Convergence Trends for Profitability and Payout

Trevor Harris
Morgan Stanley

and

Doron Nissim*
Columbia Business School

December 2004

* Corresponding author; 604 Uris Hall, 3022 Broadway, New York, NY 10027; phone: (212) 854-4249; fax: (212) 316-9219; dn75@columbia.edu.

The comments of Peter Easton, Tom Frecka, Stephen Penman, Tom Stober and seminar participants at the University of Notre Dame have been helpful.

Convergence Trends for Profitability and Payout

Abstract

This study investigates the convergence patterns of return on equity (ROE) and net payout to shareholders. We show analytically and empirically that typical ROE trends are non-linear due to the effects of transitory earnings items and equity investments (including earnings reinvestments). Accordingly, quadratic trends for profitability provide a substantially better fit than linear interpolations, especially when the magnitude of transitory items or the rate of equity investment is relatively large. The dividend component of payout is relatively stable and its slow convergence can be approximated by a linear trend. The share transactions component of payout, reflecting net share repurchases, contains a potentially large transitory part and a more permanent part that behaves similar to dividends. These findings are relevant for forming expectations regarding future values of ROE and payout, which in turn determine equity value.

KEYWORDS: equity valuation, profitability, return on equity, payout

Convergence Trends for Profitability and Payout

1. Introduction

Equity value reflects investors' expectations regarding future profitability and growth. Growth, in turn, is determined by profitability (return on equity, or ROE) and payout (the portion of earnings paid out net of new equity issues). Thus, to value the equity, one must forecast profitability and payout. This study investigates how profitability and payout evolve over time, to aid in the forecasting of these value drivers. Such analysis is important primarily because explicit forecasts for earnings and book value are typically made for a few subsequent years, while it may take a longer period for profitability and payout to converge to their steady state levels. Prior research provides little guidance for the estimation of profitability and payout between the last year of explicit forecasts and the year in which the firm is expected to reach a steady state. Lee et al. (1999), Gebhardt et al. (2001) and Liu at el. (2002), among others, note the lack of such evidence and use a simple linear interpolation of ROE from the last year of explicit forecasts (year t + 3 in their analyses) to the estimated steady state value of ROE in year t + T, for several values of T. We conduct an analysis that offers guidance for the estimation of convergence rates for profitability and payout.

We start by documenting typical convergence patterns of profitability and payout. While previous studies have examined the time-series behavior of ROE (e.g., Penman (1991)), there is little evidence on the behavior of payout. Payout consists of dividend and share transactions components, which evolve differently over time. Specifically, we show that the dividend component of payout is relatively stable and its slow convergence can be approximated by a linear trend. The share transactions component consists of a potentially large transitory part and a more permanent part that, similar to dividends, drifts slowly and linearly towards the mean. In contrast, ROE trends are typically non-linear, concave for small initial ROEs and convex for large initial ROEs. After replicating this result, we show analytically and empirically that the non-linearity of ROE trends is due to transitory earnings items and equity investments, including new share issues and earnings reinvestment.

We then examine the improvement obtained by using a quadratic instead of linear approach for specifying convergence trends for ROE. Similar to the linear approach, the quadratic approach requires only three inputs: the initial value of ROE, its steady-state level, and the length of the convergence period. Yet, we demonstrate that the quadratic approach provides a large improvement in ROE forecasts, especially when the difference between the initial and steady state levels of ROE is large in absolute value. More fundamentally, the improvement increases with the magnitude of transitory earnings and the rate of equity investment.[1]

The findings of this study are of consequence for both academics and practitioners. Predicting profitability and payout is a necessary step in fundamental valuation, including applications of residual income, dividend discount, and discounted cash flow models (RIM, DDM and DCF, respectively). RIM applications typically use forecasts of profitability and payout as primary inputs in the valuation. In DDM and DCF valuations, one typically predicts balance sheet and income statement data, and derives dividends or cash flows from the projected statements. The projected statements in turn are derived from forecasts of profitability and payout. Thus, understating the time-series behavior of these value drivers is critical for generating sound valuations. Our finding that the quadratic approach predicts ROE much better than linear trends has clear implications for academic research (e.g., estimating the implied cost

[1] An alternative approach, which we do not focus on in this study, is to assume geometric convergence (i.e., ROE follows an AR(1) process). This approach, however, assumes a very fast rate of mean-reversion, which is not likely to fit the data. Indeed, in unreported analysis we compared the quadratic and geometric approaches and found that the former clearly dominates the latter.

of capital) as well as for practice (e.g., analysts' valuation models). The analytical and empirical evidence on factors that affect the shape of ROE trends is relevant for identifying situations where ROE trends are likely to be especially nonlinear (e.g., when growth in capital is relatively high). In such cases, valuation models which assume linear convergence are likely to perform especially poorly.

The paper proceeds as follows. Section 2 explains the motivation for the investigation and discusses the linear and quadratic approaches. Section 3 presents the empirical results, and Section 4 concludes. Analytical derivations are included in the Appendix.

2. The Role and Estimation of Convergence Trends for Profitability and Payout

In this section, we first show that current book value and estimates of future profitability, future payout, and the cost of equity capital suffice to value the equity. We then describe the linear and quadratic approaches for estimating convergence rates and discuss their consistency (or lack thereof) with prior evidence.

2.1 Equity Valuation

The value of any financial claim is the present value of expected net cash flows associated with the claim. Accordingly, the value of equity (P) is the present value of expected net dividends:

$$P_0 = \sum_{t=1}^{\infty} E_0\left[DIV_t\right] \times \left(1 + r_e\right)^{-t}, \tag{1}$$

where DIV_t is dividends plus share repurchases and minus share issues, and r_e is the cost of equity capital. This model can be restated in terms of earnings (NI) and book value (CE), by substituting the following relation for DIV_t:

$$\mathrm{DIV}_t = \mathrm{NI}_t - \mathrm{CE}_t + \mathrm{CE}_{t-1}. \tag{2}$$

(Equation (2) is a statement about the accounting: Changes in equity are due to earnings or net dividends.) After simplifying, the following model is obtained:

$$P_0 = CE_0 + \sum_{t=1}^{\infty} E_0\left[NI_t - r_e CE_{t-1}\right] \times \left(1 + r_e\right)^{-t}. \tag{3}$$

That is, price is equal to current book value plus the present value of expected residual income in all future years (residual income is earnings in excess of required earnings on book value, or $NI_t - r_e CE_{t-1}$).[2]

We next define profitability (ROE) and payout (DIVR) as the ratios of earnings and net dividends, respectively, to the book value of equity at the beginning of the year: $ROE_t = \frac{NI_t}{CE_{t-1}}$, and $DIVR_t = \frac{DIV_t}{CE_{t-1}}$.[3] Substituting $ROE_t \times CE_{t-1}$ for NI_t in equation (3), we get

$$P_0 = CE_0 + \sum_{t=1}^{\infty} E_0\left[\left(ROE_t - r_e\right) \times CE_{t-1}\right] \times \left(1 + r_e\right)^{-t}. \tag{4}$$

Equation (2) and the definitions of ROE and DIVR imply that

[2] In fact, to derive Equation (3) one only need to assume that Equation (2) holds in expectations; that is, the expected values of "dirty surplus" items in future years are equal to zero. Similar to the derivation of the dividend discount model (equation (1)) which assumes that the present value of price at time T converges to zero as T converges to infinity, to derive equation (3) one has to assume that the present value of book value at time T converges to zero as T converges to infinity. See Ohlson (1995).

[3] Note that DIVR is different from the traditional dividend-earnings ratio. Measuring dividend payout relative to book value rather than earnings offers several advantages. Most importantly, book value is more stable over time than earnings, which implies that DIVR is more stable than the dividend-earnings ratio because dividends are also stable over time. In addition, the frequency of negative book values is smaller than that of negative earnings, which is an advantage since payout is not well defined when measured relative to a negative number. Finally, it is easier to analyze the interaction between profitability, payout and growth when payout is measured relative to book value than when it is measured relative to earnings. This follows because growth in capital equals ROE minus DIVR (i.e., a linear relationship) while, when payout is measured relative to earnings (PAYOUT), growth in capital equals ROE times (1 + PAYOUT) (i.e., a nonlinear relationship).

$$CE_t = (1 + ROE_t - DIVR_t) \times CE_{t-1} =$$

$$(1 + ROE_t - DIVR_t) \times (1 + ROE_{t-1} - DIVR_{t-1}) \times \ldots \times (1 + ROE_1 - DIVR_1) \times CE_0 =$$

$$CE_0 \times \prod_{j=1}^{t} (1 + ROE_j - DIVR_j)$$

Substituting into equation (4), we get

$$P_0 = CE_0 \times \left\{ 1 + \sum_{t=1}^{\infty} E_0 \left[(ROE_t - r_e) \times \prod_{j=1}^{t-1} (1 + ROE_j - DIVR_j) \right] \times (1 + r_e)^{-t} \right\}. \tag{5}$$

Thus, price depends on the current book value (CE_0), the cost of equity capital (r_e), and expectations regarding ROE and DIVR in all future years.

In a typical valuation, one predicts earnings and book value for several years subsequent to the valuation date, and estimates or assumes the steady state levels of relevant value drivers.[4] This information defines ROE and DIVR for the explicit forecast years and at steady state, but it does not specify how ROE and DIVR converge to their steady state levels. To complete the forecasts needed for valuation, therefore, one must specify such trends. Lee et al. (1999), Gebhardt et al. (2001), Liu at el. (2002), Gode and Mohanram (2003), Botosan and Plumlee (2004) and Easton and Monahan (2003), for example, use a linear interpolation of ROE from year t + 3 to the industry median ROE in year t + T, for several values of T.[5] However, these studies do not provide evidence on the accuracy of the predicted linear trends. We address this issue and also evaluate an alternative, quadratic approach for specifying convergence rates. We

[4] Note that discounted cash flow analysis also involves projections of income statements and balance sheets, as free cash flows are typically derived from forecasted income statements and balance sheets.

[5] Lee et al. (1999) and Easton et al. (2001) note that using the historic industry ROE as a proxy for steady state ROE may induce bias. As discussed below, instead of attempting to estimate steady-state ROE based on ex-ante information, we use the actual value of future ROE.

next discuss the linear approach and the factors inducing non-linearity, and then develop the quadratic approach. In Section 3, we empirically evaluate the two approaches.

2.2 The Linear Approach and its Limitations

Under the linear approach, predictions for ROE during the convergence period are calculated as follows:

$$ROE_t = a \times [t - T_0] + b \tag{6}$$

where T_0 is the last year with explicit forecast for ROE, and t is any year during the convergence period (i.e., $T_0 < t \leq T_1$, where T_1 is the year in which ROE is expected to reach a steady state). Simple algebra indicates that $a = [ROE_{T1} - ROE_{T0}] / [T_1 - T_0]$, and $b = ROE_{T0}$.

While simple to implement, this approach is inconsistent with empirical observations and theoretical considerations. In particular, prior empirical evidence indicates that ROE mean-reverts faster when it is further away from the long-term level (e.g., Nissim and Penman (2001)); that is, the trend is convex (concave) when ROE is above (below) its long-term level. Consequently, when the level of profitability at the beginning of the convergence period is above (below) the long-term level, a linear trend is likely to overstate (understate) profitability during the convergence period. This is partially due to transitory items: Firms with high (low) ROE tend to have relatively large positive (negative) transitory earnings items, and so their ROE reverts to the mean faster than for firms with more normal levels of profitability. The speed of mean-reversion is especially high for small ROEs (e.g., Fama and French (2000)), consistent with evidence that negative transitory items are recognized more frequently than positive items and are larger in magnitude (e.g., Burgstahler et al. (2002)).[6]

---

[6] Negative transitory earnings are likely to be more frequent and larger in magnitude than positive items, because: (1) real options, such as the option to abandon unsuccessful operations, allow firms to "cut their losses," (2) negative transitory items are often due to "big bath" charges, which reduce current profitability but subsequently reverse, and

There are two additional, less recognized reasons for the non-linearity of ROE trends. Both are related to the hypothesis that the profitability of new equity investments (reinvested earnings and new share issues) is on average closer to long-term profitability than is the profitability of existing capital. The intuition for this hypothesis is as follows. Firms with abnormally high current profitability were successful in their past investments, but on average are not expected to be as successful going forward. Similarly, firms with abnormally low current profitability were unsuccessful in their past investments, but on average are expected to be more successful in their future investments. Accordingly, the return on new capital is expected to be closer to normal levels of profitability than is the return on existing capital (which reflects past, ex-post success or lack of success). In the long run, the effects of abnormal success in past investments die out, and long-term profitability converges to more normal levels.[7]

The non-linearity in ROE trends implied by this hypothesis is demonstrated in the Appendix. Here we provide the intuition. The change in ROE next year depends on two factors: the difference between the profitability of new and existing capital, and the growth in capital. High current profitability implies both (1) a large negative difference between the next year's returns on new and existing capital (due to the persistence of the profitability of existing capital), and (2) a large new equity investment (due to the reinvestment of earnings). Both effects imply that when the initial ROE is high, its convergence trend is likely to be convex.[8] For low initial

(3) under conservative accounting, profits are recognized gradually as earned while losses are recognized fully when anticipated.

[7] This does not imply that steady state ROE is identical across firms. Differences in risk (cost of equity capital) and in the effects of conservative accounting (e.g., Feltham and Ohlson (1995), Zhang (2000)) may generate differences in ROE even in the absence of economic rents.

[8] When the change in equity is negative, the direction of the non-linearity induces by the first effect reverses. As we show below, however, most firms report positive changes in equity, either due to reinvestment of earnings or new equity issues. This is especially true for firms with high ROE.

ROE, the first effect implies concave convergence while the second effect implied a convex trend.

The following table summarizes the effects of the above mentioned factors on ROE trends:

	High initial ROE	Low initial ROE
ROE reflecting transitory earnings	convex ( )	concave ( )
ROE affecting the difference in profitability between new and existing capital	convex ( )	concave ( )
ROE affecting new equity investments	convex ( )	convex ( )

For high initial ROE all three effects imply a convex trend. For low initial ROE, the first two effects imply concave convergence while the last implies a convex trend. However, as discussed above, the transitory earnings effect is particularly strong for low ROE firms, and, as demonstrated below, the second effect dominates the third effect. Thus, both analytical and empirical evidence indicates that ROE trends are concave for small initial ROEs and convex for large initial ROEs.

As noted above, there is little prior evidence to indicate whether a linear trend may provide a reasonable approximation for the evolution of DIVR over time. There is evidence that dividends are relatively stable over time (firms are reluctant to cut dividends and tend to increase their dividends in small increments; see, e.g., Nissim and Ziv (2001)). However, share repurchases and share issues, which are also included in the numerator of DIVR, are less stable and often occur in lump sums. This implies mean-reversion in DIVR: Small or large net dividends are on average followed by more normal net dividends. It also implies that the two components of DIVR (dividends and share transactions) should be analyzed separately. We return to this issue in Section 3.

2.3 The Quadratic Approach

An alternative approach to specifying convergence rates, which allows for non-linearity in the trend and facilitates smooth transition to the steady state level, is to use a second order polynomial in time. Focusing on ROE, the quadratic approach specifies:

$$ROE_t = a \times [t - T_0]^2 + b \times [t - T_0] + c, \tag{7}$$

where, as before, T_0 is the last year with explicit forecasts, and t is any year during the convergence period.

To estimate the parameters (a, b, and c), note that at the end of the explicit forecast period (i.e., for $t = T_0$), $ROE_{T0} = c$, and at the end of the convergence period (i.e., for $t = T_1$), $ROE_{T1} = a \times [T_1 - T_0]^2 + b \times [T_1 - T_0] + c$. In addition, because ROE remains constant from year T_1 on, the annual change in ROE should converge to zero by T_1. Thus, the derivative of the polynomial in (7) with respect to time (i.e., w.r.t. $[t - T_0]$), evaluated at $[T_1 - T_0]$, should equal zero. That is, $2 \times a \times [T_1 - T_0) + b = 0$. These relationships imply that $a = [ROE_{T0} - ROE_{T1}] / [T_1 - T_0]^2$, $b = - 2 \times [ROE_{T0} - ROE_{T1}] / [T_1 - T_0]$, and $c = ROE_{T0}$. Therefore, given values for ROE_{T0} (the initial ROE), ROE_{T1} (the terminal ROE), and $[T_1 - T_0]$ (the length of the convergence period), we can calculate the parameters of equation (7) and use the equation to predict ROE for each year t during the convergence period. Whether this approach provides better ROE forecasts compared with linear trends is not clear, however. We next turn to the empirical analysis, which evaluates and compares the linear and quadratic approaches.

3. Empirical Evidence

We first describe the data (Section 3.1), and then discuss the results of the analyses of profitability (Section 3.2) and payout (Section 3.3).

3.1 Data

The analysis covers all firm-year observations on the combined COMPUSTAT (Industry and Research) files for any of the 39 years from 1963 to 2001, which satisfy the following requirements: (1) the company was listed on the NYSE or AMEX, (2) the company was not a financial institution (i.e., excluding firms with SIC codes between 6000 and 6999), and (3) common equity (COMPUSTAT data item #60), net income (#172), number of shares outstanding (#25), and price per share at fiscal year end (#199) for the current and previous year are all available.[9]

ROE is calculated as comprehensive net income divided by common equity at the beginning of the year. Common equity is measured as COMPUSTAT's common equity adjusted for preferred treasury stock and preferred dividends in arrears (#60 + #227 – #242). Comprehensive net income is calculated as net income (#172) minus preferred dividends (#19) and plus a clean surplus adjustment. The clean surplus adjustment is calculated as the change in marketable securities adjustment (change in #238) plus the change in cumulative translation adjustment (change in #230).

Comprehensive income includes transitory items, which are often difficult to forecast and affect the slope and shape of ROE trends (see Section 2.2 and the Appendix). Thus, the evolution of realized ROE over time may not provide a good indication for the convergence of expected ROE. To address this concern, we also examine the time-series behavior of Core ROE. Core

[9] The requirement of price per share availability mitigates selection bias due to the inclusion of past data for IPOs in the COMPUSTAT files.

ROE differs from ROE in the measure of income (numerator) used in calculating the ratio. Unlike ROE, it excludes the clean surplus adjustment, extraordinary items, and after-tax special items.[10]

The dividend-to-book ratio (DIVR) is calculated as the difference between comprehensive income and the change in common equity during the year, divided by common equity at the beginning of the year. That is, net dividends are calculated indirectly using the clean surplus relation (equation (2)). Because the two components of DIVR (dividends and share transactions) are likely to evolve differently over time, we examine each of them separately. The dividend component of DIVR (DIVR1) is measured as common dividends (#21) divided by the balance of common equity at the beginning of the year. The share transactions component is measured as the difference (DIVR2 = DIVR – DIVR1).

Since the rate of return on negative or zero investment is not well defined, firm-year observations with non-positive beginning of year balance for common equity are excluded from the analysis. In addition, to mitigate the effects of outliers, extreme values for ROE, Core ROE, DIVR, DIVR1 or DIVR2 (upper and lower one percent of each distribution) are deleted. The resulting sample includes 63,845 observations (4,299 different firms).

Panel A of Table 1 presents summary statistics for the pooled time series cross-section distribution of the variables. As shown, ROE has a mean of 11.26 percent and a median of 12.70 percent. The difference between the mean and the median reflects the negative skewness of ROE, which is caused primarily by negative transitory items (negative transitory items are more

---

[10] Specifically, Core ROE is measured as core income divided by beginning common equity, where core income is calculated as net income (#172) minus preferred dividends (#19) and excluding after-tax special items (#17 × (1 – marginal tax rate)) and extraordinary items and discontinued operations (#48). The marginal tax rate is measured as the top statutory federal tax rate plus 2% average state tax rate. The top federal statutory corporate tax rate was 52% in 1963, 50% in 1964, 48% in 1965-1967, 52.8% in 1968-1969, 49.2% in 1970, 48% in 1971-1978, 46% in 1979-1986, 40% in 1987, 34% in 1988-1992 and 35% in 1993-2001.

common and larger in magnitude than positive items; see, e.g., Burgstahler et al. (2002)). Indeed, the distribution of Core ROE (which excludes transitory items) is substantially less skewed and, with the exception of the 5th percentile, is quite similar to that of ROE.

The distribution of DIVR indicates that the average net payout is small, with mean of –0.61 percent and median of 2.57 percent. The negative skewness of DIVR is even larger than that of ROE, reflecting the lump sum nature of share issues. As the frequencies of share issues and large share repurchases are relatively small (see distribution of DIVR2), the interquartile range of DIVR is relatively small (6.66=6.21–(–0.45) percentage points, compared with 12.46=18.80–6.34 for ROE) and is similar to that of DIVR1 (5.91=5.91–0). In contrast, the standard deviation of DIVR, which reflects variation due to share issues and share repurchases in addition to dividends, is relatively large (19.17 percent, compared with 16.50 percent for ROE).

The last row in Panel A provides statistics for the growth in equity, ROE – DIVR. As reported, more than three quarters of the firms reported positive change in equity, and both the mean and median growth in equity are quite large. In fact, the mean growth in equity is larger than the mean ROE, due to firms with large equity issues. We show below, analytically (in the Appendix) and empirically (in Section 3.2), that these equity increases contribute to the non-linearity of ROE trends.

Panel B of Table 1 presents the time-series means over the years 1963 through 2001 of the Pearson (below the main diagonal) and Spearman (above the main diagonal) cross-sectional correlations of ROE, Core ROE, ROE – Core ROE, DIVR, DIVR1, DIVR2 and ROE – DIVR. As expected, the average correlation between ROE and Core ROE is very high (0.90 Pearson and 0.93 Spearman). In contrast, the average Pearson correlations between DIVR and the profitability measures (ROE and Core ROE) are essentially zero, and the average Spearman correlations, while positive and significant, are not particularly large. These results are due to two offsetting effects: The average correlation between profitability and dividends is positive (e.g., the Pearson correlation between ROE and DIVR1 is 0.28) while the correlation with share transactions is negative (e.g., the Pearson correlation between ROE and DIVR2 is -0.07).

3.2 Analysis of Profitability

Return on Equity (ROE)

In each of the years 1963 through 1996 (year t), we sort all firms by the value of ROE and form ten equal-size portfolios. For each portfolio, we then calculate the mean value of ROE in that year and in each of the subsequent five years (i.e., years t through t+5).[11] Next we calculate the time-series means over the years 1963 through 1996 of the portfolio means. The results of this analysis are plotted in Panel A of Figure 1. Consistent with prior research, we observe that (1) ROE reverts toward the mean (e.g., Freeman et al. (1982), Penman (1991)), (2) the mean reversion is faster when ROE is further away from the mean, especially for low ROEs (e.g., Fama and French (2000)), and (3) the ranking of ROE remains similar to that in the base year even after five years, that is, ROE does not fully revert to the mean within five years (e.g., Nissim and Penman (2001)).

To evaluate and contrast the fitted linear and quadratic trends, we perform the following analysis. For each of the years 1963 through 1996 (year t), and each portfolio, we use the mean portfolio ROEs in years t and t+5 to calculate fitted values for ROE in years t+1 through t+4, assuming (1) a linear trend, and (2) a quadratic trend that convergences to zero change by year t+5 (see Section 2.3). For each set of fitted values, we then calculate the time-series means over the period 1963 through 1996 of the fitted portfolio ROEs. Panel B (Panel C) of Figure 1

[11] To eliminate look-ahead bias, firms are included in the calculations until they drop out.

presents the results for the linear (quadratic) trend. Comparison of the actual (Panel A) and linear (Panel B) trends suggests that the linear approach provides a poor fit for the extreme portfolios. In contrast, the quadratic trends in Panel C appear to provide a reasonable fit.

To more formally test the differences in fit between the linear and quadratic approaches, and to assess the magnitude of improvement from using the quadratic approach, we conduct the following analysis. For each annual analysis (1963 through 1996), we calculate the differences between the actual portfolio ROEs and the corresponding fitted values from the linear and quadratic trends in each of the years t+1 through t+4 (for the years t and t+5 the difference is zero by construction). We then measure the improvement from using quadratic trends as the differences between the absolute values of the prediction errors from the linear and quadratic models.

Panel A of Table 2 presents the mean improvement for all the portfolios (340 observations; 10 portfolios in each of the 34 years from 1963 through 1996), and Panels B and C give the means for the low and high ROE portfolios (34 observations each). The mean improvement across all portfolio-year observations is 0.593 percentage points for t+1, 0.839 for t+2, 0.607 for t+3, and 0.259 for t+4. Given that the average ROE is about 11 percent (see Table 1), the improvement is clearly not negligible and, as indicated by the reported *t*-statistics, is highly significant. The improvement is especially large for the extreme portfolios (Panels B and C), with values ranging from 0.943 to 4.972 percentage points per year. Considering the average magnitude of ROE for these portfolios (plotted in Panel A of Figure 1), the improvement appears even more relevant. For example, the mean ROE in the years t+1 through t+4 for the low ROE portfolio ranges between –5 percent and +10 percent, and the average improvement in fit for this portfolio is about 3.5 percentage points per year.

The results in Figure 1 and Table 2 are based on the assumption that the length of the convergence period is five years. Visual examination of the actual convergence rates of ROE in Panel A of Figure 1 suggests that this assumption provides a reasonable approximation, as the changes in ROE in t+5 are small compared to the changes in prior years.[12] Nevertheless, to check the sensitivity of the results with respect to this assumption, we repeat the analysis using convergence periods of three and eight years. In both cases, the inference is unchanged; the quadratic approach provides a large improvement relative to the linear approach.

Core Return on Equity (Core ROE)

As noted above, the evolution of ROE may not provide a good indication for expected changes in ROE, as realized ROE contains transitory unpredictable items. To address this concern, we next examine the time-series behavior of Core ROE, which excludes extraordinary and special items. The results for Core ROE are presented in Figure 2 and Table 3. As expected, Core ROE reverts to the mean at a slower pace than ROE, and differences in Core ROE across the portfolios remain substantial even after five years. In addition, consistent with the analysis in Section 2.2 and the Appendix, the trend lines for Core ROE (which excludes transitory items) are less non-linear than for ROE. Consequently, the mean improvement from using quadratic instead of linear trends for Core ROE (Table 3) is smaller than that for ROE, although it is still highly significant. Visually, the actual and quadratic trends for Core ROE (Figure 2) appear almost identical.

[12] Note that this may not be the case when additional information, besides the current level of ROE, is used in sorting the portfolios.

Incorporating Information from the Price-to-Book Ratio

Our measure of Core ROE is not likely to exclude all transitory items.[13] To further examine the effect of transitory items, therefore, we divide each Core ROE portfolio into two equal-size subportfolios based on the price-to-book ratio at the beginning of year t. Firms with high Core ROE should have high price-to-book ratios, unless Core ROE contains positive transitory items (e.g., Beaver and Ryan (2000)). Similarly, firms with low Core ROE should have low price-to-book ratios, unless Core ROE contains negative transitory items. Accordingly, we classify the high price-to-book subportfolios of the top (low) five Core ROE portfolios as having small (large) magnitude of transitory items, and we classify the low price-to-book subportfolios of the low (top) five Core ROE portfolios as having small (large) magnitude of transitory items. We then rerun the analyses separately for the small and large transitory items portfolios.

The Core ROE trends of firms with small (large) magnitude of transitory items are plotted in Panel A (Panel B) of Figure 3. As expected, for the large transitory items portfolios, the pace of mean-reversion is faster and the differences in terminal profitability across the portfolios are smaller than for the small transitory items portfolios. Consistent with the argument that transitory items increase the non-linearity of ROE trends (Section 2.2 and the Appendix), the trend lines for the small transitory items portfolios are more linear than the corresponding lines for the large transitory items portfolios. Consequently, the improvement from using the quadratic approach is smaller for the small transitory items portfolios (Panel A of Table 4) than for the large transitory items portfolios (Panel B of Table 4). Moreover, the differences in the magnitude

[13] See Burgstahler et al. (2002) for a discussion of the likely composition of COMPUSTAT's data item "special items" and the potential omissions from this item. In addition, Elliott and Hanna (1996) document a large increase in COMPUSTAT's special items in the 1980s and 1990s, which is partially due to an increase in the identification of one-time items by companies and COMPUSTAT.

of improvement between the two subsamples are statistically significant (Panel C of Table 4). Still, for both subsamples, the trend lines are non-linear (convex for high ROE and concave for low ROE) and the improvement from using quadratic trends is economically and statistically significant, indicating that transitory items are not the only reason for the observed non-linearity of ROE trends.

<u>Partitioning on Equity Investment</u>

In Section 2.2 and the Appendix, we demonstrate that the non-linearity of ROE trends is also due to equity investments (new issues and earnings reinvestment). Equity investments induce non-linearity in ROE trends for two reasons. First, the impact of the difference between the profitability of new and existing capital on ROE trends is proportional to the relative magnitude of new equity investment (at the extreme, with no new equity investments, ROE trends reflect only the profitability of existing capital). Second, ROE itself affects the growth in capital: higher ROE generally implies a larger amount of reinvested earnings and so a larger impact of the difference between the profitability of new and existing capital on ROE trends. In this section, we empirically demonstrate the effect of equity investments. Specifically, we partition each Core ROE portfolio into subportfolios of firms with small levels of equity investment ($DIVR_t$ above the portfolio median) and large investment ($DIVR_t$ below the median), and rerun the analysis separately for small and large investment firms. Figure 4 presents the Core ROE trends, and Table 5 examines the extent of improvement from fitting quadratic instead of linear trends.

Consistent with the results of the analytical analysis, we observe that the pace of mean reversion for large investment firms (Panel B of Figure 4) is faster than for small investment firms (Panel A), and the trends are more non-linear. Thus, the improvement in fit obtained by using quadratic instead of linear trends is larger for large investment firms (Panel B of Table 5) than for small investment firms (Panel A), and the differences in improvement between the two subsamples are highly significant (Panel C).

3.3 Analysis of Payout

We next analyze the dividend-to-book ratio. Panel A of Figure 5 presents actual convergence rates for DIVR. In contrast to ROE, almost all of the mean reversion in DIVR occurs in year t+1. During the years t+2 through t+5, changes in DIVR are relatively small. DIVR does not fully revert to the unconditional mean, however; the rankings of the portfolios are almost identical in each of the six years (t through t+5), and the differences in DIVR remain substantial in t+5.

As discussed above, DIVR consists of two components, dividends and share transactions, which are likely to evolve differently over time. We therefore rerun the analysis for each component separately. As shown in Panel B of Figure 5, the dividend component of DIVR is relatively stable and its slow convergence is approximately linear. In contrast, the share transactions component (DIVR2, plotted in Panel C of Figure 5) exhibits strong mean-reversion in the year following the portfolios' formation. Yet, the differences in DIVR2 across the portfolios remain substantial during the subsequent years (note that the scale of Panel C is different from that of Panel B). From year t+1 on, DIVR2 evolves similar to DIVR and converges slowly and linearly towards the overall mean.

These results suggest that when predicting DIVR2, it is important to distinguish between one-time share transactions (e.g., seasoned public offerings) and those that are recurring in nature (e.g., share repurchase programs or share issuance in connection with ESO programs). The former are likely to revert immediately to the mean, while the latter behave similar to dividends and drift linearly and slowly towards the mean. Thus, rather than distinguishing between dividends and share transactions, one should exclude from DIVR one-time share transactions (which revert immediately to the mean) and specify a linear trend for the recurring part of DIVR. In some cases, this exercise is rather simple (e.g., seasoned public offering). In other cases, it may involve decomposing equity transactions into recurring and one-time components (e.g., a company that repurchases shares regularly may take advantage of market conditions and expedite share repurchases in a particular year). Nevertheless, as is clear from Figure 5, failure to recognize the transitory nature of some share transactions may result in poor predictions, especially when the current level of net payout is far from its steady state level.

4. Conclusion

4.1 Summary

This study investigates the time-series behaviors of return on equity (ROE) and the dividend-to-book ratio (DIVR), and their implications for equity valuation. While prior evidence suggests that ROE trends are mean reverting and non-linear, absent a specific method for specifying convergence rates, valuation studies have assumed that ROE drifts linearly to its steady-state level. The analytical and empirical analyses in this study demonstrate that ROE trends are non-linear due to transitory earnings items and equity investments. The evidence regarding the effect of equity investments is particularly relevant because, unlike transitory earnings which affect ROE trends primarily in the near term, equity investments have a prolonged effect. For example, payout policies are rather persistent and vary substantially in the cross-section. The study further demonstrates that a quadratic approach for specifying ROE convergence rates provides a considerable improvement in the forecasts relative to linear interpolations. The improvement is particularly large when the difference between the initial ROE and its steady-state level is large in absolute value, when ROE contains large transitory items, or when the rate of equity investment is high.

The analysis of payout suggests that the dividend component of DIVR is relatively stable and its (slow) convergence is approximately linear. Share transactions, in contrast, consist of a transitory part which reverts almost immediately to the mean, and a more permanent part which evolves similar to dividends (i.e., it drifts slowly and linearly towards the mean). Thus, when predicting future payout, one should specify a linear trend for the recurring part of payout and assume immediate mean-reversion for one-time share transactions.

4.2 Future Research

To focus on convergence trends, we use the actual values of ROE and DIVR at the end of the convergence period as proxies for their steady-state levels. When valuing equity, however, one has to estimate the steady-state levels of ROE and DIVR using ex-ante information. An interesting extension of the current study would be to use only ex-ante information in fitting the linear and quadratic trends, and compare the accuracy of the resulting valuations. Such analysis requires the estimation of steady-state levels for ROE and DIVR, which is beyond the scope of this paper. We leave this issue for future research.

Another interesting extension of this study is to examine the convergence of operating profitability and operating payout. We chose to focus on equity rather than operations primarily because we examine implications for specifying long-term trends. When forecasting earnings for the near- to intermediate-term, one should use detailed analyses which consider operations separately from financing and dig into the drivers of operations (e.g., profit margin, asset turnover, etc.). However, when forecasting longer-term trends in profitability, there is typically little activity-specific information that can be incorporated in the forecasts. This is reflected in the assumed time-series trends of leverage, profit margin and asset turnover, which converge to steady state levels rather quickly. (Sales growth, in contrast, is often specified as having a long-term trend.) Thus, for predicting long-term trends in profitability, there is little to be gained by analyzing operations separately from financing. Yet evidence on the determinants of convergence trends of operating profitability and payout could be useful for predicting near-term earnings.

Appendix
Determinants of ROE Trends

In this appendix, we examine the factors affecting the shape of ROE trends. We start by examining the implications of different ROE convergence trends (linear, convex and concave) for the relationship between the change in ROE each period and the level of ROE in the prior period. We then express ROE as a weighted average of the returns on existing and new capital, and use this expression to calculate the derivative of the change in ROE with respect to the prior period's ROE. Finally, we examine the derivative to identify the shape of ROE convergence trends.

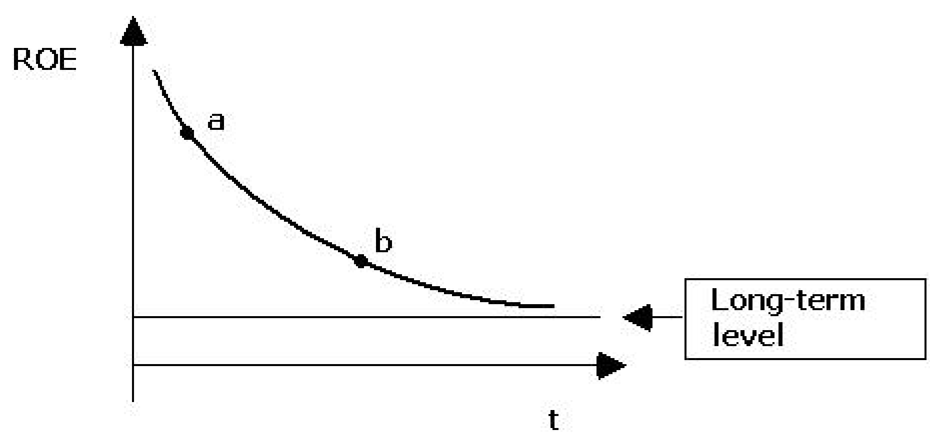
ROE Trends and the Implied Relationship between the Change in ROE and Its Prior Period Level

If ROE is above (below) its long-term level, subsequent changes in ROE are expected to be negative (positive), as ROE converges to its long-term level. The pattern of convergence can either be linear (same change each year), convex (increasing change), or concave (decreasing change).

If the ROE trend is linear, the (constant) change in ROE each period is unrelated to the level of ROE in the prior period; that is, $ROE_{t+1} - ROE_t$ is unrelated to ROE_t.

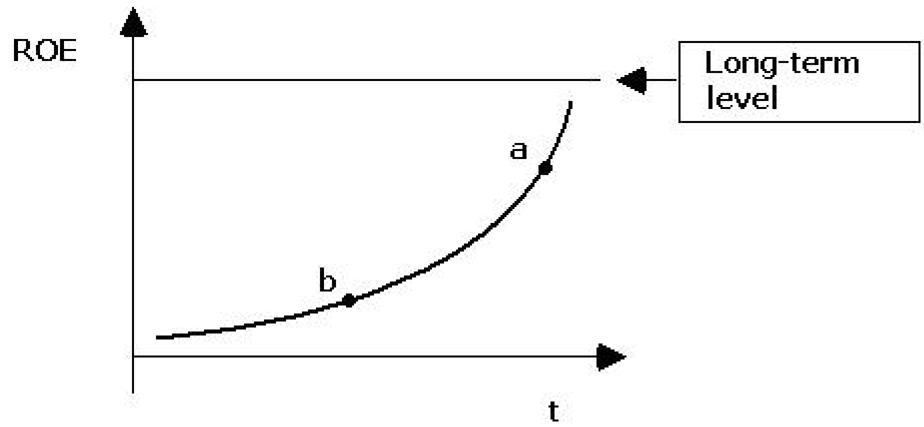
If ROE is above the long-term level and the pattern of convergence is convex (Figure A1), the change in ROE each period is negatively related to the level of ROE in the prior period. To see this, consider point a (high ROE) and b (lower ROE). The derivative of the ROE trend in point a is clearly smaller (more negative) than the derivative in point b, indicating that high ROE (as in point a) is followed by a larger drop in ROE than a lower ROE (as in point b).

Figure A1



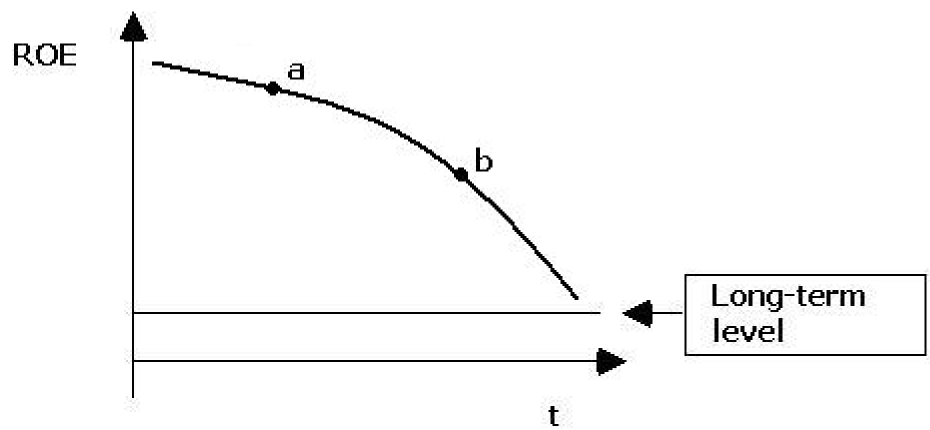
If ROE is below the long-term level and the pattern of convergence is convex (Figure A2), the change in ROE each period is positively related to the level of ROE in the prior period (high ROE, as in point a, is followed by a larger increase in ROE than a lower ROE, as in point b).

Figure A2



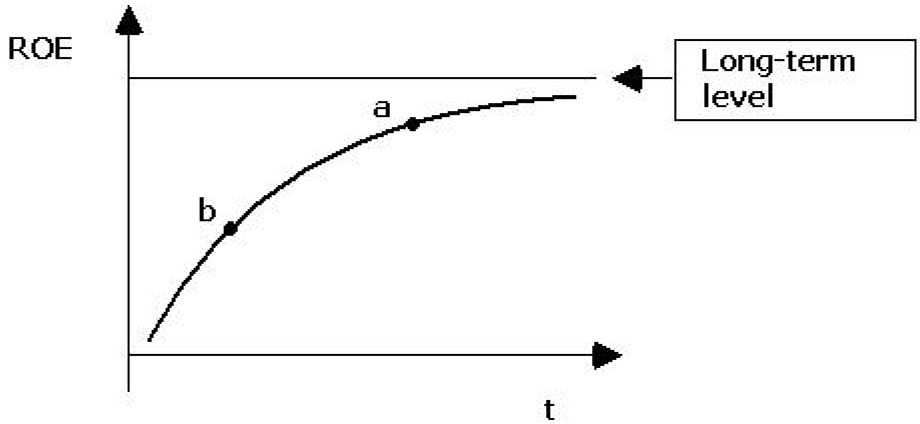
If ROE is above the long-term level and the pattern of convergence is concave (Figure A3), the change in ROE each period is positively related to the level of ROE in the prior period (high ROE, as in point a, is followed by a smaller drop in ROE than a lower ROE, as in point b).

Figure A3



Finally, if ROE is below the long-term level and the pattern of convergence is concave (Figure A4), the change in ROE each period is negatively related to the level of ROE in the prior period (high ROE, as in point a, is followed by a smaller increase in ROE than a lower ROE, as in point b).

Figure A4



ROE as a Weighted Average of the Returns on Existing and New Capital

Next year's ROE can be expressed as the following weighted average of the return on equity that existed at the beginning of the current year (ROE^e) and the return on equity that was added during the current year (ROE^n):

$$ROE_{t+1} \equiv \frac{NI_{t+1}}{CE_t} = \frac{CE_{t-1}}{CE_t}\frac{NI^e_{t+1}}{CE_{t-1}} + \frac{\Delta CE_t}{CE_t}\frac{NI^n_{t+1}}{\Delta CE_t} = \left(1 - \frac{\Delta CE_t}{CE_t}\right)ROE^e_{t+1} + \frac{\Delta CE_t}{CE_t}ROE^n_{t+1}, \tag{a1}$$

where NI^e (NI^n) is income earned on existing equity (new equity). Thus,

$$ROE_{t+1} = (1 - w_t)ROE^e_{t+1} + w_t ROE^n_{t+1}, \tag{a2}$$

where $w_t = \Delta CE_t / CE_t$.

Determinants of the Relationship between the Change in ROE and Its Prior Period Level

Deducting ROE_t from both sides of equation (a2) and simplifying, we get

$$ROE_{t+1} - ROE_t = -w_t\left(ROE^e_{t+1} - ROE^n_{t+1}\right) + \left(ROE^e_{t+1} - ROE_t\right). \tag{a3}$$

The derivative of the change in ROE with respect to ROE in the prior period is therefore

$$\frac{\partial\left(ROE_{t+1} - ROE_t\right)}{\partial ROE_t} = -\frac{\partial w_t}{\partial ROE_t}\left(ROE^e_{t+1} - ROE^n_{t+1}\right) - w_t\frac{\partial\left(ROE^e_{t+1} - ROE^n_{t+1}\right)}{\partial ROE_t} + \frac{\partial\left(ROE^e_{t+1} - ROE_t\right)}{\partial ROE_t}. \tag{a4}$$

As discussed above, the sign of the derivative in (a4) indicates the trend of ROE convergence: positive derivative implies convex convergence, negative derivative implies concave convergence, and zero derivative implies linear convergence. To identify the sign, we examine the components of this expression, starting with w_t:

$$w_t = \frac{\Delta CE_t}{CE_t} = \frac{CE_{t-1} \times (ROE_t - DIVR_t)}{CE_{t-1} \times (1 + ROE_t - DIVR_t)} = \frac{ROE_t - DIVR_t}{1 + ROE_t - DIVR_t}. \quad \text{(a5)}$$

Note that w_t is positive when the firm retains earnings (i.e., when ROE_t is greater than $DIVR_t$) and negative when net dividends are larger than earnings.

Deriving w_t with respect to ROE_t, we get

$$\frac{\partial w_t}{\partial ROE_t} = \frac{1}{(1 + ROE_t - DIVR_t)^2}, \quad \text{(a6)}$$

which is positive for all values of ROE_t and $DIVR_t$ as long as the firm does not pay all equity as dividends (since then $DIVR_t = 1 + ROE_t$). Thus, w_t is an increasing function of ROE_t.

The sign of $(ROE^e_{t+1} - ROE^n_{t+1})$ is related to the level of current profitability (i.e., ROE_t). High current profitability implies that past investments were successful, and so next year's profitability from existing capital (reflecting the profitability of existing projects) should also be high. Past success in investments, however, does not necessarily imply future success, so next year's return on new investments is on average expected to be smaller than the return on existing capital. Accordingly, $(ROE^e_{t+1} - ROE^n_{t+1})$ is expected to be positive when current profitability is high and negative when current profitability is low. Relatedly, the sign of $\frac{\partial(ROE^e_{t+1} - ROE^n_{t+1})}{\partial ROE_t}$ is expected to be positive, because higher current profitability implies larger return on existing capital in the following year.

The final term in equation (a4), $\frac{\partial(ROE^e_{t+1} - ROE_t)}{\partial ROE_t}$, is likely to be negative. This follows because the next year's change in the profitability of existing capital (i.e., $\partial(ROE^e_{t+1} - ROE_t)$) is expected to be negatively related to the current level of transitory items and thus to current profitability (ROE_t).[14]

[14] ROE_t is positively related to transitory items in year t because high values of profitability are more likely to include positive transitory items, and low values of profitability are more likely to include negative transitory items. By definition, transitory items are not expected to recur and so are negatively related to the subsequent year change in profitability

To sum up,

$$\frac{\partial\left(ROE_{t+1}-ROE_t\right)}{\partial ROE_t} = -\underbrace{\frac{\partial w_t}{\partial ROE_t}}_{\substack{t1\\+}}\underbrace{\left(ROE^{e}_{t+1}-ROE^{n}_{t+1}\right)}_{\substack{t2\\+/-}} - \underbrace{w_t}_{\substack{t3\\+/-}}\underbrace{\frac{\partial\left(ROE^{e}_{t+1}-ROE^{n}_{t+1}\right)}{\partial ROE_t}}_{\substack{t4\\+}} + \underbrace{\frac{\partial\left(ROE^{e}_{t+1}-ROE_t\right)}{\partial ROE_t}}_{\substack{t5\\-}}$$

* Profitability increases the amount of new equity investment, which interacts with the difference between the returns on existing and new capital to produce a faster convergence of ROE towards normal levels.	** Higher profitability implies a larger difference between the returns on existing and new capital, which interacts with new equity investments to produce a larger decline in ROE.	*** Extreme values of profitability are more likely to contain transitory items, which subsequently reverse.

More specifically, there are four possible cases:

<u>Case 1: ROE_t is above the long-term level, reinvested earnings are positive</u>
t2 and t3 are both positive, and so all three effects (*, ** and ***) are negative. Thus, the overall derivative is negative, and the ROE trend is convex (the case plotted in Figure a1). The convexity increases in the extent of equity investment (t3) and in the magnitude of transitory items (t5). The descriptive statistics in Table 1 suggest that this case is quite common (ROE – DIVR is mostly positive, especially when ROE is high).

<u>Case 2: ROE_t is above the long-term level, reinvested earnings are negative</u>
t2 is positive and t3 is negative, and so * and *** are negative, and ** is positive. Thus, the sign of the overall derivatives depends on the magnitudes of the terms t1 through t5. The likelihood and magnitude of convexity (negative derivative) increases in the change in equity (t3) and in the magnitude of transitory items (t5). The descriptive statistics in Table 1 suggest that this case is quite rare (ROE – DIVR is mostly positive, especially when ROE is high).

<u>Case 3: ROE_t is below the long-term level, reinvested earnings are positive</u>
t2 is negative and t3 is positive, and so ** and *** are negative, and * is positive. Thus, the sign of the overall derivatives depends on the magnitudes of the terms t1 through t5. The likelihood and magnitude of concavity (negative derivative) increases in the change in equity (t3) and in the magnitude of transitory items (t5).

<u>Case 4: ROE_t is below the long-term level, reinvested earnings are negative</u>
t2 and t3 are both negative, and so * and ** are positive, and *** is negative. Thus, the sign of the overall derivatives depends on the magnitudes of the terms t1 through t5. The likelihood and magnitude of concavity (negative derivative) increases in the change in equity (t3) and in the magnitude of transitory items (t5).

References

Beaver W. H., and S. G. Ryan, 2000, Biases and lags in book value and their effects on the ability of the book-to-market ratio to predict book return on equity, *Journal of Accounting Research* 38, 127-148.

Biddle, G. C., P. Chen, and G. Zhang, 2001, When capital follows profitability: Non-linear residual income dynamics, *Review of Accounting Studies* 6, 229-266.

Botosan C. A., and M. A. Plumlee, 2004, Assessing alternative proxies for the expected risk premium, Working Paper, University of Utah.

Burgstahler, D., J. Jiambalvo, and T. Shevlin, 2002, Do stock prices fully reflect the implications of special items for future earnings? *Journal of Accounting Research* 40, 585-612.

Easton, P., and S. Monahan, 2003, An evaluation of the reliability of accounting based measures of expected returns: A measurement error perspective, Working Paper, University of Notre Dame.

Easton, P., G. Taylor, P. Shroff, and T. Sougiannis, 2001, Using forecasts of earnings to simultaneously estimate growth and the rate of return on equity investments, *Journal of Accounting Research* 40, 657-676.

Elliott, J., and D. Hanna, 1996, Repeated accounting write-offs and the information content of earnings, *Journal of Accounting Research* 34, 135-155.

Fama, E. F., and K. R. French, 2000, Forecasting profitability and earnings, *Journal of Business* 73, 161-175.

Feltham, G., and J. Ohlson, 1995, Valuation and clean surplus accounting for operating and financial activities, *Contemporary Accounting Research* 11, 689-731.

Freeman, R. N., J. A. Ohlson and S. H. Penman, 1982, Book rate-of-return and prediction of earnings changes: An empirical investigation, *Journal of Accounting Research* 20, 639-653.

Gebhardt, W. R., C. M. C. Lee, and B. Swaminathan, 2001, Toward and ex ante cost-of-capital, *Journal of Accounting Research* 39, 135-176.

Gode, D. and P. Mohanram, 2003, Inferring cost of capital using the Ohlson-Juettner model. *Review of Accounting Studies* 8, 399-431.

Lee, C. M. C., J. Myers, and B. Swaminathan, 1999, What Is the Intrinsic Value of the Dow? *Journal of Finance* 54, 1693-1742.

Liu, J., D. Nissim, and J. Thomas, 2002, Equity valuation using multiples, *Journal of Accounting Research* 40, 135-172.

Ohlson, J. 1995. Earnings, book values, and dividends in equity valuation. *Contemporary Accounting Research* 11: 661-687.

Nissim, D. and S. Penman, 2001, Ratio analysis and equity valuation: from research to practice, *Review of Accounting Studies* 6, 109 - 154.

Nissim, D., and A. Ziv, 2001, Dividend changes and future profitability, *Journal of Finance* 56, 2111-2133.

Penman, S. H., 1991, An evaluation of accounting rate-of-return, *Journal of Accounting, Auditing, and Finance* 6, 233-255.

Zhang, X., 2000, Conservative accounting and equity valuation, *Journal of Accounting and Economics* 29, 125-149.

Table 1
Summary Statistics

Panel A: Statistics from the pooled time-series cross-section distributions, expressed in percentage points

	Mean	Std. Dev.	P5	Q1	Median	Q3	P95
ROE	11.26	16.50	-16.82	6.34	12.70	18.80	32.94
Core ROE	12.05	14.05	-10.00	7.00	12.77	18.60	31.75
ROE – Core ROE	-0.79	7.66	-9.76	-0.29	0.00	0.00	4.80
DIVR	-0.61	19.17	-30.00	-0.45	2.57	6.21	15.51
DIVR1	3.75	3.79	0.00	0.00	3.09	5.91	10.63
DIVR2	-4.35	18.53	-32.95	-2.53	-0.21	0.28	9.65
ROE – DIVR	11.87	24.84	-18.04	2.46	8.93	17.36	51.05

Panel B: Time-series means (over the sample years) of cross-sectional correlation coefficients; Pearson (Spearman) correlations are below (above) the main diagonal

	ROE	Core ROE	ROE – Core ROE	DIVR	DIVR1	DIVR2	ROE – DIVR
ROE	1.00	0.93	0.28	0.12	0.30	-0.11	0.75
Core ROE	0.90	1.00	0.05	0.13	0.33	-0.13	0.69
ROE – Core ROE	0.50	0.07	1.00	0.00	-0.01	0.01	0.24
DIVR	0.00	-0.01	0.02	1.00	0.58	0.70	-0.43
DIVR1	0.28	0.31	0.01	0.28	1.00	0.01	-0.02
DIVR2	-0.07	-0.09	0.02	0.97	0.05	1.00	-0.53
ROE – DIVR	0.66	0.60	0.32	-0.74	-0.03	-0.76	1.00

The sample includes non-financial NYSE and AMEX firms during the period 1963 through 2001. The number of observations is 63,845 (4,299 different firms). ROE is calculated as comprehensive net income divided by common equity at the beginning of the year. Core ROE is measured as core income divided by common equity at the beginning of the year. DIVR is the ratio of net dividends (dividends plus share repurchases and minus share issues) to common equity at the beginning of the year. DIVR1 is the ratio of common dividends to common equity at the beginning of the year. DIVR2, the share transactions component of DIVR, is calculated as the difference between DIVR and DIVR2. All variables are expressed in percentage points. For the definition of comprehensive and core income, see Section 3.1.

Table 2
Improvement from using Quadratic Instead of Linear Trends for ROE

	t+1	t+2	t+3	t+4
Panel A: All portfolio-year observations (340 = 34 years $\times$ 10 portfolios)				
Mean improvement	0.593	0.839	0.607	0.259
t-statistic for improvement	6.0	5.9	4.4	2.8
Panel B: Lowest ROE decile in year t (34 years)				
Mean improvement	3.647	4.972	3.524	1.615
t-statistic for improvement	7.9	6.9	4.1	2.6
Panel C: Highest ROE decile in year t (34 years)				
Mean improvement	2.668	3.664	2.978	0.943
t-statistic for improvement	8.1	6.9	5.3	2.0

ROE is calculated as comprehensive net income divided by common equity at the beginning of the year. The improvement is measured as the reduction in the absolute value of the difference between actual and fitted ROE from using quadratic instead of linear trends, and is expressed in percentage points. For example, the mean reduction in the absolute value of the difference between actual and fitted ROE in year t+1 is 3.647 percentage points for the low ROE portfolio (Panel B), 2.668 percentage points for the high ROE portfolio (Panel C), and 0.593 percentage points on average for all portfolios (panel A). Section 3.2 provides further details.

Table 3
Improvement from using Quadratic Instead of Linear Trends for Core ROE

	t+1	t+2	t+3	t+4
Panel A: All portfolio-year observations (340 = 34 years $\times$ 10 portfolios)				
Mean improvement	0.379	0.585	0.394	0.200
t-statistic for improvement	5.1	5.4	3.8	2.9
Panel B: Lowest Core ROE decile in year t (34 years)				
Mean improvement	2.491	3.038	2.043	0.974
t-statistic for improvement	7.1	5.1	3.1	2.3
Panel C: Highest Core ROE decile in year t (34 years)				
Mean improvement	1.846	2.680	1.951	0.796
t-statistic for improvement	5.6	5.4	4.0	2.0

Core ROE is calculated as core income divided by common equity at the beginning of the year. The improvement is measured as the reduction in the absolute value of the difference between actual and fitted Core ROE from using quadratic instead of linear trends, and is expressed in percentage points. Section 3.2 provides further details.

Table 4
Improvement from using Quadratic Instead of Linear Trends for Core ROE Analysis Partitioned on the Magnitude of Transitory Items, as Indicated by the Relationship between Core ROE and the Price-to-Book Ratio

Panel A: Small magnitude of transitory items

	t+1	t+2	t+3	t+4
All portfolio-year observations (340 = 34 years × 10 portfolios)				
Mean improvement	0.271	0.334	0.235	0.100
t-statistic for improvement	4.0	3.3	2.4	1.5
Lowest Core ROE decile in year t (34 years)				
Mean improvement	1.770	2.011	1.552	0.734
t-statistic for improvement	4.8	3.1	2.4	1.7
Highest Core ROE decile in year t (34 years)				
Mean improvement	1.567	2.221	1.535	0.560
t-statistic for improvement	4.9	4.4	3.0	1.5

Panel B: Large magnitude of transitory items

	t+1	t+2	t+3	t+4
All portfolio-year observations (340 = 34 years × 10 portfolios)				
Mean improvement	0.407	0.615	0.389	0.254
t-statistic for improvement	5.0	5.3	3.4	3.2
Lowest Core ROE decile in year t (34 years)				
Mean improvement	2.701	2.944	1.923	1.281
t-statistic for improvement	7.2	4.3	2.6	2.6
Highest Core ROE decile in year t (34 years)				
Mean improvement	1.879	2.964	2.133	0.973
t-statistic for improvement	5.4	6.6	3.9	2.2

Panel C: Differences in the magnitude of improvement – large versus small transitory items

	t+1	t+2	t+3	t+4
Mean	0.136	0.281	0.154	0.155
t-statistic	2.2	2.9	1.5	2.0

Core ROE is calculated as core income divided by common equity at the beginning of the year. The improvement is measured as the reduction in the absolute value of the difference between actual and fitted Core ROE from using quadratic instead of linear trends, and is expressed in percentage points. The magnitude of transitory items is assessed based on the relationship between Core ROE in year t and the price-to-book ratio at the beginning of that year. Section 3.2 provides further details.

Table 5
Improvement from using Quadratic Instead of Linear Trends for Core ROE
Analysis Partitioned on the Rate of Equity Investment

Panel A: Small investment

	t+1	t+2	t+3	t+4
All portfolio-year observations (340 = 34 years × 10 portfolios)				
Mean improvement	0.160	0.313	0.189	0.040
t-statistic for improvement	2.5	3.3	2.0	0.6
Lowest Core ROE decile in year t (34 years)				
Mean improvement	1.762	2.069	1.650	0.352
t-statistic for improvement	4.6	3.4	2.6	0.7
Highest Core ROE decile in year t (34 years)				
Mean improvement	0.575	1.647	1.017	0.177
t-statistic for improvement	1.7	4.1	2.1	0.5

Panel B: Large investment

	t+1	t+2	t+3	t+4
All portfolio-year observations (340 = 34 years × 10 portfolios)				
Mean improvement	0.512	0.725	0.479	0.239
t-statistic for improvement	6.0	5.8	4.1	2.8
Lowest Core ROE decile in year t (34 years)				
Mean improvement	2.760	3.229	1.905	0.649
t-statistic for improvement	7.4	4.7	2.6	1.2
Highest Core ROE decile in year t (34 years)				
Mean improvement	2.394	3.514	2.404	1.466
t-statistic for improvement	6.6	7.0	4.1	3.1

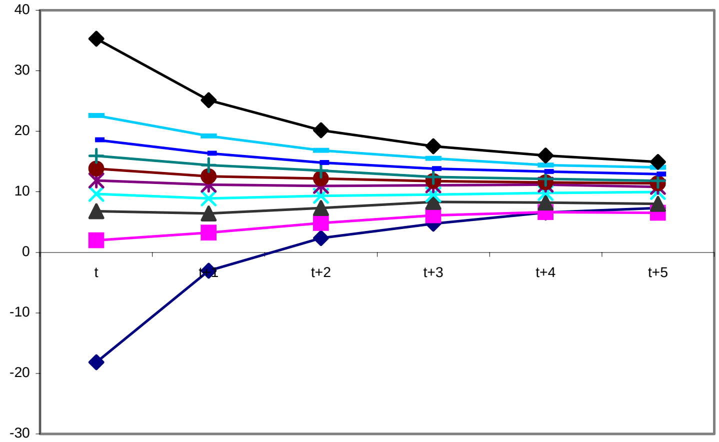
Panel C: Differences in the magnitude of improvement – large versus small investment

	t+1	t+2	t+3	t+4
Mean	0.352	0.412	0.290	0.199
t-statistic	5.1	4.5	2.9	2.2

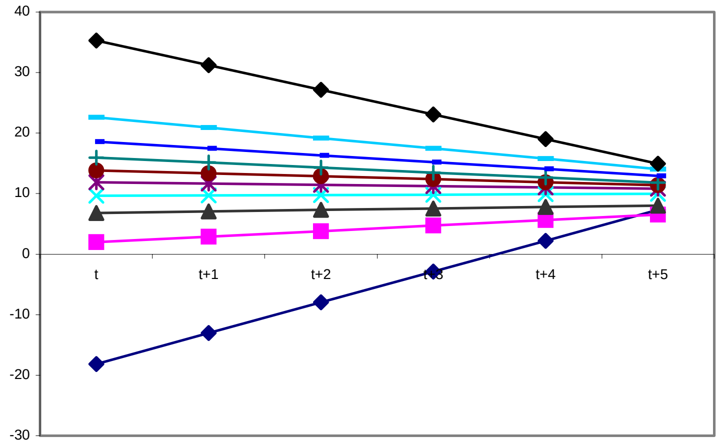
Core ROE is calculated as core income divided by common equity at the beginning of the year. The improvement is measured as the reduction in the absolute value of the difference between actual and fitted Core ROE from using quadratic instead of linear trends, and is expressed in percentage points. The magnitude of equity investment is measured by partitioning observations based on the median $DIVR_t$ within each ROE_t portfolio. Section 3.2 provides further details.

Figure 1
Convergence of ROE

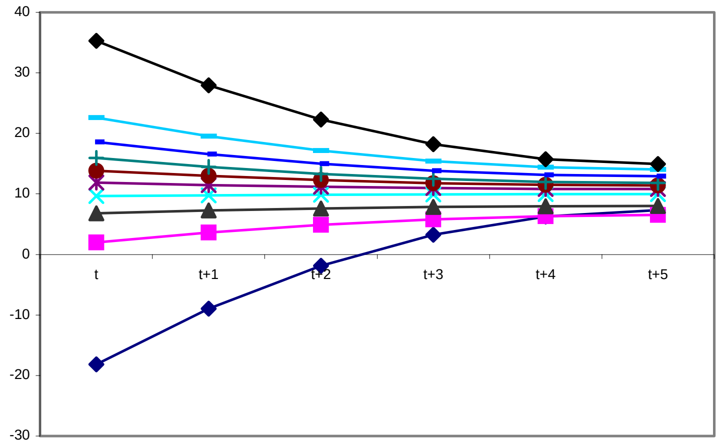
Panel A: Actual convergence



Panel B: Linear convergence



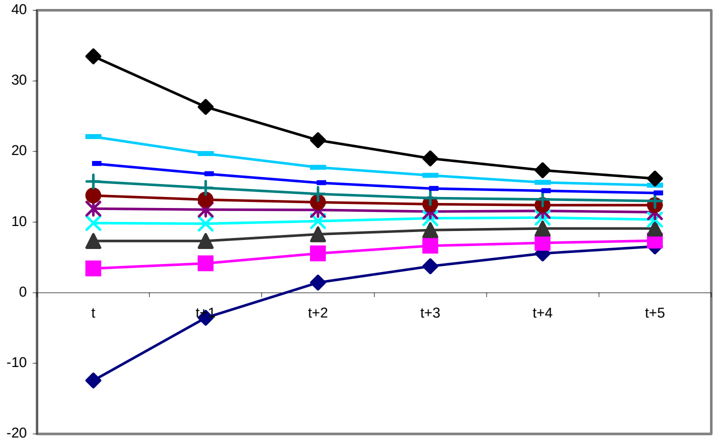
Panel C: Quadratic convergence



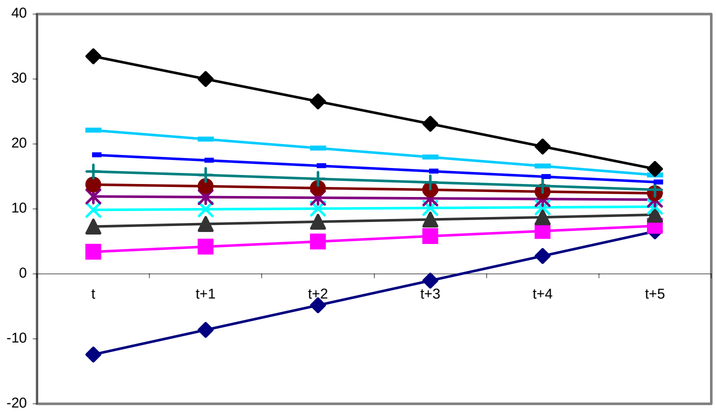
ROE is calculated as comprehensive net income divided by common equity at the beginning of the year.

Figure 2
Convergence of Core ROE

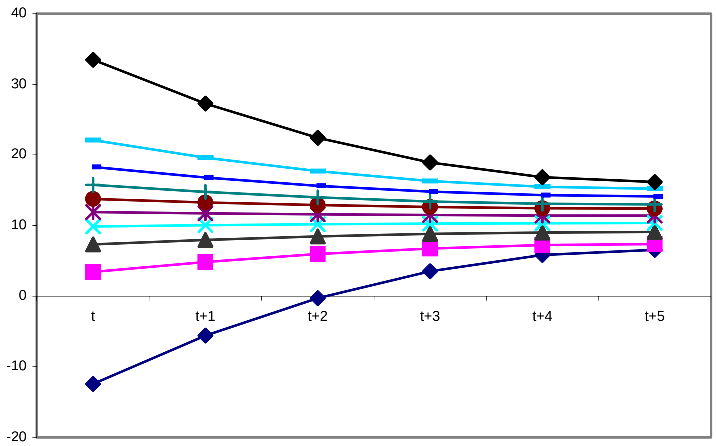
Panel A: Actual convergence



Panel B: Linear convergence



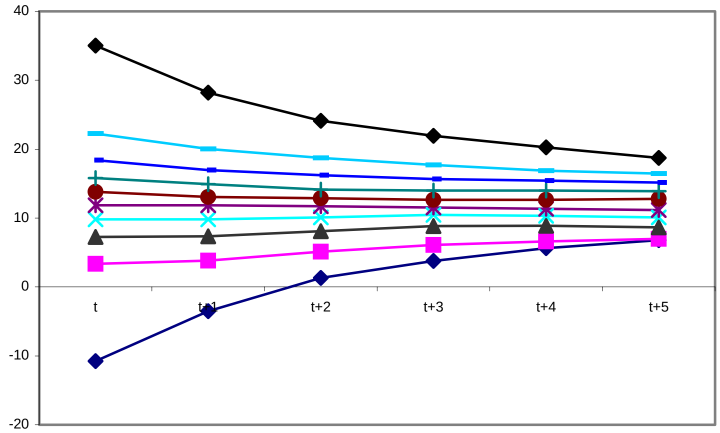
Panel C: Quadratic convergence



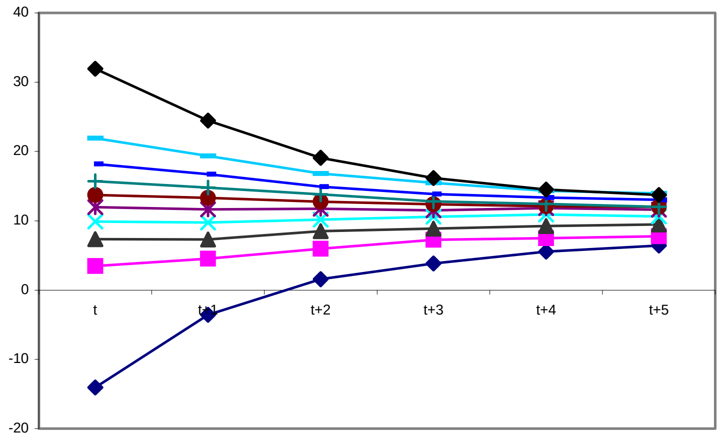
Core ROE is calculated as core income divided by common equity at the beginning of the year.

Figure 3
Convergence of Core ROE
Analysis Partitioned on the Magnitude of Transitory Items, as Indicated by the Relationship between Core ROE and the Price-to-Book Ratio

Panel A: Small magnitude of transitory items



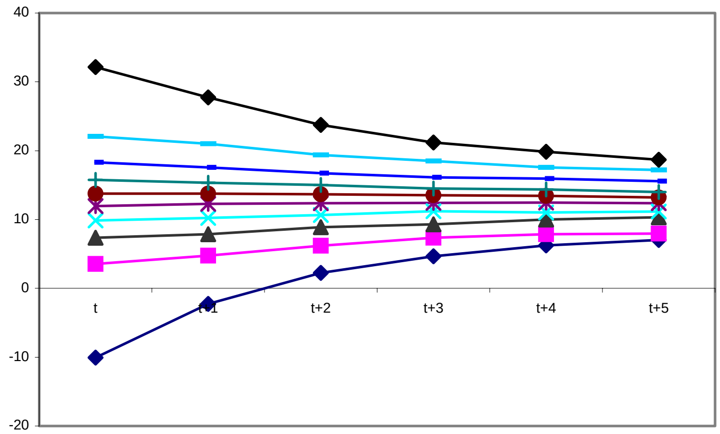
Panel B: Large magnitude of transitory items



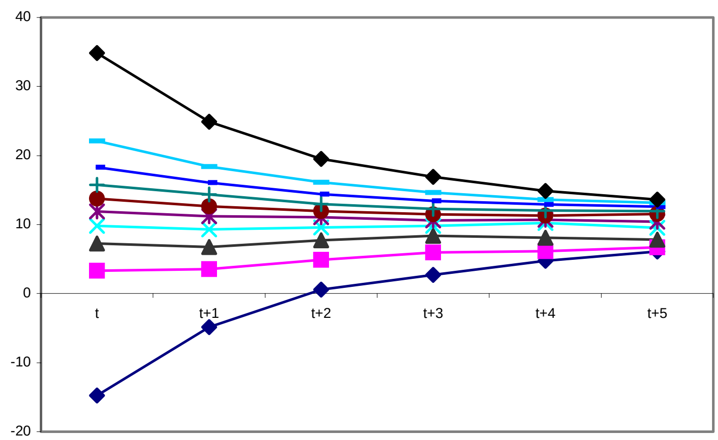
Core ROE is calculated as core income divided by common equity at the beginning of the year. The magnitude of transitory items is assessed based on the relationship between Core ROE in year t and the price-to-book ratio at the beginning of that year. Section 3.2 provides further details.

Figure 4
Convergence of Core ROE
Analysis Partitioned on the Rate of Equity Investment

Panel A: Small investment



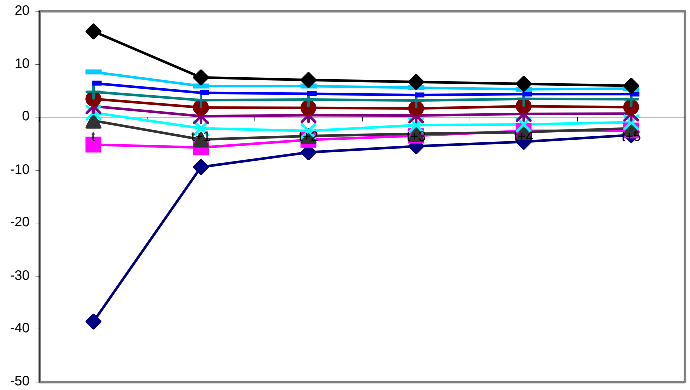
Panel B: Large investment



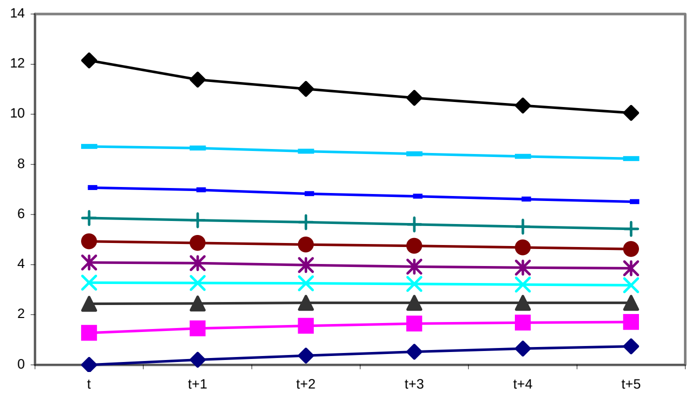
Core ROE is calculated as core income divided by common equity at the beginning of the year. The magnitude of equity investment is measured by partitioning observations based on the median $DIVR_t$ within each ROE_t portfolio. Section 3.2 provides further details.

Figure 5
Actual Convergence of DIVR and its Components

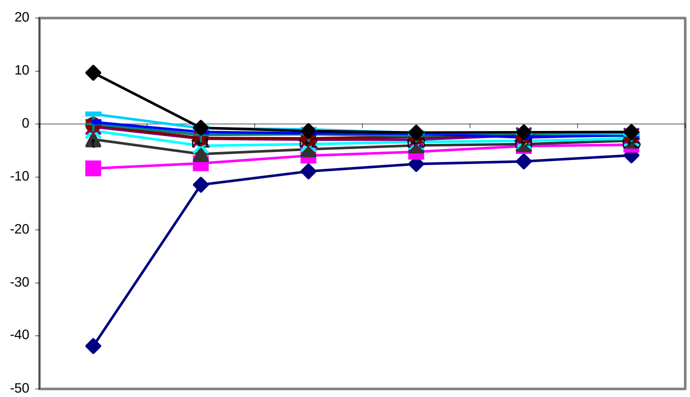
Panel A: DIVR



Panel B: DIVR1 (the dividend component of DIVR)*



Panel C: DIVR2 (the share transactions component of DIVR)



DIVR is the ratio of net dividends (dividends plus share repurchases and minus share issues) to common equity at the beginning of the year. DIVR1 is the ratio of common dividends to common equity at the beginning of the year. DIVR2, the share transactions component of DIVR, is calculated as the difference between DIVR and DIVR2.
* For DIVR1, the lowest portfolio includes all zero dividend observations (about 30.1% of the observations).