Residual income risk, intrinsic values, and share prices.

by Stephen P. Baginski and James M. Wahlen

Empirical accounting research provides surprisingly little evidence on whether accounting earnings numbers capture cross-sectional differences in risk that are associated with cross-sectional differences in share prices. We address two questions regarding the risk-relevance of accounting numbers: (1) Are accounting-related risk measures (i.e., the systematic risk and total volatility in a firm's time-series of residual return on equity) associated with the market's assessment and pricing of equity risk? (2) If so, then are these accounting-related risk measures incrementally associated with the market's assessment and pricing of equity risk beyond other observable factors, such as those in the Fama and French (1992) three-factor model?

We develop an accounting-fundamentals-based measure of the market's pricing of risk--the difference between actual share price and a residual income valuation model estimate of share value using risk-free rates of return. Our results show that both systematic risk and total volatility in residual return on equity partially explain this pricing differential, and that the explanatory power of total volatility is incremental to the Fama and French (1992) factors--market beta, firm size, and the market-to-book ratio.

Keywords: residual income; accounting risk measures; implied risk premium; equity valuation.

Data Availability: Data are commercially available from the sources listed in the text.

I. INTRODUCTION

Fundamental valuation of equity shares requires estimation of expected future payoffs and the risk inherent in those payoffs. Existing research on the usefulness of accounting earnings numbers has devoted far more attention to their role as payoff-relevant information than to their role as risk-relevant information. One exception is the seminal Beaver et al. (1970) study, which shows that accounting-based risk measures are positively associated with market model beta, but which does not examine whether accounting-based risk measures explain share prices or returns. Thus far, the empirical accounting research literature has surprisingly little to say about whether accounting earnings numbers capture cross-sectional differences in risk that are associated with cross-sectional differences in share prices. In this study, we investigate the risk-relevance of accounting numbers by addressing the question: Are accounting earnings-based risk measures associated with the capital market's assessment and pricing of firm risk? The answer to this question will inform capital markets participants, as well as accounting researchers and teachers, about the fundamental usefulness of accounting earnings numbers in assessing and pricing risk. The findings will also contribute to a better understanding of how to specify accounting earnings-based valuation models, and how to use them in settings in which market-based risk measures (e.g., market model beta) are not available.

We also address a second question: Are accounting earnings-based risk measures incrementally associated with the market's assessment and pricing of equity risk beyond other observable risk factors, such as the three factors in the Fama and French (1992) model (market model beta, firm size, and book-to-market ratios)? Research by Fama and French (1992) and others shows that the single factor capital asset pricing model may be incomplete because ad hoc factors outside of the model (including factors based on accounting numbers, such as the book-to-market ratio) appear to explain stock returns. Our investigation contributes evidence on whether accounting earnings-based risk measures capture elements of priced risk that traditional measures of equity risk (e.g., market model beta) or factors identified by more recent ad hoc approaches to risk (e.g., Fama and French 1992) do not capture.

Traditional theory on the role of accounting numbers in valuation, such as the residual income valuation models (e.g., Ohlson 1995; Feltham and Ohlson 1995), simplify the role of risk by assuming that investors are risk neutral and discount rates are nonstochastic and flat. More recently, Feltham and Ohlson (1999) point out that equity values should price as fundamental risk the nondiversifiable variability inherent in expected future residual income. Feltham and Ohlson (1999) demonstrate analytically that (at least in principle) one can incorporate risk in residual income valuation by reducing

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expected future abnormal earnings to certainty equivalents based on investors' risk aversion across all possible events and dates. (1) In this demonstration, Feltham and Ohlson (1999) measure abnormal earnings as earnings less a charge for the cost of equity capital, basing the charge on the book value of equity and the term structure of risk-free interest rates at the time of valuation. The pricing of risk therefore depends on the appropriate set of event-date-contingent prices for future abnormal earnings measured as certainty equivalents. The Feltham and Orison (1999) demonstration is silent, however, on how investors and empirical researchers should develop this complete set of event-date-contingent prices.

In the absence of implementable theoretical guidance, empirical applications of residual income valuation models have incorporated risk into valuation by adding an ad hoc risk premium to a risk-free discount rate, with results that are understandably sensitive to the risk premium assumption (e.g., Bernard 1994, 1995; Francis et al. 2000, 2001; Dechow et al. 1999). Other recent studies invert the residual income valuation model to estimate the ex ante risk premia implicit in discount rates, with mixed results (e.g., Claus and Thomas 2001; Gebhardt et al. 2001; Easton et al. 2000; Botosan and Plumlee 2001, 2002). All of these prior studies use observed share values or stock returns to estimate the risk premia and expected rates of return required by valuation models. Using observed share values or stock returns to assess risk introduces a degree of circularity into valuation.

We develop a more direct approach that uses accounting numbers to assess firm risk and share values in a residual income valuation context. First, we develop an accounting-based measure of the discount for risk inherent in share prices. We estimate risk-free value based on the residual income model, analysts' forecasts of earnings, and prevailing risk-free rates of return. We then calculate the price differential--the risk-free value estimate minus share price. Conceptually, the price differential is a simple yet theoretically defensible measure of the discount for risk implicit in share price. This measure depends only on analysts' expectations of earnings, the residual income valuation model, time value of money at prevailing risk-free rates, and share price. The price differential is a potentially appealing firm-specific measure of the cost of risk because it does not depend on any functional form of expected returns, or on explicit parameter estimates of market risk measures (i.e., betas) or risk premia. As expected, price differentials are positive for nearly all firm-years because risk-free values ignore the discounts for risk in share prices. As a practical matter, our estimates of price differentials are highly positively correlated with estimates of expected rates of return implicit in share prices, but are simpler to compute.

We next measure systematic risk and total volatility inherent in the time-series of abnormal return on equity (abnormal ROE) computed as return on book value of equity minus the prevailing risk-free interest rate, thereby isolating the measurement of abnormal ROE from the measurement of risk. (2) We measure systematic risk in residual income as abnormal ROE beta estimated using a regression of each firm's abnormal ROE on a sample-wide index of abnormal ROE, analogous to the accounting earnings beta in Beaver et al. (1970). (3) We also examine the total volatility in residual income using the standard deviation of abnormal ROE over time, because prior research has shown that total volatility in earnings is a proxy for risk (Beaver et al. 1970).

We test whether systematic risk and total volatility in residual income explain the cross-section of price differentials. If price differentials capture the fundamental discount for risk in share prices, and if abnormal ROE beta and/or the standard deviation of abnormal ROE are reliable surrogates for priced risk factors, then we expect price differentials to increase with residual income risk.

Consistent with our hypothesis, results from portfolio and univariate regression tests show that abnormal ROE beta and total volatility in abnormal ROE are significantly positively related to price differentials. The portfolio test results indicate that such differentials can be economically large relative to share prices. However, although abnormal ROE beta is positively and significantly associated with price differentials in most sample years, it provides relatively little explanatory power for price differentials (often less than 1 percent). In contrast, total volatility in abnormal ROE is more strongly and positively related with price differentials in nearly all sample years. Overall, the results validate that capital markets participants and researchers can use accounting numbers together with the residual income valuation model to measure firm risk and the discount for risk implicit in share price. The findings suggest that capital markets participants and researchers can implement residual income valuation by directly assessing risk inherent in residual income, avoiding the circularity inherent in stock-market-based risk measures. Our evidence also suggests that when the data necessary to compute market-based risk measures (e.g., the three Fama and French [1992] factors) are not available (e.g., privately held firms or initial public offerings), total volatility in abnormal ROE is a useful risk proxy in valuation.

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In multiple regressions of price differentials on risk factors, we find that the capital markets price abnormal ROE beta incrementally to the three factors in the Fama and French (1992) model and to controls for potential measurement error in price differentials (long-run earnings growth and analysts' forecast errors), but only in three of nine sample years. On the other hand, we find the capital markets price total volatility in abnormal ROE incrementally to the three factors in the Fama and French (1992) model and the measurement error controls in six of nine sample years, and total volatility in abnormal ROE provides the most explanatory power of all the risk measures for price differentials. Despite the fact that we do not measure total volatility in abnormal ROE using explicit systematic risk factors, it nevertheless captures the market's pricing of systematic risk factors, including risk factors beyond the Fama and French (1992) three-factor model.

In supplemental analyses, we compare the share price implications of our two measures of residual income risk against analogous risk measures based on reported net income. Not surprisingly, we find that the risk measures based on either reported income or residual income serve equally well as risk proxies for purposes of residual income valuation. Residual income risk measures are highly positively correlated with reported income risk measures, and both provide comparable explanatory power for price differentials.

Our measure of price differential is a conceptually sound, computationally simple, and empirically valid accounting-based measure of the discount for risk implicit in share price. We find that price differentials are related to our two measures of residual income risk, market model beta, and the other two Fama and French (1992) risk factors. The price differential measure of the discount in share prices for risk may be useful in future empirical accounting research, and in teaching courses in financial statement analysis and valuation.

We have organized the paper as follows. In Section II, we motivate our hypothesis by describing the accounting earnings valuation model, the role of residual income risk in the model, and the existing empirical evidence on risk from applications of the model. In Section III, we describe our empirical methodology, including our two measures of residual income risk and our measure of price differentials. We describe the results in Section IV, and offer concluding remarks and implications in Section V.

II. THE ACCOUNTING EARNINGS VALUATION MODEL AND RISK

Classical valuation theory describes share values as the present value of all expected future dividends to investors from the outcomes of the firm's operating and investing decisions, priced to reflect nondiversifiable risk. Research in finance and accounting commonly uses proxies for expected future dividends in assessing risk and estimating share values. For example, researchers typically use stock returns as proxies for changes in market expectations of future dividends in the assessment of nondiversifiable risk, and earnings and cash flows as proxies for dividends as the relevant payoffs to shares.

Preinreich (1938), Edwards and Bell (1961), Peasnell (1982), Ohlson (1995), and others show that, as long as forecasts of earnings, book values, and dividends follow clean surplus accounting, the dividend valuation model is equivalent to the residual income valuation model:

$$(1)\quad V_t = B_t + \sum_{i=1}^{\infty} E_t[X_{t+i} - rB_{t+i-1}] / (1+r)^i$$

where V_t denotes share value at time t, B_t denotes accounting book value of equity per share at time t, E_t represents the expectations operator as of time t, X_{t+i} represents earnings per share in period t + i, and r denotes the required rate of return. This formulation shifts the valuation focus away from wealth distribution (dividends) to wealth in place (book values) and wealth creation (future abnormal earnings.)

Ohlson (1995) and Feltham and Ohlson (1995) assume risk neutrality and homogeneous expectations; thus r is a nonstochastic and flat risk-free rate of return. Feltham and Ohlson (1999) illustrate a general approach to incorporate risk in residual income valuation by reducing the distribution of expected future abnormal earnings to certainty equivalents, which are priced based on event-date-contingent prices that span all conceivable future abnormal earnings outcomes. Such certainty equivalent adjustments include discounts for risk insofar as the event-date-contingent prices depend on the way abnormal earnings covary with economy-wide risk factors. Feltham and Ohlson (1999) also show that, under a certainty equivalent approach, abnormal earnings should include a charge for equity capital based on the spot risk-free rates implicit in the (not necessarily flat) term structure of interest rates at the time of valuation. (4) Empirical tests of such

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a formulation, however, require that the researcher specify a utility function that captures investors' risk aversion in order to price all possible date- and time-contingent abnormal earnings outcomes, a task that has so far defied empirical application.

Ohlson (1995, 680) notes that one way to incorporate risk in empirical applications of the model is to replace the risk-free rate with a risk-adjusted expected return. Accordingly, most prior empirical studies of the properties of residual income model value estimates have assumed cross-sectionally constant discount rates based on prevailing risk-free rates plus an ex post market risk premium estimate, usually on the order of 6 or 7 percent (e.g., Bernard 1994, 1995; Francis et al. 2000, 2001; Dechow et al. 1999). Ohlson (1995) observes that this approach is practical, but that it lacks theoretical foundation because it is silent about the source of the risk. Risk adjustments should depend on the nondiversifiable risk inherent in future abnormal earnings (or equivalently, future earnings, dividends, and book values).

A number of recent studies invert the residual income valuation model to infer risk premia and discount rates conditional on share prices, book values, and analysts' earnings expectations. Claus and Thomas (2001) and Gebhardt et al. (2001) obtain results that suggest that discount rates and risk premia are lower than those implied by historical data on realized returns. On the other hand, Botosan and Plumlee (2001, 2002) obtain results indicating implicit discount rates that are high relative to historical realized returns. Easton et al. (2000) point out that implied discount rates estimated by inverting the residual income valuation model depend on the assumed rate of growth in terminal-year residual income. If terminal-year growth assumptions are too low, then the implied discount rate estimates will also be too low, and vice versa. Therefore, Easton et al. (2000) invert the residual income model and estimate simultaneously the implicit discount rates and terminal-year residual income growth rates. Their implicit discount rate estimates are consistent with historical stock returns, averaging 13 percent over their 1981-1998 sample period. They also find that implicit growth rates in terminal-year residual income are much higher than assumed in prior research, averaging 10 percent over their sample period.

These ex post and ex ante approaches to estimate discount rates and share values are circular, however, relying on observed share prices to infer the discount rates required to value shares. We develop a more direct approach based on the fundamental notion of using accounting numbers to measure risk and to determine share values. We also extend Beaver et al. (1970) by directly examining how residual income-based risk measures are associated with share prices. As noted earlier, the residual income model shifts the focus of valuation to wealth creation; we therefore focus on the risk inherent in wealth creation (residual income).

To measure the discount for risk implicit in share prices, we first compute risk-free value based on the residual income model using book values of equity, analysts' consensus expectations of future earnings, and prevailing risk-free rates of return. We then compute the price differential as the risk-free value estimate minus share price. The price differential is the market's discount for risk because it measures the difference between share value in a hypothetical risk-neutral market and observed share price. This measure depends only on analysts' expectations of earnings, the residual income valuation model, time value of money at risk-free rates, and share price.

We predict that price differentials increase with the risk inherent in residual income. We therefore develop and test two measures of residual income risk. First, the pricing of abnormal earnings should depend on the way abnormal earnings covary with systematic risk factors (Feltham and Ohlson 1999). Our first estimate of firm-specific systematic risk is an abnormal ROE beta, which we obtain by regressing abnormal ROE on a sample-wide index of abnormal ROE. Our measure of abnormal ROE beta is analogous to the earnings beta in Beaver et al. (1970).

Second, because other single-factor models of risk are incomplete (e.g., the single-factor capital asset pricing model), and because prior empirical work has shown that total variability in net income is a surrogate for risk (e.g., Beaver et al. 1970), our second estimate of firm-specific systematic risk is the total variability in residual income, measured as the standard deviation in the time-series of abnormal ROE. A limitation of this volatility-based risk measure is that it represents total rather than nondiversifiable risk. We nevertheless investigate this risk measure for practical reasons. As Beaver et al. (1970) note, estimates of systematic risk (whether based on stock returns or earnings) suffer from estimation error. Our tests should indicate whether the standard deviation in abnormal ROE, which is simple to estimate and requires less data than covariation-based measures of risk, is sufficient (i.e., does not lose information) for empirical applications of the residual income model.

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If the capital markets price residual income risk and if abnormal ROE beta and the standard deviation of abnormal ROE capture such risk, then price differentials should increase across firms as residual income risk increases, all else held constant. More formally, we test the following hypothesis (stated in alternative form):

H1: Price differentials are increasing in abnormal ROE beta and the standard deviation in abnormal ROE, ceteris paribus.

The capital asset pricing model uses the covariation of stock returns with nondiversifiable, economy-wide risk factors to assess risk. Risk assessment based on covariation between systematic risk factors and either stock returns or accounting-earnings-based returns (i.e., abnormal ROE) are parallel in principle, but differ significantly in implementation. For example, our measures of abnormal ROE beta and total volatility in abnormal ROE lack precision, in part because firms report earnings infrequently (i.e., quarterly and annually). This lack of precision reduces the power of our tests of the pricing implications of accounting-based risk measures.

An even more serious concern is that residual income-based risk measures are imprecise because they are determined by the information that the accounting process recognizes in earnings and book values. By contrast, risk measures based on stock returns have an information advantage, insofar as share prices impound all value-relevant information. In addition, residual income risk measures may suffer from measurement error if the accrual accounting process imperfectly matches economy-wide risk factors with reported profits at the firm level. This could occur for any number of reasons, including conservatism (which, in some circumstances, delays recognition of good news), arbitrary cost allocation processes (e.g., straight-line depreciation of long-lived tangible assets or goodwill amortization), and earnings management.

On the other hand, accrual accounting may have certain information advantages for measuring risk. The accounting system aggregates the effects of transactions over time into periodic measures of quarterly or annual performance, which capture the extent to which the effects of risk are (or are not) diversified over time within each accounting period. (5) Earnings numbers measure the aggregate results of the firm’s operating and investing activities each period, so the time-series of earnings should reflect the fundamental, long-run risk and volatility inherent in the firm’s operations and investments. In addition, accrual accounting filters the effects of certain types of noise that influence stock-return-based measures of risk, stemming from excess volatility in returns (e.g., for glamour stocks), or temporary movements of prices away from fundamentals (e.g., noise trading, excessive exuberance, or the stock bubble in the late 1990s.)

Ultimately, the question of whether residual-income-based risk measures are economically meaningful measures of risk must be settled with empirical data. Therefore, we compare the pricing implications of residual income risk measures to the pricing implications of systematic risk in stock returns. We also test whether the capital markets price our two measures of residual income risk incrementally to the three Fama and French (1992) risk factors: market model beta, firm size, and book-to-market ratios.

III. EMPIRICAL METHODOLOGY

In this section we describe our sample selection and data collection. We also describe our key variables and discuss statistics that describe our sample data.

Sample Selection and Data Collection

Our sample of firms is the intersection of the I/B/E/S, CRSP, and Compustat Primary, Supplementary, Tertiary, and Research databases meeting the following requirements, applied yearly from 1990 to 1998:

1. From I/B/E/S (collected each April), consensus analysts’ forecasts of one-year-ahead and two-year-ahead earnings per share and three- to five-year earnings growth, actual earnings per share, April 1 price, and dividends; in addition, consensus forecasts of two-year-ahead earnings per share must be positive;

2. From Compustat, a complete set of book values of common equity, annual earnings per share, and numbers of shares outstanding for the ten consecutive years prior to each valuation date; and

3. From CRSP, sufficient data to compute firm-specific betas from five years of monthly returns preceding each valuation

date.

The sample meeting these requirements ranges from 665 firms in 1990 to 1,073 firms in 1998. The most restrictive sample requirement is that firms must have earnings forecast data available on I/B/E/S, which limits the sample to only those firms followed by analysts and by I/B/E/S, and therefore slants our sample toward larger firms. Requiring that two-year-ahead earnings forecasts be positive eliminates an average of only six firms per year among the set of firms covered by I/B/E/S. Collectively, our data requirements (particularly the requirement for ten consecutive years of data on Compustat) create the potential for survivorship bias. (6) Thus, our inferences may or may not generalize to younger firms, or to firms not followed by analysts.

Price Differentials from the Omission of Risk Premia

To test the pricing implications of residual income-based risk measures, we first measure the price differential for each sample firm-year as risk-free value ([RFV.sub.it]) from applying the residual income valuation model using the risk-free rate of return as the discount rate, minus observed share price ([P.sub.it]). Risk-free value is an estimate of firm value, assuming that investors are risk-neutral, and therefore, do not price risk.

We estimate [RFV.sub.it] by modifying Equation (1) in two ways. First, in order to isolate the effects of risk from the estimation of risk-free value, we substitute the risk-free rate of return ([r.sub.f]) for the required rate of return (r). (7) Thus, we use a risk-free rate to define abnormal earnings and discount them to present value. Second, to apply Equation (1) we must obtain expectations of earnings and book values over a finite forecast horizon and make assumptions about terminal value at the end of that horizon. To obtain earnings expectations we use I/B/E/S mean financial analysts' earnings per share forecasts for one and two years ahead, and we compute earnings expectations for years 3 through 5 by applying I/B/E/S analysts' consensus three- to five-year earnings per share growth rate estimates to their two-year-ahead forecasts. To avoid the unrealistic assumption of long-run negative earnings expectations, we eliminate firms with negative two-year-ahead earnings forecasts. To compute terminal value, we assume that the long-run nominal rate of growth in abnormal earnings (g) beyond year 5 equals 3 percent, the approximate long-run inflation rate. We compute terminal value as the present value of a growing perpetuity beginning with year 5 residual income. That is, we discount year 5 residual income using ([r.sub.ft] - g), which is the contemporaneous, nominal, ten-year risk-free rate in period t ([r.sub.ft]) less 3 percent. Our assumptions yield values of ([r.sub.ft] - g) that are consistent with (but not equivalent to) the annual sample average estimates of (r - g) in Easton et al. (2000) for the years in which our samples overlap (1990-1998). (8) In addition, we estimate future book values of equity for each firm by projecting that the firm will maintain the dividend payout policy in year t (e.g., dividends paid as a percentage of earnings in year t) over the five-year forecast horizon. (9) We also assume that any additional share issues or repurchases over the horizon have neutral implications for abnormal earnings and that we can therefore safely omit them. Thus, we estimate [RFV.sub.it] using the following equation:

(2) [RFV.sub.it] = Bt + 4[summation over (i = 1)][E.sub.t][[X.sub.t + i] - [r.sub.ft][B.sub.t + i - 1]] / (1 + [[r.sub.ft]).sup.i] + [E.sub.t][[X.sub.t + 5] - [r.sub.ft][B.sub.t + 4]] / ([r.sub.ft] - g)[(1 + [r.sub.ft]).sup.4]

We compute price differentials (PDIFFit) as:

(3) [PDIFF.sub.it] = [RFV.sub.it] - [P.sub.it],

where [P.sub.it] is the price per share for firm i as of April 1 of each sample year for which we have analysts' earnings forecast data. Given that RFV omits the effect of risk on share price, PDIFF should be positive.

Table 1 provides annual sample averages of the inputs into the residual income valuation model (Panel A) and the resulting outputs from the valuation model (Panel B). Panel A indicates that average book values per share for our sample firms declined steadily from $19.95 to $14.18 per share over 1990 to 1998, despite the decline in average dividend payout rates from 58 percent to 29 percent during that time. We use I/B/E/S earnings forecasts over the five-year valuation horizon to compute expected future ROE as year t expected earnings divided by year t - 1 expected book value of equity. Averaging across the nine years of this study, these data indicate that expected ROE increases over the five-year forecast horizon, from an average of 12.2 percent for one-year-ahead forecasts to an average of 14.1 percent for five-year-ahead forecasts. The increase in average expected ROE over the five-year horizon suggests that analysts commonly expect future earnings to grow at a faster rate than book value of equity. In addition, analysts' expectations for future ROE over

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each of the five-year forecast horizons steadily trended upward over the sample period, from an average of roughly 11 percent in 1990 to roughly 17 percent in 1998. Concurrently, risk-free rates fell from 8.8 percent in 1990 to 5.6 percent in 1998. The six rightmost columns of Panel A report the mean forecasts of abnormal ROE, computed as forecasts of ROE minus the prevailing risk-free rates. These data show a dramatic increase in mean expected abnormal ROE over the study period, from 2.2 percent in 1990 to 11.3 percent in 1998.

As shown in Table 1, Panel B, risk-free values and share prices also increased from 1990 to 1998. This is not surprising, in light of the increasing expected abnormal ROE during this period. As expected, the sample average PDIFF is positive each year. In 1990 to 1992 when the average expected abnormal ROE is less than 4 percent per year, the average PDIFF is between $6 and $11. In 1996 to 1998, when the average abnormal ROE is 8 percent or more, the average PDIFF climbs to between $22 and $47.

The pricing differentials (PDIFF) reported in Table 1, Panel B, might seem large relative to observed prices, especially in later years. To calibrate the reasonableness of our PDIFF estimates, we compute the expected risk premia that the PDIFF estimates imply for each firm-year. PDIFF is isomorphic to the present value of the difference between the risk-free interest rate and the implicit risk-adjusted expected return for each firm (i.e., the risk premium implicit in expected returns). Therefore, we first estimated the implicit expected return in share price by solving for the discount rate necessary to equate RFV to PRICE (i.e., to set PDIFF = 0). We then computed the expected risk premium implied by each PDIFF by subtracting the risk-free rate from the implicit risk-adjusted expected return estimate. The final column in Table 1, Panel B reports that the annual mean risk premium implied by each PDIFF ranges from 1.7 percent to 3.3 percent over our sample years, with a mean of 2.7 percent. Our mean implied risk premium is identical to the mean reported in Gebhardt et al. (2001) for the 1975-1995 period, and is slightly below the mean 3.4 percent reported by Claus and Thomas (2001) for our sample years. Claus and Thomas (2001) impose fewer data restrictions, and their sample includes smaller firms on average, so one would expect a slightly larger risk premium for the firms in their sample. The mean annual correlation between the estimates of implied risk premia and PDIFF is 0.88. Although the PDIFF and the implied risk premia estimates are not independent (both sets of estimates are based on the same models, the same analysts' forecasts, etc.), the implied risk premia estimates provide some calibration that the magnitudes of PDIFF are consistent with the magnitudes of risk premia observed in Gebhardt et al. (2001) and Claus and Thomas (2001). (10)

Two Residual Income-Based Risk Measures

Our first residual income-based risk measure is the systematic risk in abnormal ROE (i.e., abnormal ROE beta), which we estimate as the covariation between abnormal ROE and a sample-wide index of abnormal ROE, analogous to the accounting earnings beta in Beaver et al. (1970). For each firm-year observation, we regress abnormal ROE (denoted AROE) on an equally weighted sample average abnormal ROE (denoted AvgAROE) over the rolling ten-year window preceding the date on which we compute risk-free value:

(4) $AROE_{it} = a_0 + \beta_{AROE} \times AvgAROE_t + e_{it}$.

The coefficient estimate β_{AROE} is our proxy for systematic risk in abnormal ROE for each firm-year for which we have sufficient data. We imply subscripts i and t on each risk measure, but we drop them to streamline exposition. (11)

Our second residual income-based risk measure is the total risk in residual income, which we measure as the standard deviation of abnormal ROE (denoted σ_{AROE}) over the ten years prior to each risk-free value calculation. (12) We base our estimates of β_{AROE} and $\sigma AROE$ on only ten annual observations, and the limited time-series diminishes the power of our tests to detect their pricing implications. Based on our hypothesis, we expect PDIFF to be positively associated with β_{AROE} and σ_{AROE}.

Additional Risk Factor Measures

We use market model beta as the primary benchmark for our residual income-based risk measures. We compute market model beta (denoted β_{RET}) using a standard market model and an equally weighted market index, based on the 60 monthly returns preceding each risk-free value calculation. We expect PDIFF to be positively related to β_{RET} because it is the traditional measure of systematic equity risk.

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We also use the other two factors in the Fama and French (1992) three-factor model (firm size and the book-to-market ratio) as benchmarks for our residual income risk measures. As in Fama and French (1992), we measure size as the natural log of market value of equity (denoted LNSIZE) as of the beginning of each year. We measure the book-to-market ratio as the natural log of the ratio of book value of equity divided by the market value of equity (denoted LNBM) as of the beginning of each year. If PDIFF measures the cost of risk, then we expect PDIFF to be negatively related to LNSIZE and positively related to LNBM, ceteris paribus, consistent with Fama and French (1992).

Controls for Potential Sources of Measurement Error in PDIFF

Each set of assumptions we use to compute RFV (analyst forecasts, terminal value growth rates, and dividend payout) creates potential measurement error. If measurement error occurs in RFV (e.g., analysts forecast earnings with a bias), and the same error occurs in PRICE (i.e., investors forecast earnings with the same bias), then the differencing process (RFV - PRICE = PDIFF) removes the error. For additional tests of the robustness of the pricing implications of our two residual income risk measures, we control for measurement error that might exist differentially in RFV and PRICE.

Analyst Forecast Errors

Prior research has detected an optimism bias in analysts' earnings forecasts, particularly for longer-term forecasts of annual earnings (e.g., McNichols and O'Brien 1997). Upwardly biased analyst forecasts increase RFV. If share prices reflect less optimism bias than analysts' earnings forecasts, then PDIFF is biased upward as well. (13) Our tests might be confounded if our risk factors are associated with the analyst forecast errors that introduce measurement error in PDIFF. To assess the effect of analyst forecast errors on our results, we control for the combined errors in one- and two-year-ahead forecasts for each firm-year (denoted AFE). (14)

Terminal Value Growth Assumption

Our assumption that residual income grows 3 percent per year after year 5 could introduce error into PDIFF if market prices are based on different growth assumptions. Cross-sectional differences in expected long-run growth are likely to be positively related to risk. Therefore, our tests of the association between PDIFF and residual income risk measures could be confounded if PDIFF and our risk measures both capture cross-sectional differences in expected earnings growth. (15) To control for this potential measurement error, we also include expected future earnings growth (denoted GROWTH), measured as I/B/E/S analysts' consensus forecasts of three- to five-year earnings growth.

Dividend Payout Assumption

We assume that each firm's dividend payout rate remains constant, which could cause measurement error in PDIFF if market prices are based on expected changes in dividend payout rates. This assumption is likely to introduce less measurement error than the other two sources, given that most firms maintain stable dividend payout rates, so we do not explicitly control for expected changes in dividend payout. (16)

Descriptive Statistics

Table 2 contains descriptive statistics for our two measures of residual income risk, [[beta].sub.AROE] and [[sigma].sub.AROE], as well as our primary benchmark risk measure, [[bata].sub.RET]. Mean (median) [[beta].sub.RET] is approximately 1 during the years 1990 to 1992, but then drops to less than 0.80 in 1993 and years after. (17) Median [[beta].sub.AROE] exhibits a more gradual downward trend from 0.84 in 1990 to 0.60 in 1998. Mean [[beta].sub.AROE] equals 1 by construction. The mean (median) [[sigma].sub.AROE] gradually increases from 0.08 (0.06) in 1990 to 0.10 (0.08) in 1998. Of the three risk measures, [[beta].sub.AROE] exhibits the greatest degree of in-sample dispersion. For example, in most sample years (except for 1998), the cross-sectional standard deviation of [[beta].sub.AROE] is roughly four times greater than that of [[beta].sub.RET]. Interestingly, Beaver et al. (1970, 667) make the same observation, even though their accounting beta is based on total (not abnormal) earnings and their sample period (1947-1965) precedes ours by at least 25 years.

Spearman rank correlations among [[beta].sub.RET], [[beta].sub.AROE], and [[sigma].sub.AROE] (not tabulated) indicate that our residual income risk measures are related to but are not substitutes for market model beta. The correlations

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between [[sigma].sub.AROE] and [[beta].sub.RET] are statistically significantly positive (at $p < 0.05$) in six out of nine years, although the correlations are modest, ranging from 0.06 (1998) to 0.11 (1997). These low correlations suggest that [[beta].sub.RET] and [[beta].sub.AROE] are not close substitutes. The correlations between [[sigma].sub.AROE] and [[beta].sub.RET] are statistically significantly positive each year and average 0.35, suggesting the two risk measures capture similar but not identical factors. Not surprisingly, the correlations between [[sigma].sub.AROE] and [[beta].sub.AROE] are significant and positive each year. A curious result in these correlations (and in the analogous correlations reported in Beaver et al. [1970]) is that [[sigma].sub.AROE] is uniformly more positively associated with [[beta].sub.RET] than with [[beta].sub.AROE].

IV. TESTS AND RESULTS

We assess the share price implications of our three risk measures with a series of portfolio and regression tests. In this section we describe these tests and the results.

Portfolio Analysis

In H1 we predict that PDIFF increases as residual income risk increases, all else equal. As a preliminary analysis, we group our sample firms into ten portfolios each year based on deciles of [[beta].sub.AROE] and [[sigma].sub.AROE]. TO measure the magnitude of the average risk-related discount implicit in share price across deciles of [[beta].sub.AROE] and [[sigma].sub.AROE], we computed mean PDIFFs for each decile for each year, 1990 to 1998. Grouping firms into deciles limits the power of statistical tests by collapsing hundreds of firms into ten portfolios each year. Moreover, these portfolio tests do not control explicitly for potentially confounding covariates (e.g., potentially correlated measurement error in PDIFF). Despite these limitations, we report the portfolio test results because the decile mean PDIFFs provide some insight into the likely magnitude (in dollars per share) of the effect of residual income risk on share prices. Prior studies report cross-sectional averages of implied rates of return or risk premia, but they do not provide dollar estimates of the economic effects of ignoring risk (e.g., Claus and Thomas 2001; Gebhardt et al. 2001).

Table 3 reports the median [[beta].sub.AROE] and [[sigma].sub.AROE] for each decile across all nine sample years and the across-year average PDIFF for each annual decile mean (in dollars per share). The results in Table 3, Columns 2 and 3 indicate that, averaging across years, the mean PDIFF is $18.64 for the firms in the lowest [[beta].sub.AROE] decile, and $27.40 for firms in the highest [[beta].sub.AROE] decile (nearly 47 percent larger). These magnitudes indicate that if the average stock in the lowest [[beta].sub.AROE] decile has the sample mean share price of $24.31 (see Table 1, Panel B), then it would be priced at $42.95 in a hypothetical environment in which investors are risk-neutral and all else is held equal. Likewise, the average stock in the highest [[beta].sub.AROE] decile would be priced at $51.71. Consistent with our expectations that price differentials are increasing in [[beta].sub.AROE], the Spearman rank correlation between decile ranks of [[beta].sub.AROE] and decile mean PDIFF is 0.79 ($p < 0.005$). In eight out of nine years (1990 is the exception), the Spearman rank correlations between decile ranks of [[beta].sub.AROE] and mean PDIFF are positive and significant at $p < 0.10$ or better (not tabulated). (18)

The results in Table 3, Columns 4 and 5 show that the mean PDIFF across years for the lowest [[sigma].sub.AROE] decile firms is $14.05, whereas it is $21.59 for the highest [[sigma].sub.AROE] decile firms (more than 53 percent larger). Consistent with price differentials increasing in [[sigma].sub.AROE], the Spearman rank correlation between decile ranks of [[sigma].sub.AROE] and decile mean PDIFF is 0.81 ($p < 0.005$). In addition, in every sample year, the Spearman rank correlation between decile ranks of [[sigma].sub.AROE] and decile mean PDIFF is positive and significant at $p < 0.05$ or lower (not tabulated).

Regression Tests

We estimate a series of annual cross-sectional regressions to test whether PDIFF is positively associated with [[beta].sub.AROE] and [[sigma].sub.AROE]. We first estimate univariate regressions of PDIFF on the ranks (within each sample year) of each residual income risk measure. We also estimate univariate regressions of PDIFF on ranked [[beta].sub.RET] to benchmark the explanatory power of [[beta].sub.AROE] and [[sigma].sub.AROE]. The univariate regressions take the form:

(5) [PDIFF.sub.it] / [P.sub.it] = a + c[RiskMeasureRank.sub.it] + [e.sub.it],

where [RiskMeasureRank.sub.it] denotes the annual within-sample rank of the risk factor regressor (Rank[[beta].sub.AROE], Rank[[sigma].sub.AROE], or Rank[[beta].sub.RET]), for firm i in year t. We use the within-sample rank of each risk measure (rather than the estimated value of each risk measure) to mitigate the effects of measurement error in the risk measures. We scale [PDIFF.sub.it] by [P.sub.it] to control for possible effects of per-share scale on our regression results. (19)

We then estimate multiple regressions including all three ranked risk measures to assess their incremental implications for PDIFF:

(6) [PDIFF.sub.it] / [P.sub.it] = a + [c.sub.1]Rank[[beta].sub.AROEit] + [c.sub.2]Rank[[sigma].sub.AROEit] + [d.sub.1]Rank[[beta].sub.RETit] + [e.sub.it],

where all variables are as defined in Equation (5).

Finally, in our most complete multiple regressions, we regress PDIFF on three classes of variables: (1) the two residual income risk measures (our primary variables of interest); (2) the three Fama and French (1992) risk factors ([[beta].sub.RET], LNSIZE, and LNBM); and (3) two controls for potential measurement error in PDIFF (GROWTH and AFE):

(7) [PDIFF.sub.it] / [P.sub.it] = a + [c.sub.1]Rank[[beta].sub.AROEit] + [c.sub.2]Rank[[sigma].sub.AROEit] + [d.sub.1]Rank[[beta].sub.RETit] + [d.sub.2][LNSIZE.sub.it] + [d.sub.3][LNBM.sub.it] + [f.sub.1][GROWTH.sub.it] + [f.sub.2][AFE.sub.it] + [e.sub.it],

where all variables are as defined previously.

Hypothesis 1 predicts that the coefficient estimates on each ranked residual income risk measure will be positive in univariate regressions. In the multiple regressions, the [c.sub.1] and [c.sub.2] coefficient estimates on Rank[[beta].sub.AROE] and Rank[[sigma].sub.AROE] in Equation (6) will indicate whether the capital markets price these risk measures incrementally to systematic risk in returns (Rank[[beta].sub.RET]). The [c.sub.1] and [c.sub.2] coefficient estimates from Equation (7) will indicate whether the capital markets price Rank[[beta].sub.AROE] and Rank[[sigma].sub.AROE] incrementally to the three factors in the Fama and French (1992) model, after controlling for analyst forecast errors and growth.

Table 4 contains the results of the regression estimations. For each set of annual cross-sectional regressions, we report the results for the three univariate regressions (in the first three rows for each year); the multiple regressions with Rank[[beta].sub.AROE], Rank[[sigma].sub.AROE], and Rank[[beta].sub.RET] (in the fourth rows); and the multiple regressions with the three Fama and French (1992) factors and the controls (in the fifth rows). At the end of the table, we aggregate the results over time by reporting a Z-statistic for each intertemporal mean t-statistic. (20)

The first row of results for each year in Table 4 reports that the univariate regression coefficient estimates for Rank[[beta].sub.AROE] are positive and significant, as hypothesized, in six of nine years and aggregated across years (Z = 4.42). However, these annual regressions' adjusted [R.sup.2]s range from -0.1 percent to 1.7 percent, indicating that Rank[[beta].sub.AROE] explains little of the variation in PDIFF. Overall, these results suggest that systematic risk in residual income has a positive, but modest, association with price differentials.

The second row of results for each year in Table 4 shows that the coefficients on Rank[[sigma].sub.AROE] in the univariate regressions are positive and significant, as hypothesized, in eight of nine years and aggregated across years (Z = 7.46). The adjusted [R.sup.2] on Rank[[sigma].sub.AROE] ranges from 0.2 percent to 7.2 percent, and is the highest of all three risk measures in five of nine years. These results suggest that total volatility in residual income is positively associated with price differentials.

As reported in the third row of results for each year in Table 4, the univariate regression coefficient estimates on Rank[[beta].sub.RET] are positive and significant (at $p < 0.05$ or lower) in seven of nine sample years and aggregated over time (Z = 4.49). The adjusted [R.sub.2] ranges from -0.1 percent to 9.2 percent in the annual regressions. These results are consistent with the traditional notion that the capital markets price systematic risk in returns.

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The fourth row in each set of annual results in Table 4 reports the coefficient estimates from multiple regressions in which all three ranked risk measures compete to explain PDIFF. The coefficient estimates on Rank[[beta].sub.AROE] are significantly positive in only two of nine years; the pooled Z-statistic is 2.71. The coefficients on Rank[[sigma].sub.AROE] are consistently positive and significant (at $p < 0.05$ or lower) in all but one of the nine sample years; the pooled Z-statistic is 10.26. The coefficient estimates on Rank[[beta].sub.RET] are positive and significant (at $p < 0.05$ or better) in six of nine sample years; the pooled Z-statistic is 3.33. These results indicate that total volatility in residual income has the most robust incremental relation with price differentials, even beyond that of systematic risk in returns. These results also suggest that systematic risk in residual income does not have robust incremental relevance for share prices beyond either systematic risk in returns or total volatility in residual income.

We report the results for the multiple regressions including all three Fama and French (1992) factors and the control variables in the fifth row in each set of annual results in Table 4. In these regressions, the coefficient estimates on Rank[[beta].sub.AROE] are significantly positive in only three of nine years (pooled Z = 2.85). The coefficients on Rank[[sigma].sub.AROE] diminish in significance, but remain significantly positive in six out of nine years (pooled Z = 4.36). These results confirm that total volatility in residual income has robust incremental association with price differentials, even beyond the Fama and French (1992) risk factors, and after controlling for potential measurement error attributable to AFE and GROWTH. The results for Rank[[beta].sub.RET] are the most sensitive to the inclusion of the other risk factors and the controls. The coefficient estimates on Rank[[beta].sub.RET] are significantly positive in only three of nine sample years, and are not significant in the aggregate (Z = 1.16). This latter result is not surprising--others (e.g., Fama and French 1992) have shown that after controlling for firm size and the book-to-market ratio, beta has little explanatory power for returns. As expected, the coefficients on LNSIZE are significant and negative in six of the nine sample years (pooled Z = -3.12). The coefficients on LNBM are unstable--negative and significant from 1990 to 1993, and then positive and significant in 1995, 1996, and 1998 (pooled Z = -1.28). The coefficients on the control variables GROWTH and AFE are positive and significant in most sample years, indicating that long-run expected earnings growth and analyst forecast errors provide incremental explanatory power for price differentials beyond our two measures of residual income risk and the three Fama and French (1992) risk factors. (21)

Supplemental Analysis--Risk Measures Based on Reported Net Income

We next investigate whether risk measures based on reported net income exhibit associations with price differentials that are similar to those found for risk measures based on residual income. We are interested in this question because it is easier to measure and use reported net income than residual income.

Our residual income risk measures are highly positively correlated with analogous risk measures based on reported net income. Thus, when we repeat the regression analyses reported in Table 4, substituting [[beta].sub.ROE] for [[beta].sub.AROE] (i.e., systematic risk in income measured using ROE rather than abnormal ROE) and substituting [[sigma].sub.ROE] for [[sigma].sub.AROE] (i.e., total volatility in ROE rather than abnormal ROE), we find that both provide comparable explanatory power for price differentials (results not tabulated). (22) Comparable to the multiple regression results in Table 4, we find that the capital market prices total volatility in ROE incrementally to systematic risk in returns, and that systematic risk based on ROE does not provide consistent incremental explanatory power for share prices. Although residual income-based risk measures are consistent with theory (Feltham and Ohlson 1999), as a practical matter, risk measures based on reported income are simpler to compute than risk measures based on residual income, and both have similar share price implications.

V. SUMMARY AND CONCLUSIONS

Risk plays a fundamental but not yet well-understood role in residual income valuation. Feltham and Ohlson (1999) emphasize the role of risk in residual income valuation and point out that the capital markets should price nondiversifiable (systematic) variability inherent in expected future residual income. However, it is not clear exactly how one should incorporate risk into empirical tests or practical applications of the residual income valuation framework. Consequently, empirical researchers have used different methods of incorporating risk in empirical applications of residual income valuation, with different results.

The objective of this study is to enhance our understanding of the role of risk in residual income-based valuation. We develop a new accounting-based measure of the effect of risk on share price, using the difference between observed

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share price and risk-free value, measured using the residual income model and risk-free rates of return. This new measure--which we denote the price differential--captures the magnitude of the discount for risk implicit in share prices. We also develop two accounting-based measures of risk in residual income--systematic risk and total volatility. Our tests examine whether our risk measures explain the cross-section of price differentials, and whether the capital markets price these two risk measures incrementally to the three Fama and French (1992) risk factors (i.e., beta, firm size, and book-to-market ratios).

Our results suggest that the capital markets price systematic risk in residual income. Abnormal ROE beta is significantly positively related to price differentials in univariate regressions, but provides only limited explanatory power, indicating that abnormal ROE beta is, at best, a weak indicator of risk. Multiple regressions confirm these results--we find that in only three of nine years does the capital market price abnormal ROE beta incrementally to the three Fama and French (1992) risk factors and two control variables for measurement error. These tests have low power because of the inherent difficulty in estimating abnormal earnings betas, so it may be fruitful to explore more powerful ways to estimate abnormal (or raw) earnings betas.

Our results suggest that total volatility in residual income is robustly positively associated with price differentials, and that the capital markets price total volatility in residual income incrementally to the three Fama and French (1992) risk factors. In fact, our findings suggest that total volatility in residual income has more explanatory power for price differentials than systematic risk in residual income, beta, firm size, or the book-to-market ratio. Despite the fact that we do not measure total volatility in residual income using explicit systematic risk factors, total volatility in residual income nevertheless captures priced risk factors. These results help explain why corporate managers interested in maximizing share value might prefer smooth income series over income volatility.

If our accounting- and market-based risk proxies are valid measures of risk, then our findings suggest that our measure of the discount for risk implicit in share price, which is based on the residual income model and prevailing risk-free rates, is a theoretically defensible, computationally simple, and empirically valid measure of the impact of risk on share prices. Our findings also suggest that one can assess firm risk using volatility and covariation in abnormal earnings, consistent with the residual income model's focus on abnormal earnings as the fundamental valuation attribute. In future research, we plan to test whether accounting risk proxies (especially abnormal ROE volatility) explain share prices in initial public offering settings in which market data are not available, and thus, in which one cannot use the market model or the Fama and French (1992) model to assess and price firm risk.

TABLE 1
Annual Means of Residual Income Valuation Model Inputs and Outputs

Panel A: Residual Income Valuation Model Inputs (a)

Year	Number of Firms	Book Value per Share	Dividend Payout Rate (%)
1990	665	19.95	58
1991	773	18.46	56
1992	802	18.11	68
1993	822	16.45	52
1994	908	15.36	44
1995	898	15.50	38
1996	966	15.16	34
1997	1,060	14.85	33
1998	1,073	14.18	29
Mean	885	16.45	46

Year	ROE Forecasts for Years (%): t + 1	t + 2	t + 3
1990	10.1	11.1	11.1
1991	9.0	10.5	10.9

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1992	9.5	11.3	11.2
1993	11.1	12.5	12.6
1994	11.9	13.4	12.6
1995	13.3	14.3	13.7
1996	13.9	14.9	14.5
1997	14.9	15.8	15.2
1998	16.3	17.5	15.9
Mean	12.2	13.5	13.1

Year	ROE Forecasts for Years (%):		Risk-Free Rates (%)
	t + 4	t + 5	
1990	11.2	11.5	8.8
1991	11.1	11.7	8.0
1992	11.8	11.9	7.5
1993	13.2	13.3	6.0
1994	14.0	13.9	7.0
1995	15.0	15.2	7.0
1996	15.3	15.3	6.5
1997	16.0	16.1	6.9
1998	17.3	17.6	5.6
Mean	13.9	14.1	7.0

	Implied AROE Forecasts for Years (%):		
Year	t + 1	t + 2	t + 3
1990	1.3	2.3	2.3
1991	1.0	2.5	2.9
1992	2.0	3.8	3.7
1993	5.1	6.5	6.6
1994	4.9	6.4	5.6
1995	6.2	7.2	6.6
1996	7.4	8.4	8.0
1997	8.0	8.9	8.3
1998	10.7	11.9	10.3
Mean	5.2	6.4	6.0

	Implied AROE Forecasts for Years (%):		
Year	t + 4	t + 5	Mean
1990	2.4	2.7	2.2
1991	3.1	3.7	2.6
1992	4.3	4.4	3.7
1993	7.2	7.3	6.6
1994	7.0	6.9	6.2
1995	7.9	8.1	7.2
1996	8.8	8.8	8.3
1997	9.1	9.2	8.7
1998	11.7	12.0	11.3
Mean	6.8	7.0	6.3

Panel B: Annual Means of Share Prices and Residual Income Valuation Model Outputs (b)

Year	Number of Firms	Risk-Free Value per Share (RFV)	Price per Share (P)
1990	665	25.96	19.09
1991	773	26.31	19.97
1992	802	32.10	21.26
1993	822	51.76	23.23
1994	908	38.70	22.01

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1995	898	45.36	23.37
1996	966	51.64	26.09
1997	1,060	49.63	27.10
1998	1,073	83.60	36.64
Overall Means	885	45.01	24.31

Year	Price Differential per Share (PDIFF)	Implied Risk Premium (%)
1990	6.86	2.0
1991	6.34	1.7
1992	10.84	2.1
1993	28.53	3.3
1994	16.69	2.8
1995	21.99	3.3
1996	25.56	3.2
1997	22.54	3.1
1998	46.99	3.2
Overall Means	20.70	2.7

(a) We collect book value (of common equity per share) as of the end of year t - 1, immediately preceding April of year t, from Compustat. Dividend payout rates equal the annual dividend per share divided by actual earnings per share (both from I/B/E/S). If actual earnings are negative, then we deflate dividends by average expected earnings per share for one year ahead through five years ahead (from I/B/E/S). [ROE.sub.t] + i (i = 1-5) is the return on common equity derived from I/B/E/S i-period-ahead forecasts and t + i - 1 book values. We estimate book values for periods beyond the current period as prior book value plus earnings times 1 minus the dividend payout ratio. We winsorize ROE data at 100 percent. Risk-free rates are yields on ten-year U.S. government bonds as of April of the indicated year, obtained from Federal Reserve Bulletins (Table 1.35). Implied forecasts of AROE (abnormal ROE) for year t + 1 through t + 5 equal forecasted ROE minus the prevailing risk-free rate.

(b) We use the residual income model, risk-free rates of return, and Equation (2) to compute risk-free value. Price is the actual price per share as of April 1 of each year for which we have earnings forecasts. Price differential is risk-free value less actual share price. Implied risk premia denote the annual mean risk premia, computed by estimating the risky interest rate implied by security prices and then subtracting the risk-free rate. We obtain the interest rate implied by security prices by solving for the interest rate in Equation (2) that would cause RFV to equal PRICE.

TABLE 2

Annual and Pooled Descriptive Statistics for Three Alternative Measures of Risk: Systematic Risk in Stock Returns ([[beta].sub.RET]), Systematic Risk in Abnormal ROE ([[beta].sub.AROE]), and Standard Deviation in Abnormal ROE ([[sigma].sub.AROE]) (a)

Year	Number of firms	Risk Measure	Mean	Standard Deviation
1990	665	[[beta].sub.RET]	0.95	0.38
		[[beta].sub.AROE]	1.00	1.93
		[[sigma].sub.AROE]	0.08	0.06

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1991	773	[[beta].sub.RET]	0.99	0.42
		[[beta].sub.AROE]	1.00	2.21
		[[sigma].sub.AROE]	0.08	0.06
1992	802	[[beta].sub.RET]	1.00	0.45
		[[beta].sub.AROE]	1.00	2.21
		[[sigma].sub.AROE]	0.09	0.07
1993	822	[[beta].sub.RET]	0.78	0.50
		[[beta].sub.AROE]	1.00	2.57
		[[sigma].sub.AROE]	0.09	0.07
1994	908	[[beta].sub.RET]	0.78	0.50
		[[beta].sub.AROE]	1.00	2.52
		[[sigma].sub.AROE]	0.09	0.07
1995	898	[[beta].sub.RET]	0.78	0.56
		[[beta].sub.AROE]	1.00	2.39
		[[beta].sub.AROE]	0.10	0.07
1996	966	[[beta].sub.RET]	0.72	0.61
		[[beta].sub.AROE]	1.00	2.86
		[[sigma].sub.AROE]	0.10	0.08
1997	1,060	[[beta].sub.RET]	0.69	0.74
		[[beta].sub.AROE]	1.00	2.62
		[[sigma].sub.AROE]	0.11	0.08
1998	1,073	[[beta].sub.RET]	0.71	1.96
		[[beta].sub.AROE]	1.00	2.54
		[[sigma].sub.AROE]	0.10	0.08
Pooled	7,967	[[beta].sub.RET]	0.80	0.89
Across		[[beta].sub.AROE]	1.00	2.47
Years		[[sigma].sub.AROE]	0.10	0.07

Year	Minimum	Median	Maximum
1990	-0.25	0.96	4.11
	-9.06	0.84	11.31
	0.02	0.06	0.38
1991	-0.10	0.99	4.58
	-8.47	0.88	13.45
	0.02	0.06	0.40
1992	-2.18	0.95	4.54
	-8.73	0.83	14.39
	0.00	0.06	0.43
1993	-0.24	0.74	4.96
	-11.32	0.76	13.19
	0.00	0.07	0.46
1994	-1.22	0.74	3.61
	-8.36	0.79	14.05
	0.00	0.07	0.48
1995	-1.44	0.72	6.11
	-9.11	0.72	11.57
	0.01	0.07	0.45
1996	-0.79	0.61	7.24
	-15.70	0.59	14.79

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	0.01	0.08	0.47
1997	-5.29	0.57	9.81
	-7.86	0.58	14.59
	0.01	0.08	0.48
1998	-60.76	0.66	3.08
	-8.51	0.60	15.04
	0.01	0.08	0.44
Pooled	-60.76	0.78	9.81
Across	-15.70	0.73	15.04
Years	0.00	0.07	0.48

(a) [[beta].sub.RET] is a market model beta estimated using monthly stock returns and equally weighted market index returns over the 60 months prior to the year in which we compute price differentials from actual prices and Equation (2) (CRSP data). [[beta].sub.AROE] is a proxy for systematic risk in abnormal ROE obtained by regressing abnormal ROE on the sample-wide average abnormal ROE over the ten-year period preceding the year in which we compute price differentials (Equation (4); Compustat data). [[sigma].sub.AROE] is the standard deviation of abnormal ROE over a ten-year period preceding the year in which we compute price differentials (Compustat data). We winsorize abnormal ROEs at 50 percent prior to estimating [[beta].sub.AROE] and [[sigma].sub.AROE].

TABLE 3

Mean Price Differentials (PDIFF) across Deciles of Systematic Risk in Residual Income ([[beta].sub.AROE]) and Total Risk in Residual Income ([[sigma].sub.AROE]) (a)

Decile	Median [[beta].sub.AROE] across Years	Decile Mean PDIFF Averaged across Years
1 (lowest risk)	-3.00	18.64
2	-0.88	18.92
3	-0.12	16.98
4	0.23	18.07
5	0.59	17.50
6	0.95	20.48
7	1.38	22.03
8	1.98	21.87
9	2.95	25.14
10 (highest risk)	6.18	27.40
Annual means across deciles	--	20.70
Spearman correlation	--	0.79
Probability	--	<0.005

Decile	Median [[sigma].sub.AROE] across Years	Decile Mean PDIFF Averaged across Years
1 (lowest risk)	0.02	14.05
2	0.03	16.73
3	0.04	18.20
4	0.05	20.46
5	0.06	21.63
6	0.07	22.57
7	0.10	22.15

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8	0.12	22.76
9	0.16	26.81
10 (highest risk)	0.26	21.59
Annual means across deciles	--	20.70
Spearman correlation	--	0.81
Probability	--	<0.005

(a) PDIFF denotes risk-free value (computed from the residual income model using risk-free rates of return; Equation (3) minus share price), [[sigma].sub.AROE]is a proxy for systematic risk in abnormal ROE obtained by regressing abnormal ROE on the sample-wide average abnormal ROE over the ten-year period preceding each year in which we compute the residual income model (Equation (4)). [[sigma].sub.AROE] is the standard deviation of abnormal ROE over a ten-year period preceding each residual income model computation. In estimating [[beta].sub.AROE] and [[sigma].sub.AROE], we winsorize abnormal ROEs at 50 percent.

TABLE 4

Annual Cross-Sectional Regressions of Percent Pricing Differentials (PDIFF) on Residual Income Risk Measures, Fama and French Risk Factors, and Control Variables (a)

Table entries are estimated coefficients, t-statistics (in parentheses), and adjusted [R.sup.2] (last column).

Year (number of firms)		Intercept		Ranked Abnormal ROE Beta (Rank[[beta].sub.AROE])	
1990	(665)	0.34	(5.18)	-0.01	(-0.57)
	(665)	0.22	(3.31)		
	(665)	0.28	(4.16)		
	(665)	0.27	(3.00)	-0.02	(-0.95)
	(643)	-0.08	(-0.41)	-0.00	(-0.86)
1991	(773)	0.21	(4.02)	0.02	(1.48)
	(773)	0.08	(1.61)		
	(773)	0.24	(4.57)		
	(773)	0.09	(1.23)	0.01	(0.63)
	(753)	0.06	(0.44)	0.00	(0.95)
1992	(802)	0.33	(5.72)	0.03	(2.66)
	(802)	0.22	(3.82)		
	(802)	0.37	(6.46)		
	(802)	0.16	(2.06)	0.02	(1.55)
	(782)	0.17	(1.06)	0.00	(1.06)
1993	(822)	1.10	(15.04)	0.03	(2.00)
	(822)	0.76	(10.65)		
	(822)	0.81	(11.35)		
	(822)	0.56	(5.86)	0.01	(0.34)
	(799)	0.33	(1.50)	0.00	(0.32)
1994	(908)	0.73	(14.53)	0.01	(1.44)
	(908)	0.53	(10.85)		
	(908)	0.51	(10.33)		
	(908)	0.37	(5.40)	0.01	(0.65)
	(867)	-0.01	(-0.07)	0.00	(0.56)

Residual income risk, intrinsic values, and share prices.

1995	(898)	0.83	(14.93)	0.03	(2.94)
	(898)	0.58	(10.80)		
	(898)	0.53	(9.97)		
	(898)	0.32	(4.49)	0.01	(1.22)
	(851)	-0.05	(-0.32)	0.00	(1.86)
1996	(966)	0.87	(15.78)	0.04	(4.26)
	(966)	0.72	(13.35)		
	(966)	0.67	(12.53)		
	(966)	0.42	(5.92)	0.03	(2.73)
	(899)	0.57	(3.31)	0.00	(3.21)
1997	(1,060)	0.75	(11.66)	0.05	(4.34)
	(1,060)	0.50	(8.07)		
	(1,060)	0.54	(8.62)		
	(1,060)	0.23	(2.87)	0.02	(2.15)
	(968)	0.98	(4.95)	0.00	(3.65)
1998	(1,073)	1.28	(18.42)	0.03	(2.84)
	(1,073)	0.95	(14.10)		
	(1,073)	0.92	(13.75)		
	(1,073)	0.68	(7.66)	0.01	(0.91)
	(1,034)	1.10	(6.25)	0.00	(2.36)
Z-statistics computed from the sample of nine annual t-statistics					(4.42)
					(2.71)
					(2.85)

Year (number of firms)		Ranked Abnormal ROE Volatility (Rank[[sigma].sub.AROE])	
1990	(665)		
	(665)	0.03	(1.59)
	(665)		
	(665)	0.03	(1.63)
	(643)	-0.00	(-0.35)
1991	(773)		
	(773)	0.05	(4.33)
	(773)		
	(773)	0.05	(4.13)
	(753)	0.00	(1.49)
1992	(802)		
	(802)	0.06	(4.96)
	(802)		
	(802)	0.06	(4.10)
	(782)	0.00	(1.70)
1993	(822)		
	(822)	0.12	(7.72)
	(822)		
	(822)	0.09	(5.36)
	(799)	0.00	(2.59)
1994	(908)		
	(908)	0.06	(6.03)
	(908)		
	(908)	0.04	(3.74)
	(867)	0.00	(1.24)

Residual income risk, intrinsic values, and share prices.

1995	(898)		
	(898)	0.09	(8.38)
	(898)		
	(898)	0.06	(5.03)
	(851)	0.00	(4.86)
1996	(966)		
	(966)	0.07	(7.49)
	(966)		
	(966)	0.04	(4.20)
	(899)	0.00	(3.43)
1997	(1,060)		
	(1,060)	0.09	(8.99)
	(1,060)		
	(1,060)	0.06	(5.57)
	(968)	0.00	(3.32)
1998	(1,073)		
	(1,073)	0.09	(8.54)
	(1,073)		
	(1,073)	0.06	(4.98)
	(1,034)	0.00	(2.66)
Z-statistics computed			
from the			(7.46)
sample of			
nine annual			(10.26)
t-statistics			(4.36)

Year (number of firms)		Ranked Market Return Beta (Rank[[beta].sub.RET])	
1990	(665)		
	(665)		
	(665)	0.01	(0.60)
	(665)	-0.00	(-0.09)
	(643)	-0.00	(-0.33)
1991	(773)		
	(773)		
	(773)	0.01	(0.84)
	(773)	-0.01	(-0.83)
	(753)	0.00	(-0.89)
1992	(802)		
	(802)		
	(802)	0.02	(1.79)
	(802)	-0.01	(-0.07)
	(782)	0.00	(0.14)
1993	(822)		
	(822)		
	(822)	0.10	(6.76)
	(822)	0.07	(4.34)
	(799)	0.00	(3.72)
1994	(908)		
	(908)		
	(908)	0.06	(7.72)
	(908)	0.05	(4.99)
	(867)	0.00	(3.23)

Residual income risk, intrinsic values, and share prices.

1995	(898)		
	(898)		
	(898)	0.10	(9.57)
	(898)	0.08	(7.10)
	(851)	0.00	(4.17)
1996	(966)		
	(966)		
	(966)	0.08	(8.64)
	(966)	0.07	(6.37)
	(899)	0.00	(0.76)
1997	(1,060)		
	(1,060)		
	(1,060)	0.08	(8.25)
	(1,060)	0.06	(5.22)
	(968)	-0.00	(-0.13)
1998	(1,073)		
	(1,073)		
	(1,073)	0.10	(9.03)
	(1,073)	0.07	(6.21)
	(1,034)	-0.00	(-2.34)
Z-statistics computed from the sample of nine annual t-statistics			(4.49)
			(3.33)
			(1.16)

Year (number of firms)		Log of Market Value of Equity (LNSIZE)	
1990	(665)		
	(665)		
	(665)		
	(665)		
	(643)	0.00	(0.06)
1991	(773)		
	(773)		
	(773)		
	(773)		
	(753)	-0.05	(-2.71)
1992	(802)		
	(802)		
	(802)		
	(802)		
	(782)	-0.05	(-2.51)
1993	(822)		
	(822)		
	(822)		
	(822)		
	(799)	-0.05	(-1.88)
1994	(908)		
	(908)		
	(908)		
	(908)		
	(867)	-0.01	(-0.68)

Residual income risk, intrinsic values, and share prices.

1995	(898)		
	(898)		
	(898)		
	(898)		
	(851)	-0.01	(-0.36)
1996	(966)		
	(966)		
	(966)		
	(966)		
	(899)	-0.06	(-3.39)
1997	(1,060)		
	(1,060)		
	(1,060)		
	(1,060)		
	(968)	-0.15	(-6.94)
1998	(1,073)		
	(1,073)		
	(1,073)		
	(1,073)		
	(1,034)	-0.12	(-6.29)
Z-statistics computed from the sample of nine annual t-statistics			(-3.12)

Year (number of firms)		Log of the Book-to-Market Ratio (LNBM)	
1990	(665)		
	(665)		
	(665)		
	(665)		
	(643)	-0.22	(-4.81)
1991	(773)		
	(773)		
	(773)		
	(773)		
	(753)	-2.39	(-6.48)
1992	(802)		
	(802)		
	(802)		
	(802)		
	(782)	-0.26	(-5.98)
1993	(822)		
	(822)		
	(822)		
	(822)		
	(799)	-0.24	(-4.41)
1994	(908)		
	(908)		
	(908)		
	(908)		

Residual income risk, intrinsic values, and share prices.

	(867)	-0.05	(-1.10)
1995	(898)		
	(898)		
	(898)		
	(898)		
	(851)	0.12	(2.52)
1996	(966)		
	(966)		
	(966)		
	(966)		
	(899)	0.16	(3.30)
1997	(1,060)		
	(1,060)		
	(1,060)		
	(1,060)		
	(968)	-0.03	(-0.42)
1998	(1,073)		
	(1,073)		
	(1,073)		
	(1,073)		
	(1,034)	0.10	(1.91)
Z-statistics computed from the sample of nine annual t-statistics			(-1.28)

Year (number of firms)		I/B/E/S Long-Run Growth Estimates (GROWTH)	
1990	(665)		
	(665)		
	(665)		
	(665)		
	(643)	1.60	(2.07)
1991	(773)		
	(773)		
	(773)		
	(773)		
	(753)	0.89	(1.64)
1992	(802)		
	(802)		
	(802)		
	(802)		
	(782)	0.24	(0.42)
1993	(822)		
	(822)		
	(822)		
	(822)		
	(799)	2.20	(3.13)
1994	(908)		
	(908)		
	(908)		

Residual income risk, intrinsic values, and share prices.

	(908)		
	(867)	2.07	(4.31)
1995	(898)		
	(898)		
	(898)		
	(898)		
	(851)	1.47	(2.86)
1996	(966)		
	(966)		
	(966)		
	(966)		
	(899)	3.43	(8.11)
1997	(1,060)		
	(1,060)		
	(1,060)		
	(1,060)		
	(968)	2.42	(4.70)
1998	(1,073)		
	(1,073)		
	(1,073)		
	(1,073)		
	(1,034)	7.11	(15.15)
Z-statistics computed from the sample of nine annual t-statistics			(-2.97)

Year (number of firms)		Combined One- and Two-Year Ahead Analyst Forecast Errors (AFE)	
1990	(665)		
	(665)		
	(665)		
	(665)		
	(643)	0.00	(5.13)
1991	(773)		
	(773)		
	(773)		
	(773)		
	(753)	0.00	(6.88)
1992	(802)		
	(802)		
	(802)		
	(802)		
	(782)	0.00	(6.98)
1993	(822)		
	(822)		
	(822)		
	(822)		
	(799)	0.00	(6.01)

Residual income risk, intrinsic values, and share prices.

1994	(908)		
	(908)		
	(908)		
	(908)		
	(867)	0.00	(7.66)
1995	(898)		
	(898)		
	(898)		
	(898)		
	(851)	0.00	(7.78)
1996	(966)		
	(966)		
	(966)		
	(966)		
	(899)	0.00	(4.05)
1997	(1,060)		
	(1,060)		
	(1,060)		
	(1,060)		
	(968)	0.00	(5.24)
1998	(1,073)		
	(1,073)		
	(1,073)		
	(1,073)		
	(1,034)	0.00	(3.16)
Z-statistics computed from the sample of nine annual t-statistics			(-10.32)

Year (number of firms)		Adjusted [R.sup.2] (%)
1990	(665)	-0.1
	(665)	0.2
	(665)	-0.1
	(665)	0.1
	(643)	10.9
1991	(773)	0.2
	(773)	2.3
	(773)	-0.0
	(773)	2.1
	(753)	16.8
1992	(802)	0.8
	(802)	2.9
	(802)	0.3
	(802)	2.9
	(782)	16.3
1993	(822)	0.4
	(822)	6.7
	(822)	5.2
	(822)	8.5
	(799)	18.2

Residual income risk, intrinsic values, and share prices.

1994	(908)	0.1
	(908)	3.8
	(908)	4.7
	(908)	6.1
	(867)	15.5
1995	(898)	0.9
	(898)	7.2
	(898)	9.2
	(898)	12.0
	(851)	18.6
1996	(966)	1.7
	(966)	5.4
	(966)	7.1
	(966)	9.8
	(899)	19.6
1997	(1,060)	1.7
	(1,060)	7.0
	(1,060)	6.0
	(1,060)	9.6
	(968)	19.5
1998	(1,073)	0.5
	(1,073)	6.3
	(1,073)	7.0
	(1,073)	9.4
	(1,034)	32.8

(a) Table 4 reports coefficient estimates, t-statistics, and adjusted [R.sup.2]s from the following annual cross-sectional regressions:

Univariate regressions (rows one to three each year):

(5) [PDIFF.sub.it]/[P.sub.it] = a + [cRiskMeasureRank.sub.it] + [e.sub.it]

Multiple regressions without controls (row four each year):

(6) [PDIFF.sub.it]/[P.sub.it] = a + [c.sub.1]Rank[[beta].sub.AROEit] + [c.sub.2]Rank[[sigma].sub.AROEit] + [d.sub.1]Rank[[beta].sub.RETit] + [e.sub.it]

Multiple regressions with controls (row five each year):

(7) [PDIFF.sub.it]/[P.sub.it] = a + [c.sub.1]Rank[[beta].sub.AROEit] + [c.sub.2]Rank[[sigma].sub.AROEit] + [d.sub.1]Rank[[beta].sub.RETit] + [d.sub.2][LNSIZE.sub.it] + [d.sub.3][LNBM.sub.it] + [f.sub.1][GROWTH.sub.it] + [f.sub.2][AFE.sub.it] + [e.sub.it]

PDIFF denotes risk-free value (computed from the residual income model using risk-free rates of return; Equation (3)) minus share price. P denotes share price of firm i as of April 1 for each year t for which we have earnings forecasts. [[beta].sub.AROE] is a proxy for systematic

risk in abnormal ROE obtained by regressing abnormal ROE on the sample-wide average abnormal ROE over the ten-year period preceding each year in which we compute risk-free value from the residual income model (Equation (4)). [[sigma].sub.AROE]is the standard deviation of abnormal ROE over a ten-year period preceding each residual income model computation. In estimating [[beta].sub.AROE] and [[sigma].sub.AROE], we winsorized abnormal ROEs at 50 percent. [[beta].sub.RET] is a market model beta estimated using monthly stock returns and equally weighted market index returns over the 60 months

Residual income risk, intrinsic values, and share prices.

prior to the year in which we compute risk-free value from the residual income model (CRSP data). We transform all three risk measures into ranks based on their within-sample rank each year. LNSIZE is a control variable measured as the natural log of firm size. LNBM is the natural log of the book-to-market ratio. GROWTH controls for expected future earnings growth, measured as I/B/E/S consensus analysts' forecasts of three- to five-year earnings growth. AFE controls for analyst forecast errors, measured as the combined forecast errors for one- and two-year-ahead forecasts for each year in the sample.

We appreciate research assistance and comments from M. Kimbrough, and comments from two anonymous referees, G. Clinch (the associate editor), D. Barrett, B. Beaver, W. Blacconiere, P. Easton, I. Jansen, B. Jorgensen, L. Maines, G. Miller, J. Ohlson, S. Penman, J. Salamon, M. Wallmeier, and L. Vincent; participants at the Financial Economics and Accounting Conference at the University of Michigan, the First Annual Winter Accounting Research Conference at the University of Utah, the Third Annual AAA Globalization Conference in Berlin, the 2001 Stanford Summer Camp, and the 2002 AAA Midwest meetings; and workshop participants at the following: Arizona State University, Indiana University, University of Missouri, The Ohio State University, and Washington University in St. Louis. We also gratefully acknowledge the contribution of I/B/E/S International Inc. for providing earnings per share forecast data. These data have been provided as part of a broad academic program to encourage earnings expectations research. Professor Wahlen gratefully acknowledges financial support from the Ford Motor Company Teaching Fellowship.

Submitted January 2001 Accepted September 2002

(1) We use the terms residual income and abnormal earnings interchangeably.

(2) Our use of risk-free rates to determine abnormal earnings is consistent with Feltham and Ohlson (1999).

(3) Like an earnings-based beta, abnormal ROE beta should measure time-series covariation between earnings and market-wide risk factors. In addition, abnormal ROE beta should also measure time-series covariation between market-wide risk factors and book values and dividends.

(4) These results require no risk-free arbitrage in book values and future abnormal earnings, as well as the clean surplus accounting relation.

(5) For example, suppose a firm exposes its operations to input and output price movements on a daily or weekly basis. That firm's quarterly and annual reports would report the aggregated (i.e., diversified over time) exposure to such risks.

(6) We increase the potential for survivorship bias and reduce our sample sizes in one set of multiple regressions in which we also require firms to report earnings in year t + 2, to control for a potential source of measurement error in analysts' two-year-ahead earnings forecasts.

(7) Our proxies for risk-free rates of return are the yields on ten-year U.S. government bonds, which we obtained from the Federal Reserve Bulletins (Table 1.35) as of April 1 of each sample year.

(8) The mean difference between our assumptions for ([r.sub.ft] - g) and the Easton et al. (2000) estimates of (r - g) is less than 0.50 percent, although in three of our nine sample years the difference exceeds 1 percent in absolute value. Because r is greater than [r.sub.ft] due to risk, we would expect Easton et al.'s (2000) (r - g) estimates to be greater than our ([r.sub.ft] - g) assumptions, unless Easton et al.'s (2000) growth estimates are large (which they are). We explicitly control for different growth expectations in tests described later.

(9) When year t earnings are negative, we compute the dividend payout rate as year t dividends divided by the mean expected earnings over the five-year earnings forecast horizon.

(10) We repeated our empirical tests of our two residual income-based risk measures by examining their associations with the implied risk premia estimates rather than PDIFFs, and obtained very similar results.

(11) We winsorize AROE at 0.50 for each sample firm-year before constructing the sample-wide AvgAROE. Our results are not sensitive to alternative winsorization values up to 1.00.

(12) We do not deflate by the mean to obtain a coefficient of variation because AROE is already deflated by the book value of common equity. Controlling for measures of scale (market value of equity, earnings growth) does not change any of our conclusions about associations of [[sigma].sub.AROE] with PDIFF.

(13) As expected by the way in which we construct RFV, ranked analyst forecast errors are positively correlated with RFVs--the median correlation is 0.275, which is very close to the median annual correlation of ranked analyst forecast error and PDIFF (deflated by price), 0.270. This result implies that security prices do not fully reflect the bias in analysts' forecasts.

(14) Our inferences are unaffected if we control for only one-year-ahead forecast errors for each year in the sample.

(15) Our computations of RFV capture cross-sectional differences in residual income growth through year 5, but they do not capture cross-sectional differences in expected growth rates in residual income beyond year 5 (which we assume to be a cross-sectional constant 3 percent). Insofar as differences in terminal-period residual income growth rates affect share prices, they will therefore affect PDIFF. For firms for which our assumption of 3 percent expected growth in residual income beyond year 5 is understated, our computation of PDIFF will be understated, and vice versa. Terminal-period expected growth in residual income is likely to covary positively with risk. If so, then measurement error in our assumption of 3 percent growth in terminal-year residual income will most likely bias our tests against our hypothesis of a positive association between PDIFF and residual income risk.

(16) Supplemental analysis (not tabulated) suggests that assuming constant dividend payout introduces little error in PDIFF, in part because our sample selection criteria tilt the sample toward larger, more mature firms that likely have stable dividend policies. However, the sample does include firms with zero dividend payout policies. For example, in the 1990 sample of 665 firms, 82 (12.3 percent) had a 1990 payout ratio of zero. Four years later, 47 of the 54 firms common to both the 1990 and 1994 samples (87.1 percent) had maintained a zero payout ratio.

(17) Diagnostic analyses of our data reveal that this downward shift in [[beta].sub.RET] is not attributable to changing sample composition over time or estimation procedures. In addition, supplemental analyses show a steady decline in market model betas over our sample period among all firms with 60 months of returns data in the intersection of the CRSP and I/B/E/S, as well as among all firms on CRSP with 60 months of returns data throughout our sample period.

(18) Note that the median [[beta].sub.AROE] is -3.0 among the 1st decile firms, but the mean PDIFF for these firms is greater than the mean PDIFF for the 3rd, 4th, and 5th deciles. Subsequent analyses (not tabulated) reveal that the 1st decile firms have higher-than-average [[sigma].sub.AROE] and [[beta].sub.RET]. These firms--with abnormal ROEs that seem to hedge market movements but stock returns that mirror market movements--are an interesting group in their own right. Another alternative explanation is that these firms have [[beta].sub.AROE] measured with great error. We also formed the deciles based on PDIFF, similar to the technique in Beaver et al. (1980) and the reverse regression approach in Beaver et al. (1987), and found that the correlation between PDIFF and [[beta].sub.AROE] was only slightly higher.

(19) Our primary motivation for deflating PDIFF by price in the univariate regressions is to obtain results that will be comparable with the multiple regression results that include control variables that are correlated with scale. When we do not deflate PDIFF by price, the univariate and multiple regression results for our two residual income risk measures are very similar to those reported in the paper. In addition, untabulated tests using unranked winsorized data yield similar conclusions.

(20) We calculate this Z-statistic as Z = [bar]t[square root (N - 1)] / stddev(t), where [bar]t is the average t-statistic over all sample years, N is the number of sample years (9), and stddev(t) is the standard deviation of our sample t-statistics (Barth 1994; Collins et al. 1995.) We do not report results from regressions pooled over time because they suffer from cross-sectionally dependent residuals and overstated t-statistics (Bernard 1987).

(21) The significant associations between PDIFF and GROWTH and AFE imply that future research may be warranted to (1) develop measures of RFV that correct for both long-run earnings growth and analysts' forecast errors, and (2) examine

the extent to which share prices fully reflect long-run earnings growth and analysts' forecast errors.

(22) Beaver et al. (1970) use reported earnings deflated by market prices in constructing total and systematic accounting risk measures. We deflate by an accrual accounting measure, book value of equity.

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Stephen P. Baginski
University of Georgia

James M. Wahlen
Indiana University