	1.91	0.97	61.06	85.97	2.46	271
US-DEC1	3.56	1.39	0.11	6.62	0.59	3.18	0.75	13.05	60.73	1.79	167
US-DEC2	1.64	0.58	0.16	10.07	0.65	3.23	0.82	18.16	64.92	1.88	167
US-DEC3	-0.17	-0.07	0.13	7.30	1.04	5.63	0.76	14.91	68.15	1.84	167
US-DEC4	-2.39	-0.84	0.18	7.09	1.16	5.72	0.72	13.06	65.56	1.86	167
US-DEC5	-3.57	-1.36	0.22	9.45	1.19	6.23	0.73	13.29	73.95	1.89	167
US-DEC6	-3.29	-1.12	0.27	9.95	1.12	5.32	0.76	14.31	72.10	1.95	167
US-DEC7	-4.94	-2.08	0.24	7.72	1.35	8.04	0.70	12.38	76.17	1.98	167
US-DEC8	-1.46	-0.74	0.22	7.03	1.14	8.57	0.63	9.92	75.78	2.08	167
US-DEC9	-1.25	-0.58	0.28	11.35	1.05	6.88	0.75	13.55	77.82	2.23	167
US-DEC10	11.42	3.29	0.20	6.49	0.38	1.83	0.95	36.93	76.55	1.93	167

Table 8: P/E and Expected Earnings Growth Rates in the Country Universe

We report the mean and standard deviation, each for the forward P/E ratio, the expected analyst earnings growth rate, and the nominal interest rate. For each stock, the time t P/E ratio is obtained by dividing the current stock price by FY1 earnings. The expected earnings growth rate, G, is computed as: $FY2/FY1 - 1$. In any given month, the country P/E (G) is obtained by averaging the P/E (G) across all available stocks. Exclusionary filters applied to construct the country universe coincide with those in Table 1. The source of the US nominal interest rate, R, is the Federal Reserve Board. All other interest rates are taken from International Financial Statistics. The observations on stock price, FY1, and FY2 earnings are from IBES.

	P/E		G		R	
Country	**Mean**	**Std.**	**Mean**	**Std.**	**Mean**	**Std.**
Austria	24.26	6.33	17.94	14.21	6.81	1.31
Australia	18.45	5.03	35.28	13.82	9.99	2.55
Belgium	20.35	5.32	20.79	14.15	7.71	1.40
UK	16.44	2.99	27.53	5.54	8.75	1.33
Canada	23.72	6.19	47.63	14.84	8.98	1.56
Switzerland	19.49	3.53	21.44	9.07	4.81	1.12
Germany	29.92	6.01	22.47	10.27	6.68	1.29
Denmark	23.10	6.28	31.08	15.34	8.32	2.10
Spain	19.71	5.32	22.41	11.21	10.82	2.88
Finland	17.56	6.93	40.02	31.79	8.57	4.22
France	20.03	4.82	28.25	8.22	7.91	1.52
Ireland	13.90	3.59	22.98	10.92	8.55	1.51
Italy	21.74	5.48	22.41	11.94	10.50	2.23
Japan	64.83	14.53	17.60	7.20	4.05	1.81
Netherlands	15.10	3.56	20.45	7.30	7.08	1.09
Norway	19.73	7.70	45.85	24.22	8.85	2.88
New Zealand	13.82	3.77	24.32	8.74	9.88	3.16
Sweden	20.72	7.52	33.18	26.46	9.89	2.15
US	17.19	5.66	34.79	9.88	8.90	2.14
Argentina	15.98	3.74	32.37	16.16	12.06	4.73
Chile	16.89	4.19	18.78	7.56	19.41	5.79
China	15.69	5.22	14.64	4.58	10.61	1.01
Colombia	12.45	2.14	25.31	9.19	39.86	4.24
Czech	17.40	3.11	31.93	10.68	12.98	0.75
Greece	23.67	7.56	27.78	7.70	13.79	3.60
Hong Kong	11.75	3.94	22.98	4.63	8.48	1.55
Indonesia	14.19	3.31	23.52	6.54	18.12	4.05
India	20.14	9.96	29.66	6.33	9.43	5.50
Korea	25.09	15.07	26.03	16.91	13.80	3.26
Sri Lanka	15.22	4.56	32.09	8.27	13.58	3.42
Mexico	17.50	4.71	37.91	24.01	24.44	11.63
Malaysia	28.08	11.32	26.52	12.58	6.08	2.01
Philippines	20.74	6.79	39.78	12.55	17.86	4.05
Pakistan	12.69	4.00	34.70	8.92	11.23	3.40
Poland	13.11	2.69	28.18	5.01	21.82	2.11
Portugal	24.67	10.63	37.84	18.99	10.62	4.32
Singapore	25.80	6.44	22.90	5.78	4.08	1.52
Thailand	21.49	6.22	21.27	8.62	10.44	4.34
Turkey	14.87	5.49	87.96	18.07	116.59	32.47
Taiwan	43.39	15.63	16.85	11.54	8.15	0.64
Brazil	15.59	4.94	65.95	58.06	31484.17	2873.73
South Africa	15.35	3.60	21.04	8.85	15.49	1.24

Table 9: Analyzing Divergences in the P/E Across Countries

In constructing the regression estimates, we follow two steps. First, each variable (i.e., P/E, G, and R) is averaged across all available months to create an yearly series. Next, starting in 1987 (1992), for developed (emerging) markets, we run a cross-sectional regression with the annualized P/E as the dependent variable:

$$\ln(P_k/E_k) = \alpha + \beta_g \, G_k + \beta_r \, \frac{1}{R_k} + \epsilon_k, \qquad k = 1, \cdots, K.$$

As selected years are representative of our conclusions, we report (i) the regression coefficients, (ii) the t-statistics for the coefficients (in parenthesis), (iii) the number of countries used in the cross-sectional regression, K, and (iv) the adjusted R^2. In curly brackets below the adjusted R^2, we display the adjusted R^2 for the restricted regression with $\beta_g \equiv 0$ (i.e., the regression with inverse interest alone).

Year	**Markets**	K	α	β_g	β_r	R^2
1998	Developed	19	11.8	0.21	0.23	38.16
			(3.28)	(2.10)	(3.28)	{25.69}
	Emerging	23	2.35	0.00	0.03	1.52
			(8.69)	(0.43)	(1.52)	{ 3.61}
1996	Developed	19	-4.11	0.18	1.17	61.16
			(-0.56)	(0.85)	(5.48)	{61.79}
	Emerging	23	2.65	-0.00	0.02	17.35
			(14.91)	(-0.29)	(2.35)	{12.85}
1994	Developed	19	-5.33	-0.14	2.63	50.00
			(-0.48)	(-0.86)	(4.36)	{50.74}
	Emerging	21	2.84	0.00	0.02	4.30
			(11.84)	(0.60)	(1.70)	{-1.28}
1992	Developed	19	-6.49	0.13	2.03	30.76
			(-0.02)	(1.19)	(3.15)	{29.09}
	Emerging	15	2.71	0.00	0.01	-6.16
			(13.20)	(0.11)	(1.05)	{-3.36}
1990	Developed	19	1.9	-0.46	2.66	19.60
			(0.11)	(-1.22)	(1.94)	{17.26}
1988	Developed	19	-8.74	0.15	2.01	31.97
			(-0.76)	(0.67)	(3.11)	{37.19}

Table 4: Cross-sectional Regression of P/E on Expected Earnings Growth Rate and Size

Classify, each month, the available stock universe into ten groups according to their market capitalization (Decile 1 stocks represents the lowest, and Decile 10 stocks the highest, capitalization). Controlling for size, we regress: $P_n(t)/E_n(t) = \alpha(t) + \beta(t) G_n(t) + \gamma(t) \ln[\text{Size}_n(t)] + \epsilon_n(t)$, $n = 1, \cdots, N$, $t = 1, \cdots, T$. Thus, we obtain a time-series of $\{\alpha(t), \beta(t), \gamma(t) : t = 1, \cdots, T\}$, one for each size grouping. We report the average intercept, the average slope coefficient, and the average R^2 of each decile regression. The t-statistic is computed as the average coefficient divided by its standard error. Among all slope-coefficients, 1_β (1_γ) reflects the proportion with negative β (γ). We also display $1_{t(\beta)>2}$ ($1_{t(\gamma)>2}$), which is a counting indicator for the event $t(\beta) > 2$ ($t(\gamma) > 2$). The market capitalization is measured in *Billions* of local currency, and N is the average number of stocks. Respectively for US, UK, and Japan, N is 310,93, and 175. The US regressions start in 1984:09, which coincides with the availability of shares outstanding from IBES.

	Expected Earnings Growth				Log of Size						Decile Characteristics		
Country/Decile	β	t(β)	1_β (%)	$1_{t(\beta)>2}$ (%)	γ	t(γ)	1_γ (%)	$1_{t(\gamma)>2}$ (%)	R^2 (Full)	R^2_g for $\gamma \equiv 0$	P/E	G	Size
US-DEC1	0.11	40.73	1.20	98.80	3.72	22.65	1.20	51.50	43.31	42.43	18.12	70.07	0.24
US-DEC2	0.15	33.37	0.00	99.40	3.19	7.58	26.35	10.78	48.99	48.96	19.16	55.53	0.55
US-DEC3	0.17	32.01	1.20	98.20	3.95	6.31	27.54	8.98	49.63	49.57	19.86	49.05	0.93
US-DEC4	0.20	27.62	0.60	99.40	2.69	3.16	37.72	5.39	47.02	46.96	20.33	42.95	1.46
US-DEC5	0.21	30.59	0.00	99.40	1.19	1.83	44.31	0.60	44.77	44.80	20.69	39.45	2.29
US-DEC6	0.23	30.33	1.20	98.80	0.81	1.14	46.11	2.99	42.11	42.10	20.79	34.48	3.62
US-DEC7	0.23	26.77	0.60	99.40	0.88	1.75	40.72	3.59	47.63	47.63	19.95	31.52	6.05
US-DEC8	0.25	21.05	1.20	98.80	1.04	2.11	40.12	3.59	43.35	43.36	19.59	27.83	11.11
US-DEC9	0.29	20.02	0.60	98.80	-1.25	-3.67	61.68	1.80	38.43	38.41	18.85	24.05	23.95
US-DEC10	0.23	14.29	2.40	94.01	2.27	9.07	14.97	31.74	29.51	28.51	18.65	19.86	122.46
UK-DEC1	0.10	17.60	0.00	92.81	2.22	9.75	19.42	25.18	43.04	42.17	14.65	52.21	8.79
UK-DEC2	0.11	17.10	2.88	94.96	4.74	5.05	29.50	2.16	41.63	41.46	15.16	38.45	21.04
UK-DEC3	0.12	10.62	7.19	89.21	4.32	3.77	32.37	3.60	41.91	41.94	15.88	33.08	35.19
UK-DEC4	0.17	22.13	0.00	97.84	3.10	5.39	25.90	3.60	49.50	49.53	15.84	27.69	55.82
UK-DEC5	0.18	15.65	0.72	90.65	2.29	3.80	36.69	7.91	42.35	42.10	15.84	23.09	85.89
UK-DEC6	0.24	11.42	2.16	87.05	3.82	4.76	28.06	2.88	40.24	40.28	16.71	22.64	131.73
UK-DEC7	0.29	17.76	0.00	92.09	4.45	5.95	23.74	7.19	40.94	41.01	18.08	23.25	212.64
UK-DEC8	0.24	17.08	4.32	87.77	0.57	1.42	46.04	3.60	31.92	31.72	16.83	18.64	384.27
UK-DEC9	0.27	16.66	0.72	83.45	-1.15	-3.99	61.87	2.88	31.99	31.69	15.91	17.37	872.67
UK-DEC10	0.30	5.41	0.00	93.53	0.18	1.76	41.01	0.00	39.70	40.11	16.04	17.55	4766.61
Japan-DEC1	0.61	15.15	3.60	89.93	-1.77	-1.16	52.52	2.16	28.85	28.74	71.60	28.28	15.16
Japan-DEC2	0.65	10.94	5.76	82.73	-3.44	-0.76	49.64	0.72	26.07	26.28	63.95	22.90	26.27
Japan-DEC3	0.67	15.34	4.32	84.17	-1.01	-0.22	46.76	1.44	26.67	26.63	61.16	19.43	37.56
Japan-DEC4	0.80	14.15	5.04	84.89	4.77	0.65	45.32	2.16	24.71	24.41	64.05	16.01	50.53
Japan-DEC5	0.66	14.02	5.76	82.01	-4.87	-0.95	51.80	4.32	22.33	22.44	64.75	15.81	68.49
Japan-DEC6	0.81	16.06	5.04	87.05	8.40	1.65	41.01	4.32	25.37	25.38	64.10	14.61	95.34
Japan-DEC7	0.86	12.55	3.60	76.98	-2.65	-0.63	58.99	0.00	22.31	22.56	64.18	14.17	137.05
Japan-DEC8	0.87	18.12	2.88	89.93	-8.44	-3.07	60.43	0.72	22.61	22.78	63.85	14.26	213.14
Japan-DEC9	0.82	15.45	7.19	83.45	9.10	4.28	38.13	12.95	28.19	28.09	64.14	14.73	385.13
Japan-DEC10	0.72	15.02	10.79	72.66	3.49	3.74	34.53	19.42	22.09	21.91	65.59	15.68	2023.61

Table 6: Time-Series Regressions of P/E on Expected Earnings Growth and Interest Rate

The time-series regression results shown below are based on the econometric specification: $P_k(t)/E_k(t) = \Delta_0 + \Delta_g\, G_k(t) + \Delta_r\, \frac{1}{R_k(t)} + \epsilon_k(t)$, with $\epsilon(t) = \rho\, \epsilon(t-1) + \eta(t)$. For each month t, $P_k(t)/E_k(t)$ represents the P/E ratio of country k, and $G_k(t)$ ($R_k(t)$) is the expected earnings growth rate (nominal interest rate). The method of estimation is Cochrane-Orcutt (see Greene (1997), Chapter 13). The regression results reported under the heading "Univariate Regression" are obtained by respectively constraining $\Delta_r \equiv 0$ and $\Delta_g \equiv 0$. We report the regression coefficients, their t-statistics, and the adjusted R^2 (from the OLS estimation). DW denotes Durbin-Watson statistic and is reported for the multiple regression only. The sample period for each regression coincides with the one shown in Table 1.

Panel A: Regression Results for Developed Markets

		Multiple Regression										Univariate Regression					
		Intercept		Expected Earnings Growth		Inverse Interest		Serial Corr.				Constrained $\Delta_r \equiv 0$			Constrained $\Delta_g \equiv 0$		
Country	T	Δ_0	t(Δ_0)	Δ_g	t(Δ_g)	Δ_r	t(Δ_r)	ρ	t(ρ)	R^2	DW	Δ_g	t(Δ_g)	R^2	Δ_r	t(Δ_r)	R^2
Austria	139	37.86	7.70	0.16	5.07	-1.00	-3.29	0.69	11.03	31.74	2.05	0.16	4.91	4.72	-0.87	-2.66	20.48
Australia	139	4.67	1.48	0.23	8.21	0.52	2.14	0.77	13.64	46.77	2.07	0.22	7.94	27.63	0.14	0.45	7.99
Belgium	139	14.14	3.52	0.22	6.04	0.13	0.47	0.62	9.10	24.04	2.11	0.21	6.07	23.84	0.18	0.56	0.66
UK	139	4.19	1.60	0.24	6.03	0.46	2.55	0.87	20.67	64.45	1.85	0.23	5.66	33.87	0.34	1.47	35.67
Canada	163	9.76	2.91	0.18	6.36	0.50	1.81	0.78	14.68	77.79	2.41	0.16	5.82	72.77	0.41	1.04	27.01
Switzerland	139	9.79	5.65	0.21	5.92	0.23	3.08	0.52	7.02	47.59	2.15	0.23	5.96	35.04	0.30	3.12	25.13
Germany	139	23.30	4.14	0.25	3.99	0.06	0.17	0.83	17.51	34.17	2.07	0.25	4.06	33.51	0.20	0.50	1.22
Denmark	139	23.88	5.67	0.08	2.28	-0.24	-0.84	0.76	13.43	13.20	1.65	0.08	2.27	10.06	-0.24	-0.78	3.19
Spain	139	13.61	4.04	0.17	5.06	0.23	0.82	0.81	15.92	14.29	1.90	0.17	5.09	11.57	0.27	0.88	2.23
Finland	127	9.74	3.33	0.15	8.41	0.12	0.77	0.79	14.21	40.57	2.05	0.15	8.47	40.52	0.19	0.96	0.24
France	139	2.29	0.69	0.13	3.59	1.03	4.39	0.81	16.68	48.33	1.92	0.13	3.58	33.76	1.14	4.55	38.06
Ireland	138	6.55	2.34	0.13	4.49	0.35	1.53	0.75	13.08	32.38	1.80	0.13	4.81	25.86	0.56	2.21	13.27
Italy	139	13.17	4.06	0.14	3.26	0.51	1.80	0.68	11.16	20.60	2.21	0.14	3.19	16.64	0.55	1.67	4.13
Japan	139	71.19	9.58	0.21	1.31	-0.30	-2.85	0.93	28.63	41.51	1.90	0.19	1.22	0.68	-0.29	-2.76	33.18
Netherlands	139	2.89	0.86	0.12	3.77	0.67	3.03	0.74	12.47	47.62	2.19	0.11	3.51	18.52	0.62	2.42	31.34
Norway	139	2.95	1.04	0.09	3.83	0.98	5.01	0.51	6.90	46.91	1.84	0.09	3.31	12.39	0.98	4.28	35.82
New Zealand	139	0.63	0.33	0.17	4.80	0.81	6.12	0.52	7.44	43.22	2.13	0.15	3.98	2.99	0.69	4.67	34.86
Sweden	139	3.79	0.98	0.09	3.50	1.28	3.66	0.64	9.52	46.77	2.02	0.10	3.55	35.72	1.63	3.73	27.65
US	271	2.93	1.21	0.21	6.80	0.63	4.10	0.93	42.11	91.58	2.12	0.19	6.06	62.79	0.51	2.95	41.43

Panel B of Table 6: Regression Results for Emerging Markets

		Multiple Regression										Univariate Regression					
		Intercept		Expected Earnings Growth		Inverse Interest		Serial Corr.				Constrained $\Delta_r \equiv 0$			Constrained $\Delta_g \equiv 0$		
Country	T	Δ_0	t(Δ_0)	Δ_g	t(Δ_g)	Δ_r	t(Δ_r)	ρ	t(ρ)	R^2	DW	Δ_g	t(Δ_g)	R^2	Δ_r	t(Δ_r)	R^2
Argentina	72	4.45	1.99	0.09	2.91	0.94	5.22	0.19	1.60	37.16	1.98	0.08	1.78	2.22	0.76	4.04	24.14
Chile	70	12.28	5.12	0.14	3.22	0.23	1.06	0.87	13.05	23.18	1.96	0.15	3.47	22.90	0.36	1.57	0.01
China	60	17.14	1.41	0.11	0.93	-0.29	-0.24	0.82	10.22	14.00	1.98	0.11	0.93	0.01	-0.26	-0.21	12.72
Colombia	49	5.04	1.01	0.04	1.67	2.09	1.15	0.88	11.60	5.91	1.73	0.03	1.44	5.88	1.41	0.79	1.00
Czech	38	-1.25	-0.13	0.17	3.74	1.70	1.44	0.30	1.80	36.70	1.99	0.16	3.40	30.97	0.95	0.68	0.50
Greece	60	25.15	3.41	-0.02	-0.21	0.33	0.44	0.86	11.01	1.70	2.00	-0.01	-0.18	0.60	0.31	0.42	1.30
Hong Kong	139	1.82	0.56	0.22	2.81	0.38	1.77	0.48	6.28	16.28	2.18	0.23	2.83	4.61	0.39	1.76	10.98
Indonesia	91	2.92	1.12	0.05	1.37	1.70	4.21	0.71	9.62	47.70	1.66	0.04	1.24	0.20	1.65	4.02	39.96
India	67	15.46	1.94	0.13	1.50	-0.00	-0.13	0.94	22.77	23.85	1.92	0.13	1.53	23.85	-0.01	-0.26	0.10
Korea	123	3.72	0.49	0.61	10.55	0.73	0.79	0.75	12.18	44.31	1.81	0.62	10.57	44.13	0.78	0.61	0.30
Sri Lanka	67	13.70	4.39	0.08	1.95	-0.14	-0.53	0.79	9.70	18.98	1.83	0.07	1.95	5.86	-0.13	-0.45	15.18
Mexico	74	15.55	4.20	0.02	0.71	0.27	0.42	0.73	8.36	20.48	1.78	0.01	0.62	15.51	0.17	0.27	0.30
Malaysia	139	18.32	4.50	0.23	5.18	0.18	1.57	0.88	21.71	54.16	1.24	0.21	4.88	43.02	0.03	0.22	43.77
Philippines	103	11.69	2.40	0.18	5.50	0.22	0.33	0.86	15.47	48.85	1.80	0.17	5.53	37.28	-0.68	-0.89	21.96
Pakistan	67	10.77	2.92	0.00	0.07	0.03	1.07	0.94	19.89	17.45	1.99	0.00	0.10	1.30	0.03	1.08	15.40
Poland	37	8.50	2.33	0.24	3.39	-0.33	-0.53	0.74	7.58	18.64	1.59	0.24	3.47	11.05	-0.44	-0.63	0.70
Portugal	88	11.13	1.67	0.27	4.56	0.29	0.68	0.78	11.01	40.11	2.04	0.26	4.48	31.41	-0.26	-0.44	6.71
Singapore	139	20.55	7.46	0.16	3.36	0.01	0.22	0.89	20.48	23.77	2.37	0.16	3.37	23.28	0.01	0.25	1.37
Thailand	131	14.89	7.47	0.30	10.01	0.06	0.86	0.86	19.61	19.40	1.84	0.30	10.03	16.76	0.07	0.79	5.87
Turkey	80	15.41	2.43	0.01	0.27	-1.53	-0.29	0.50	4.71	5.52	2.00	0.01	0.29	0.10	-1.68	-0.32	5.52
Taiwan	91	133.55	2.72	0.37	3.12	-7.92	-2.01	0.69	9.57	5.57	2.16	0.37	3.12	0.14	-6.70	-1.92	5.51
Brazil	72	16.23	7.94	0.03	2.35	-1.12	-1.87	0.74	10.11	27.35	1.99	0.03	2.14	7.34	-1.06	-1.62	26.47
South Africa	138	17.00	2.91	-0.04	-1.11	-0.11	-0.13	0.84	16.63	9.48	2.18	-0.04	-1.10	6.04	-0.05	-0.06	5.05