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Estimating the Cost of Capital Implied by Market Prices and Accounting Data*

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Abstract

Estimating the Cost of Capital Implied by Market Prices and Accounting Data focuses on estimating the expected rate of return implied by market prices, summary accounting numbers, and forecasts of earnings and dividends. Estimates of the expected rate of return, often used as proxies for the cost of capital, are obtained by inverting accounting-based valuation models. The author describes accounting-based valuation models and discusses how these models have been used, and how they may be used, to obtain estimates of the cost of capital.

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1

Introduction

The focus of this survey is on estimating the expected rate of return implied by market prices, summary accounting numbers (such as book value and earnings), and forecasts of earnings and dividends. Estimates of the expected rate of return, which are often used as proxies for the cost of capital, are obtained by inverting accounting-based valuation models. I begin by describing accounting-based valuation models and then I discuss the way these models have been used, and how they may be used, to obtain estimates of the cost of capital.

The re-introduction of the residual income valuation model by Ohlson (1995) and the development of the abnormal growth in earnings model by Ohlson and Juettner-Nauroth (2005) have been the driving force behind the burgeoning empirical literature that reverse engineers these models to infer markets expectations of the rate of return on equity capital. The obvious advantage of this reverse-engineering approach is that estimates of the expected rate of return are based on forecasts rather than extrapolation from historical data. Prior to the development of these approaches, researchers and valuation practitioners relied on estimates based on historical data (estimated via the market model, the empirical analogue of the Sharpe–Lintner Capital

Asset Pricing Model, or variants of the Fama and French (1992) three/four-factor model). As a practical matter the usefulness of these estimates is very limited. Fama and French (1997, 2002) conclude that these estimates, based on historical return data are "unavoidably imprecise" and empirical problems "probably invalidate their use in applications."

The practical appeal of accounting-based valuation models, particularly the abnormal growth in earnings model, is that they focus on the two variables that are most commonly at the heart of valuations carried out by practicing equity analysts; namely, forecasts of earnings and forecasts of earnings growth. The question at the core of this survey is: How can these forecasts be used to obtain an estimate of the cost of capital? After addressing this question, I will examine the empirical validity of the estimates based on these forecasts and then I will explore possible means of improving these estimates.

The later part of the survey details a method for isolating the effect of any factor of interest (such as cross-listing, fraud, disclosure quality, taxes, analyst following, accounting standards, etc.) on the cost of capital.[1]

If you are interested in understanding the key ingredients of the academic literature on accounting-based estimates of expected rate of return this survey is for you. My aim is to provide a foundation for a deeper comprehension of this literature and to give a jump start to those who may have an interest in extending this literature.

I have deliberately chosen to introduce the key ideas via examples based on actual forecasts, accounting information, and market prices for listed firms. I have found that people exposed to this literature for the first time find this a useful way to gain a sound intuitive understanding of the essential elements of the models and methods. I then show how the numerical examples are based on sound algebraic relations.[2]

[1] I do not review the large literature that examines the effect of various factors on the cost of capital. This literature developed very shortly after the first accounting based empirical estimates of the cost of capital were developed. I expect that the reader of this survey may conclude that many of these studies should be re-visited after more refined estimates of the cost of capital have been developed.

[2] Many readers of this survey have observed that these numerical examples have been critical to their understanding. Some have underscored the importance of these examples when

The survey proceeds as follows:

Section 2: Valuing the firm

The survey begins by reviewing, in Section 2, the discounted cash flow valuation model and the closely related accounting-based valuation model; namely, the residual operating income valuation model. These models are used to value the operations of the firm. I have chosen to use the discounted cash flow valuation model as the starting point because most readers have at least some familiarity with the use of this valuation model.

The theoretical papers that underpin this survey are, by and large, based on the dividend capitalization model, which is a model of equity valuation, rather a model for the valuation of the firm. The key papers are Ohlson (1995) and Ohlson and Juettner-Nauroth (2005). The empirical literature has also focused on the valuation of equity. My sense is that this emphasis is primarily driven by the availability of data. The models used in the valuation of equity are discussed in Sections 3 and 4. I will discuss the related empirical literature in the later sections. There is still a great deal of room for research that focuses on the operations of the firm rather than the portion of those assets that are owned by equity shareholders. I return to this point at the end of the survey.

I demonstrate valuation of the firm in Section 2 by means of a simple example similar to those used in introductory accounting and finance courses.[3] In this example, there are forecasts of free cash flow from operations for the next four years, together with forecasts of expected growth beyond this four-year horizon. The forecasted free cash flows are discounted to determine the present value of the firm, which is often referred to as the enterprise value. Other terms used include firm value, asset value, and value of operations.

Next, I illustrate the residual operating income valuation model using the same example. Again, the focus is on valuing the operations. I show, through the example, that free cash flow from operations is

telling me that they have undertaken the exercise of setting up the related spreadsheets and repeating the calculations; this ensures a thorough understanding of the valuation models because all of the algebraic relations are implicit in the set up of the spreadsheets.

[3] The example is the same as that in Easton et al. (2008).

equal to net operating profit after taxes (NOPAT) adjusted for the accrual components, which may also be referred to as non cash-flow components, of operating income. I use this equality to show how the residual operating income valuation model is derived from the free cash flow valuation model.

Section 3: Changing the focus to the valuation of equity and introducing reverse engineering

The structure of Section 3 closely parallels Section 2. Focus is shifted from valuation of the firm to valuation of equity. Most of the remaining sections focus on valuing equity and, in turn, on calculating the implied expected rate of return on equity capital. The parallels between Sections 2 and 3 should be borne in mind when reading the remainder of the survey. I begin Section 3 by introducing the dividend capitalization model from which I derive the residual income valuation model. The parallels between: (1) the valuation of the firm based on the discounted cash flow valuation model and the valuation of equity based on the dividend capitalization model; and (2) the derivation of the residual operating income valuation model from the discounted cash flow valuation model and the derivation of the residual income model from the dividend capitalization model, become apparent.

This survey is on estimating the cost of capital implied by market prices and accounting data. The empirical literature that estimates the cost of capital based on market prices and accounting data reverse engineers the accounting-based valuation models to obtain estimates of the implied expected rate of return, which, in turn is used as a proxy for the cost of capital. The concept of reverse engineering is introduced at the end of Section 3. Reverse engineering to obtain the implied expected rate of return depends critically on the maintained assumption about the growth rate beyond the period for which forecasts are available. The effect of the growth-rate assumption on estimates of the implied expected rate of return becomes evident in the example.

Although the term cost of capital is commonly used to describe the implied expected rates of return, they are not the cost of capital unless the market prices are efficient and the earnings forecasts are the market's earnings expectations. A more precise term would be "the internal rate of return implied by market prices, accounting book values and analysts' forecasts of earnings." Since many of the earnings forecasts used in the extant literature are made by analysts who are in the business of making stock buy/sell recommendations, estimates of the expected rate of return implied by these analysts' forecasts and market prices are, arguably, not estimates of the cost of capital. It would seem reasonable to suggest, for example, that analysts may base their recommendations on the difference between the internal rate of return implied by market prices, accounting book values and analysts' forecasts of earnings and the cost of equity capital.

Section 4: Reverse engineering the abnormal growth in earnings valuation model: PE ratios and PEG ratios

The residual income valuation model anchors the valuation of equity on book value of equity and makes adjustments to this valuation via future expected residual income. The abnormal growth in earnings model, which is also derived from the dividend capitalization model, anchors the valuation of equity on capitalized future earnings and then makes adjustments to this value via future expected abnormal growth in earnings.

In Section 4, I derive and illustrate the abnormal growth in earnings valuation model, focusing on the meaning of abnormal growth in earnings. Reverse engineering the abnormal growth in earnings valuation model to obtain estimates of the expected rate of return and expected growth beyond the earnings forecast horizon is also illustrated. Valuations based on the price-earnings (PE) ratio and on the PEG ratio (the PE ratio divided by short-term earnings growth) are special cases of the abnormal growth in earnings valuation model. I show in Section 4 that reverse engineering these ratios to obtain estimates of the expected rate of return may rely on assumptions that are not descriptively valid. I illustrate modifications that may improve these estimates of the expected rate of return.

Section 5: Reverse-engineering accounting-based valuation models to obtain firm-specific estimates of the implied expected rate of return

Section 5 focuses on reverse engineering the residual income valuation model and the abnormal growth in earnings valuation model to obtain *firm-specific* estimates of the implied expected rate of return on equity, which, in turn, may be used as estimates of the cost of equity capital. I present a critical assessment of the most commonly used reverse-engineering methods.

Sections 6 and *7: Reverse engineering the valuation models to obtain portfolio-level estimates of the implied expected rate of return*

Section 6 describes methods of reverse engineering the *abnormal growth in earnings* valuation model to obtain *portfolio-level* estimates of the implied expected rate of return. Section 7 describes two methods for reverse engineering the *residual income* valuation model to obtain *portfolio-level* estimates of the expected rate of return. The clear advantage of these methods is that they simultaneously estimate the expected rate of return *and* the expected growth rate implied by the data. Estimating both of these rates avoids the need for making inevitably erroneous assumptions about the expected growth rate beyond the earnings forecast horizon. The growth rates are the expected rate of change in abnormal growth in earnings and the expected residual income growth rate.

Section 8: Methods for assessing the quality/validity of firm-specific estimates

Section 8 describes and evaluates two approaches to assessing the validity/reliability of firm-specific estimates of the expected rate of return on equity capital. The first method asks: Do the estimates of *ex ante* expected return explain *ex post* realized return? The second method, which is more common in the literature, asks: What is the correlation between the estimates of the expected rate of return and commonly used risk proxies? I show that the second method has serious shortcomings and conclude that the method that relies on explanatory power for *ex post* realized returns, after controlling for omitted correlated variables, is the best extant method for evaluation of the estimates.

Section 9: Measurement error in firm-specific estimates of the expected rate of return

Section 9 focuses on the *firm-specific* estimates of the implied expected rate of return in the extant literature and summarizes results of analyses of their quality and validity. Unfortunately, the news is bad; the *firm-specific* estimates are quite poor, and thus unreliable. I hasten to add, however, that this is not a reason to abandon the use of these estimates. The lack of reliability is a reflection of the fact that the research literature is in its infancy; there are significant opportunities for research that has the aim of improving these estimates. Section 11 provides some suggestions.

Section 10: Bias in estimates of the expected rate of return due to bias in earnings forecasts

Evidence of bias, that is systematic or nonzero average error, in estimates of the implied expected rate of return is presented and discussed in this section. This evidence complements the evidence of error at the firm-specific level discussed in Section 9.

Section 11: Dealing with shortcomings in firm-specific estimates

Section 11 suggests ways of dealing with the shortcomings in firm-specific estimates of the implied expected rate of return and ways of mitigating the effects of bias in portfolio-level estimates. Possible directions for future research are also discussed.

Section 12: Methods for determining the effect of a phenomenon of interest on the cost of capital

Much of the research literature asks the question: What is the effect of a phenomenon of interest (for example, disclosure quality, cross-listing, adoption of IFRS) on the cost of equity capital? Section 12 describes a method for determining these effects. The method compares estimates of the implied expected rate of return among groups of stocks, which differ in the phenomenon of interest. The method also permits introduction of control variables to deal with differences among the groups of stocks.

Section 13: Data Issues

Section 13 describes data issues that are often, in fact usually, encountered when estimating rates of return implied by accounting data and market prices. These issues are often overlooked even though they may be important as a practical matter. Ways of dealing with these issues are discussed. The main focus is on developing a method that facilitates daily estimation of the implied expected rate of return using only publicly available information at the estimation date.

Section 14: Some thoughts on future directions

Section 14 provides a brief summary and speculates on possible directions for future research.

2

Valuing the Firm

The next three sections of the survey lay out the basic elements of the valuation models that have been reverse-engineered to obtain estimates of the cost of capital. Since the emphasis of this survey is on the estimates of the cost of capital rather than on the valuation models *per se*, my discussion of these models is brief. Details of the derivations of these models, of the properties of these models, and of their relative strengths and weaknesses as practical valuation tools may be found elsewhere; see, for example, Ohlson and Gao (2006) and Penman (2007).

I have chosen to begin this survey with a discussion of the discounted cash flow valuation model for two reasons. First, the discounted cash flow valuation model is familiar to most people who have an interest in estimates of the cost of capital. Often the reason for this interest is the need to obtain an estimate of the discount rate to be used to estimate the present value of a series of cash flow forecasts. Second, the approach of "undoing" the accounting accruals to obtain an estimate of the free cash flow from forecasts of earnings, which is often taught in finance classes, may be turned on its head to show that the accounting-based valuation models are readily derived from this discounted cash flow model.

After laying out the basic ingredients of the discounted cash flow valuation model, I discuss an example based on forecasts for Procter and Gamble Inc. (P&G). In this example, there are forecasts of free cash flow from operations for the next four years, together with forecasts of expected growth in free cash flow beyond this four year horizon; these forecasts of free cash flow and growth are derived from forecasted income statement and balance sheet data. The forecasted free cash flows are discounted using the weighted average cost of capital as the discount rate to determine the present value of the firm (usually referred to as the enterprise value).

I also introduce the residual operating income valuation model in this section and I illustrate its use with the P&G example. Again, the focus is on valuing the firm rather than valuing the equity. I show, by means of the example, that free cash flow from operations is equal to net operating profit after taxes (NOPAT) adjusted for the accrual components, which may also be referred to as non-cash-flow components, of operating income. It follows that a variant of the free cash flow valuation model that focuses on operating income minus a capital charge for the investment in operations, that is, residual operating income, may be derived. I illustrate this residual operating income valuation model using the P&G example.

Since the focus of this survey is on reverse-engineering accounting-based valuation models to obtain estimates of the cost of capital, I illustrate the fundamental idea behind these estimates by reverse-engineering the residual operating income valuation model with the P&G data. Rather than calculating an intrinsic value of P&G, I determine the internal rate of return that is implied by P&G's market value and the forecasts of NOPAT. This internal rate of return may be viewed as the market's expected rate of return on P&G, and, in turn, it may be viewed as an estimate of the cost of capital for P&G.

At the outset, it is important to repeat the point made in the introduction that using this internal rate of return as an estimate of the cost of capital implicitly assumes that the market prices are efficient and that the operating income forecasts capture the market's expectations. It is important to bear in mind that these assumptions may not be valid.

The P&G example illustrates the equivalence of the discounted cash flow valuation model and the residual operating income valuation model. This equivalence is underscored at the end of the section via a formal derivation of the residual operating income valuation model from the discounted cash flow valuation model.

2.1 The Discounted Cash Flow Valuation Model

The discounted cash flow (DCF) valuation model may be written as follows:

$$V_0 = \sum_{t=1}^{\infty} \left(\frac{\text{FCF}_t}{(1+r_o)^t} \right), \tag{2.1}$$

where V_0 is the intrinsic (or true economic) value of the operations of the firm, FCF_t is the after-tax free cash flow from the operations of the firm in period t, and r_o is the expected rate of return on the operations of the firm.[1]

As a practical matter, we do not have forecasts for an infinite period. If we have an estimate of the expected growth in free cash flows beyond the forecast horizon (g_{fcf}), we can implement the following finite-horizon version of the DCF valuation model[2]:

$$V_0 = \sum_{t=1}^{T-1} \left(\frac{\text{FCF}_t}{(1+r_o)^t} \right) + \left(\frac{\text{FCF}_T}{(r_o - g_{\text{fcf}}) * (1+r_o)^{T-1}} \right) \tag{2.2}$$

[1] This expected rate of return on operations is often referred to as the cost of capital for the firm and, as a practical matter, is often determined as the weighted average of the after-tax cost of debt and the cost of equity capital; referred to as the weighted average cost of capital (WACC).

[2] This form of the model implicitly assumes that the cash flow grows at g_{fcf} during year T. If the infinite growth rate begins for year $T+1$, the model must be written as follows:

$$V_0 = \sum_{t=1}^{T} \left(\frac{\text{FCF}_t}{(1+r_o)^t} \right) + \left(\frac{\text{FCF}_T(1+g_{\text{fcf}})}{(r_o - g_{\text{fcf}}) * (1+r_o)^T} \right).$$

2.2 A Simple Example

I use forecasts for P&G to illustrate discounted cash flow valuation. These forecasts are based on a careful review of the financial statements and some knowledge of the company's plans. I use P&G's 2006 income statement and balance sheet as the basis for the forecasts[3]:

Sales	\$68,222
Sales growth rate	4.4%
Net operating profit *before* tax	\$13,249
Net operating profit *after* tax (NOPAT)	\$9,221
Net operating assets (NOA)	\$99,879
Net operating profit margin (NOPM) (\$9,221/\$68,222)	13.52%
Net operating asset turnover (NOAT) (\$68,222/\$99,879)	0.683

Using these inputs, I forecast P&G's sales, NOPAT and NOA.[4] Each year's forecasted sales is the prior year sales multiplied successively by (one-plus) the expected sales growth rate, or 1.044 in this case, and then rounded to whole digits. NOPAT is computed using forecasted (and rounded) sales each year times the 2006 net operating profit margin (NOPM) of 13.52%; and NOA is computed using forecasted (and rounded) sales divided by the 2006 net operating asset turnover (NOAT) of 0.683.[5] Forecasted numbers for 2007 through 2010 are provided in the following table.

[3] P&G's fiscal year ended on June 30, 2006. In this example, "years" are fiscal years. Comparing P&G sales for 2005 and 2006, we see a 20.2% increase ([\$68,222/\$56,741] − 1). This sales growth is high and I question its persistence. Further analysis reveals P&G's 2006 sales include eight months of sales from Gillette after its acquisition by P&G during 2006. P&G's 2005 sales do not include those from Gillette. Thus, comparing 2005 to 2006 is not valid. Footnotes reveal pro forma sales that show what the income statement would have reported had Gillette's full-year sales been included in both 2005 and 2006; P&G's sales growth would have been 4.4%, which is more realistic, and is the forecasted sales growth I use.

[4] NOPAT is sales less operating expenses (including the effect of taxes), NOA is current and long-term operating assets less current and long-term operating liabilities; or operating working capital plus long-term net operating assets.

[5] NOPM is the ratio of NOPAT to sales; NOAT is the ratio of sales to net operating assets.

	Procter & Gamble Multiyear Forecasts of Sales, NOPAT and NOA ($millions)		
	2006	2007 Est.	2008 Est.
Net sales	$68,222	$71,224 ($68,222 × 1.044)	$74,358 ($71,224 × 1.044)
NOPAT	$9,221	$9,627 ($71,224 × 13.52%)	$10,051 ($74,358 × 13.52%)
NOA	$99,879	$104,274 ($71,224/0.683)	$108,862 ($74,358/0.683)
	2009 Est.	2010 Est.	
Net sales	$77,629 ($74,358 × 1.044)	$81,045 ($77,629 × 1.044)	
NOPAT	$10,493 ($77,629 × 13.52%)	$10,955 ($81,045 × 13.52%)	
NOA	$113,652 ($77,629/0.683)	$118,652 ($81,045/0.683)	

These forecasts of NOPAT and NOA may be used to obtain forecasts of FCF; which is equal to NOPAT minus the change in net operating assets. Note that this is, in fact, the standard calculation seen in most valuation texts where change in net operating assets is broken into several main components; such as change in working capital (change in inventory, change in accounts receivable, and change in accounts payable), depreciation, and capital expenditure.[6]

For the sake of the example, assume a growth rate beyond the four-year forecast horizon of 4.4%, and a cost of capital for operations (also referred to as the weighted average cost of capital) of 7%.[7] The calculation of free cash flow and the valuation based on the discounted cash flow valuation model are provided in the following table.

[6] Another way of understanding this calculation is to note that we are adjusting NOPAT for the accounting accruals to get to a free cash flow number; note that NOPAT contains accruals such as change in receivables, change in payables, change in inventory, etc. and change in NOA also contains these same items so that it follows that NOPAT minus change in NOA is equal to free cash flow.

[7] The weighted average cost of capital for P&G of 7% was obtained from Bloomberg on June 30, 2006.

	Year					Terminal
(In millions)	2006	2007	2008	2009	2010	year
Sales	\$68,222	\$71,224	\$74,358	\$77,629	\$81,045	\$84,611
NOPAT	9,221	9,627	10,051	10,493	10,955	11,437
NOA	99,879	104,274	108,862	113,652	118,652	123,873
Increase in NOA		4,394	4,588	4,790	5,001	5,221
FCF		5,232	5,463	5,703	5,954	6,216

$$V_0 = \frac{5,232}{1.07} + \frac{5,463}{1.07^2} + \frac{5,703}{1.07^3} + \frac{5,954}{1.07^4} + \frac{6,216}{(0.07 - 0.044) * 1.07^4}$$
$$= \$201,245.$$

That is, the estimated intrinsic value of the operations of P&G is \$201,245.

2.3 The Residual Operating Income Valuation Model

Notice that in determining the forecasts of free cash flow, we use the fact that:

$$\text{FCF}_t = \text{NOPAT}_t - \Delta\text{NOA}_t. \tag{2.3}$$

Recognizing this fact, we can substitute for FCF_t in Equation (2.1) to obtain the residual operating income valuation model[8]

$$V_0 = \text{NOA}_0 + \sum_{t=1}^{\infty} \left(\frac{\text{NOPAT}_t - r_o \text{NOA}_{t-1}}{(1 + r_o)^t} \right). \tag{2.4}$$

And, since we only have forecasts for a finite future period, we implement the finite horizon version of this model:

$$V_0 = \text{NOA}_0 + \sum_{t=1}^{T-1} \left(\frac{\text{NOPAT}_t - r_o \text{NOA}_{t-1}}{(1 + r_o)^t} \right) + \left(\frac{\text{NOPAT}_T - r_o \text{NOA}_{T-1}}{(r - g_{\text{ropi}}) * (1 + r_o)^{T-1}} \right), \tag{2.5}$$

[8] More details of this derivation are provided in Section 2.6.

where g_{ropi} is the expected growth in residual operating income beyond the forecast horizon.

Applying this model to the P&G forecasts, we obtain:

$$\begin{aligned}V_0 &= 99{,}879 + \frac{(9{,}627 - 0.07 * 99{,}879)}{1.07} + \frac{(10{,}051 - 0.07 * 104{,}274)}{1.07^2}\\ &\quad + \frac{(10{,}493 - 0.07 * 108{,}862)}{1.07^3} + \frac{(10{,}955 - 0.07 * 113{,}652)}{1.07^4}\\ &\quad + \frac{(11{,}437 - 0.07 * 118{,}652)}{(0.07 - 0.044) * 1.07^4}\\ &= \$201{,}245.\end{aligned}$$

This value is the same as we obtained using the discounted cash flow valuation model. This is expected because models (2.1) and (2.4) are linked by an identity, Equation (2.3). However, in the finite horizon we also need g_{fcf} to be equal to g_{ropi} if we are to obtain the same valuation. This will be so if (as in our P&G example) we have forecasted to the point where sales are assumed to be growing at a constant rate (4.4% for P&G) and the NOPM and the NOAT are assumed to be constant. In other words, we have forecasted to "steady-state," which is often done in practice.

2.4 Reverse Engineering

The focus of this survey is on using forecasts of accounting numbers to estimate the cost of capital. I illustrate the fundamental idea behind these estimates by reverse engineering the residual operating income valuation model with the P&G data. Rather than calculating an intrinsic value of P&G as we have just done, we can determine the internal rate of return that is implied by P&G's market value and the forecasts we have made. This internal rate of return may be viewed as the market's expected rate of return on P&G, and, in turn, it may be viewed as an estimate of the cost of capital for P&G. Note that, since the focus remains on the operations of the firm, we obtain an estimate of the cost of capital for operations, which is also called the cost of capital for the firm or the weighted-average cost of capital. I will return to this point.

On July 1, 2006, P&G's market value was \$212,557 million.[9] This market value and the forecast of NOPAT and NOA, imply an internal rate of return of 6.86%; which is the solution to the following equation:

$$
\begin{aligned}
212{,}557 = 99{,}879 &+ \frac{(9{,}627 - r_o * 99{,}879)}{(1+r_o)} + \frac{(10{,}051 - r_o * 104{,}274)}{(1+r_o)^2} \\
&+ \frac{(10{,}493 - r_o * 108{,}862)}{(1+r_o)^3} + \frac{(10{,}955 - r_o * 113{,}652)}{(1+r_o)^4} \\
&+ \frac{(11{,}437 - r_o * 118{,}652)}{(r_o - 0.044) * (1+r_o)^4}
\end{aligned}
$$

That is, our forecasts, taken together with the market price, suggest that the market expects a return of 6.86% on the operations of P&G; this expected rate of return may be viewed as an estimate of the cost of capital for operations.

2.5 The Algebra of the Derivation of the Accounting-based Valuation Models

The algebra of the derivation of the accounting-based valuation models is as follows. We will see this algebra in the derivation of the residual operating income model in the next section, in the derivation of the residual income model in Section 3, and in the derivation of the abnormal growth in earnings valuation model in Section 4.

The derivation of accounting-based valuation models begins with the capitalization model:

$$V = \sum_{t=1}^{\infty}\left(\frac{x_t}{(1+r)^t}\right), \tag{2.6}$$

where x_t is the pay-off; either free cash flow if V is the value of the firm, or dividends (that is, net payments to equity holders) if V is the value of equity. The next step is introduction of the following zero-sum equality[10]:

$$0 = y_0 + \frac{y_1 - (1+r)y_0}{(1+r)} + \frac{y_2 - (1+r)y_1}{(1+r)^2} + \cdots \tag{2.7}$$

[9] \$35,816 million owned by debt-holders and \$176,741 million owned by equity holders (3,178,800,000 shares priced at \$55.60 per share).

[10] The role of this zero-sum equality is explained in Ohlson and Gao (2006).

this may be more easily understood if re-written as follows:

$$0 = y_0 - y_0 + \frac{y_1}{(1+r)} - \frac{y_1}{(1+r)} + \frac{y_2}{(1+r)^2} - \frac{y_2}{(1+r)^2} + \cdots$$

where y_t is a valuation anchor such as book value or capitalized next-period earnings. This zero-sum equality permits the introduction of the accounting-based valuation anchor to the valuation model.

Adding Equations (2.6) and (2.7) yields:

$$V = y_0 + \sum_{t=1}^{\infty} \left(\frac{y_t + x_t - (1+r) * y_{t-1}}{(1+r)^t} \right). \tag{2.8}$$

2.6 The Derivation of the Residual Operating Income Valuation Model

Using Equations (2.6), (2.7), and (2.8), we derive the residual operating income model as follows:

$$V_0 = \sum_{t=1}^{\infty} \left(\frac{\text{FCF}_t}{(1+r_o)^t} \right) \tag{2.9}$$

$$0 = \text{NOA}_0 + \frac{\text{NOA}_1 - (1+r_o)\text{NOA}_0}{(1+r_o)} + \frac{\text{NOA}_2 - (1+r_o)\text{NOA}_1}{(1+r_o)^2} + \cdots \tag{2.10}$$

Adding Equations (2.9) and (2.10) yields:

$$V_0 = \text{NOA}_0 + \sum_{t=1}^{\infty} \left(\frac{\text{NOA}_t + \text{FCF}_t - (1+r_o) * \text{NOA}_{t-1}}{(1+r_o)^t} \right). \tag{2.11}$$

Recognizing that $\text{FCF}_t = \text{NOPAT}_t - \Delta\text{NOA}_t$ and substituting in (2.11) yields the residual operating income valuation model:

$$V_0 = \text{NOA}_0 + \sum_{t=1}^{\infty} \left(\frac{\text{NOPAT}_t - r_o\text{NOA}_{t-1}}{(1+r_o)^t} \right). \tag{2.12}$$

2.7 Summary

This section has maintained a focus on valuing the operations of the firm. We have illustrated the fact that the residual operating income valuation model may be derived from the discounted cash flow valuation model and we have seen that the residual operating income valuation model may be reverse-engineered to determine the expected rate of return that is implied by market prices, the book value of net operating assets, and forecasts of NOPAT.

Although we may be able to make our own forecasts of NOPAT, these forecasts are generally not readily available for large samples of observations. On the other hand, forecasts of earnings are readily available and this is the most likely reason why the research literature has tended to focus on reverse-engineering earnings-based valuation models rather than models based on NOPAT and free cash flow. The next two sections examine earnings-based valuation models that are at the center of much of the academic literature.

3

Changing the Focus to the Valuation of Equity and Introducing Reverse Engineering

Professional analysts tend to forecast dividends and earnings.[1] For a large company, like P&G, these forecasts are available from a variety of sources. For example, ValueLine provided the following forecasts for P&G at the end of June 2006:

	year				
	2007	2008	2009	2010	2011
Earnings per share	3.02	3.45	3.83	4.22	4.60
Dividends per share	1.41	1.54	1.66	1.78	1.90
Price per share					100.00

How can these forecasts be converted into an estimate of the intrinsic value of an equity share of P&G? How can these forecasts be used to obtain an estimate of the cost of capital? How might these forecasts be used as the basis for stock recommendations? I will answer these questions in this section.

[1] Analysts have, more recently been forecasting cash flow numbers; these numbers must be used cautiously as they are likely not free cash flow as defined in Section 2.

I begin Section 3 with a discussion of the dividend capitalization model from which I derive the residual income valuation model. I illustrate this model using the forecasts for P&G. In the latter part of the section, I demonstrate reverse engineering of the dividend capitalization model and the residual income valuation model to obtain estimates of the cost of equity capital.

The set-up of Section 3 closely parallels that of Section 2. The parallels between: (1) the valuation of the firm based on the discounted cash flow valuation and the valuation of equity based on the dividend capitalization model; and (2) the derivation of the residual operating income valuation model from the discounted cash flow valuation model and the derivation of the residual income model from the dividend capitalization model, become apparent.

This survey is on estimating the cost of capital implied by market prices and accounting data. The empirical literature that estimates the cost of capital based on market prices and accounting data reverse engineers the accounting-based valuation models to obtain estimates of the implied expected rate of return, which, in turn is used as a proxy for the cost of capital. The concept of reverse engineering is introduced at the end of the section. Reverse engineering to obtain the implied expected rate of return depends critically on the maintained assumption about the growth rate beyond the period for which forecasts are available. The effect of the growth-rate assumption on estimates of the implied expected rate of return becomes evident in the example.

3.1 The Dividend Capitalization Model

The dividend capitalization model may be written as follows:

$$V_0^E = \sum_{t=1}^{\infty} \left(\frac{\text{dps}_t}{(1 + r_E)^t} \right), \tag{3.1}$$

where V_0^E is the intrinsic value of an equity share, dps_t is the expected dividend per share paid to a shareholder of the firm in period t, and r_E is the expected rate of return on the equity investment.

Again, as a practical matter, we do not have forecasts for an infinite period. If, instead, we have estimates of the expected growth in dividends beyond the investment horizon (g_d), we can implement the following finite-horizon version of the dividend capitalization model:

$$V_0^E = \sum_{t=1}^{T}\left(\frac{\text{dps}_t}{(1+r_E)^t}\right) + \left(\frac{\text{dps}_T(1+g_d)}{(r_E - g_d) * (1+r_E)^T}\right) \tag{3.2}$$

and if we have a forecast of share prices at the end of the forecast horizon, as we do for P&G, we can invoke the following form of the model:

$$V_0^E = \sum_{t=1}^{T}\left(\frac{\text{dps}_t}{(1+r_E)^t}\right) + \left(\frac{\text{price}_T}{(1+r_E)^T}\right). \tag{3.3}$$

3.2 A Simple Example

Applying the dividend capitalization model to the forecasts for P&G we obtain:

$$\begin{aligned} V_0^E &= \frac{1.41}{1.079} + \frac{1.54}{1.079^2} + \frac{1.66}{1.079^3} + \frac{1.78}{1.079^4} + \frac{1.90}{1.079^5} + \frac{100}{1.079^5} \\ &= \$74.94 \end{aligned}$$

(in this illustrative example, I use Bloomberg's estimate of the cost of equity capital for P&G, which was 7.9% at the end of June 2006).

That is, ValueLine's forecasts of dividends and terminal price, and Bloomberg's estimate of the cost of equity capital, suggest that P&G's market price of $55.60 at the date of these forecasts was too low.

Rather than using Bloomberg's estimate of the cost of equity capital, we can reverse engineer the dividend capitalization model to determine the implied market expected rate of return. Continuing with the P&G example, we solve the following equation:

$$\begin{aligned} 55.60 &= \frac{1.41}{(1+r_E)} + \frac{1.54}{(1+r_E)^2} + \frac{1.66}{(1+r_E)^3} + \frac{1.78}{(1+r_E)^4} \\ &\quad + \frac{1.90}{(1+r_E)^5} + \frac{100}{(1+r_E)^5} \\ r_E &= 9.05\%. \end{aligned}$$

That is, analysts' forecasts of dividends and terminal prices imply that they expect a return of 9.05% on an equity investment in P&G.

Also, to illustrate the use of Equation (3.2), let us suppose that we did not have a forecast of price for P&G at the end of the forecast horizon. Then the unknown would be growth in dividends beyond the investment horizon (g_d). We can reverse engineer the dividend capitalization model to obtain an estimate of this growth rate:

$$\begin{aligned} 55.60 &= \frac{1.41}{1.079} + \frac{1.54}{1.079^2} + \frac{1.66}{1.079^3} + \frac{1.78}{1.079^4} + \frac{1.90}{1.079^5} \\ &\quad + \frac{1.90(1+g_d)}{(0.079-g_d)*(1.079)^5} \\ g_d &= 5.1\%. \end{aligned}$$

3.3 The Residual Income Valuation Model

The residual income valuation model relies on the accounting stocks and flows equation; sometimes referred to as the clean-surplus relation. This equation simply states that value at the beginning of the period, reported on the balance sheet as the book value of common shareholder equity (bps_{t-1}), plus the value created during the period, reported on the income statement as net income (eps_t), minus the value distributed during the period, in the form of dividends (dps_t), is the value at the end of the period (bps_t). That is

$$\text{bps}_t = \text{bps}_{t-1} + \text{eps}_t - \text{dps}_t$$

or,

$$\text{dps}_t = \text{eps}_t - \Delta\text{bps}_t. \tag{3.4}$$

Recognizing this fact, we can substitute for dps_t in the dividend capitalization model, Equation (3.1), to obtain the residual income valuation model[2]:

$$V_0^E = \text{bps}_0 + \sum_{t=1}^{\infty}\left(\frac{\text{eps}_t - r_E\text{bps}_{t-1}}{(1+r_E)^t}\right). \tag{3.5}$$

[2] See Section 3.6 for a formal derivation.

And, since we only have forecasts for a finite future period, we implement the finite-horizon version of this model:

$$V_0^E = \text{bps}_0 + \sum_{t=1}^{T}\left(\frac{\text{eps}_t - r_E \text{bps}_{t-1}}{(1+r_E)^t}\right) + \left(\frac{(\text{eps}_T - r_E\text{bps}_{T-1}) * (1+g_{ri})}{(r_E - g_{ri}) * (1+r_E)^T}\right). \quad (3.6)$$

If, as in the case of the P&G example, we have a forecast of price at the end of the forecast horizon we can invoke the following form of the model:

$$V_0^E = \text{bps}_0 + \sum_{t=1}^{T}\left(\frac{\text{eps}_t - r_E \text{bps}_{t-1}}{(1+r_E)^t}\right) + \frac{(\text{price}_T - \text{bps}_T)}{(1+r_E)^T}. \quad (3.7)$$

Forecasts of book value are obtained using the accounting stocks and flows equation. For the P&G example, we obtain the following forecasts of book value:

	year					
	2006	2007	2008	2009	2010	2011
Earnings per share		3.02	3.45	3.83	4.22	4.60
Dividends per share		1.41	1.54	1.66	1.78	1.90
Book value per share	20.15	21.76	23.67	25.84	28.28	30.98
Price per share						100.00

Applying the residual income valuation model to the P&G forecasts, we obtain, from Equation (3.6):

$$V_0^E = 20.15 + \frac{(3.02 - 0.079 * 20.15)}{1.079} + \frac{(3.45 - 0.079 * 21.76)}{1.079^2} + \frac{(3.83 - 0.079 * 23.67)}{1.079^3} + \frac{(4.22 - 0.079 * 25.84)}{1.079^4}$$

$$+\frac{(4.60 - 0.079 * 28.28)}{1.079^5} + \frac{(4.60 - 0.079 * 28.28) * 1.04324}{(0.079 - 0.04324) * 1.079^5}$$
$$= \$74.94.$$

and from Equation (3.7):

$$\begin{aligned} V_0^E &= 20.15 + \frac{(3.02 - 0.079 * 20.15)}{1.079} + \frac{(3.45 - 0.079 * 21.76)}{1.079^2} \\ &\quad + \frac{(3.83 - 0.079 * 23.67)}{1.079^3} + \frac{(4.22 - 0.079 * 25.84)}{1.079^4} \\ &\quad + \frac{(4.60 - 0.079 * 28.28)}{1.079^5} + \frac{(100 - 30.98)}{1.079^5} \\ &= \$74.94. \end{aligned}$$

Notice that we have reverse engineered the residual income model to obtain a growth rate $g_{ri} = 4.324\%$. The present value of residual income growing perpetually beyond the five-year forecast horizon at 4.324% from the 2011 base (\$4.60 − 0.079 ∗ \$28.28) will be equal to the 2011 difference between the forecasted price (\$100) and expected book value (\$30.98).

3.4 Reverse Engineering the Residual Income Valuation Model

Rather than calculating an intrinsic value of P&G, we can determine the internal rate of return that is implied by P&G's market price and the ValueLine forecasts. This internal rate of return may be viewed as the market's expected rate of return on P&G, and, in turn, it may be viewed as an estimate of the cost of capital for P&G. Since the focus now is on the *equity* ownership of P&G, this internal rate of return is an estimate of the cost of *equity* capital.

The price of P&G stock at the date of the forecasts in this example was \$55.60. This stock price, the forecasts of earnings, and a rate of growth in residual income of 4.324% beyond 2011, imply an internal rate of return of 9.05%, which is the solution to the following equation:

$$55.60 = 20.15 + \frac{(3.02 - r_E * 20.15)}{(1 + r_E)} + \frac{(3.45 - r_E * 21.76)}{(1 + r_E)^2} + \frac{(3.83 - r_E * 23.67)}{(1 + r_E)^3} + \frac{(4.22 - r_E * 25.84)}{(1 + r_E)^4} + \frac{(4.60 - r_E * 28.28)}{(1 + r_E)^5} + \frac{(4.60 - r_E * 28.28) * 1.04324}{(r_E - 0.04324) * (1 + r_E)^5}.$$

In other words, the ValueLine forecasts, taken together with the market price, suggest an expected rate of return of 9.05% on equity investment in P&G. This rate is higher than the Bloomberg estimate, probably reflecting optimism in the ValueLine forecasts. We will return to this point in Sections 8 and 9.

Recall that the growth rate of 4.324% beyond 2011 was based on the ValueLine 2011 price per share forecast of $100; which may be quite optimistic. Observe, alternatively, that we can take the Bloomberg estimate of the cost of equity capital (7.9%) as given, and reverse engineer the residual income valuation model, to obtain the implied expected rate of growth in residual income:

$$55.60 = \frac{20.15 + (3.02 - 0.079 * 20.15)}{1.079} + \frac{(3.45 - 0.079 * 21.76)}{(1.079)^2} + \frac{(3.83 - 0.079 * 23.67)}{(1.079)^3} + \frac{(4.22 - 0.079 * 25.84)}{(1.079)^4} + \frac{(4.60 - 7.9\% * 28.28)}{(1.079)^5} + \frac{(4.60 - 0.079 * 28.28) * (1 + g_{ri})}{(0.079 - g_{ri}) * (1.079)^5}$$

$$g_{ri} = 1.98\%.$$

3.5 The Importance of Simultaneously Estimating Both the Implied Expected Rate of Return and the Implied Expected Growth Rate

The example in Section 3.4 illustrates the interdependence of the estimate of the expected rate of return and the estimate of the expected rate of growth. The assumption about one of these expectations affects the estimate of the other, and vice versa. This underscores the need for a method that reverse engineers this valuation model to simultaneously estimate both the implied expected rate of return and the implied expected growth rate. This method will be detailed in Section 9.

3.6 Formal Derivation of the Residual Income Valuation Model

We derive the residual income model as follows:

$$V_0^E = \sum_{t=1}^{\infty} \left(\frac{\text{dps}_t}{(1 + r_E)^t} \right) \tag{3.8}$$

$$0 = \text{bps}_0 + \frac{\text{bps}_1 - (1 + r_E)\text{bps}_0}{(1 + r_E)} + \frac{\text{bps}_2 - (1 + r_E)\text{bps}_1}{(1 + r_E)^2} + \cdots \tag{3.9}$$

Adding Equations (3.8) and (3.9) yields:

$$V_0^E = \text{bps}_0 + \sum_{t=1}^{\infty} \left(\frac{\text{bps}_t + \text{dps}_t - (1 + r_E) * \text{bps}_{t-1}}{(1 + r_E)^t} \right). \tag{3.10}$$

Recognizing $\text{dps}_t = \text{eps}_t - \Delta\text{bps}_t$ and substituting in (3.9) yields the residual income valuation model:

$$V_0^E = \text{bps}_0 + \sum_{t=1}^{\infty} \left(\frac{\text{eps}_t - r_E \text{bps}_{t-1}}{(1 + r_E)^t} \right). \tag{3.11}$$

3.7 The Importance of the Clean-Surplus Assumption

I have shown the derivation of the residual income valuation model on a per share basis. Of course, one could also derive the model following the same steps to obtain the total dollar value of equity. As Ohlson (2005) points out, future equity transactions that are expected to change the number of shares outstanding generally imply that the clean-surplus assumption does not hold on a per share basis. Many studies have ignored this issue and calculated forecasted book value by assuming that the clean-surplus assumption holds; the effect of this assumption on the validity of the implied expected rate of return obtained in these papers is unknown. Ohlson (2005) further observes that for the residual income valuation model to hold on a total dollar basis, issuances and re-purchases of shares must be value-neutral from the point of view of new, future shareholders; again, the impact of these assumptions on the validity of implied expected rate of return is unknown.

These concerns lead Ohlson (2005) to advocate the use of the abnormal earnings growth valuation model discussed in the next section. It is important to note, however, that there are sound reasons for advocating the use of the extant empirical methods for obtaining estimates of the implied expected rate of return that are based on the residual income valuation model rather than the extant methods based on the abnormal growth in earnings valuation model. These reasons are discussed later in the survey.

3.8 Summary

This section has changed the focus from the valuation of the operations of the firm and reverse-engineering the residual operating income valuation model to obtain an estimate of the cost of capital for operations to a focus on the valuation of equity and reverse engineering the residual income model to obtain an estimate of the cost of equity capital. The residual income valuation model is derived from the dividend capitalization model. And, the importance of assumptions about the expected rate of growth beyond the earnings forecast horizon is illustrated. In the next section, another equity valuation model, based on earnings and earnings growth rather than on book value and residual income will be illustrated and derived.

4

Reverse Engineering the Abnormal Growth in Earnings Valuation Model: PE Ratios and PEG Ratios

The residual income valuation model discussed in Section 3 anchors the valuation of equity on book value of equity and makes adjustments to this valuation via future expected residual income. The abnormal growth in earnings model, which is also derived from the dividend capitalization model, anchors the valuation of equity on capitalized future earnings; it then makes adjustments to this value via future expected abnormal growth in earnings. This model is derived and illustrated in this section. The derivation is a somewhat over-simplified version of the derivation in Ohlson and Juettner-Nauroth (2005) and Ohlson and Gao (2006). The reader interested in the detailed derivation and the properties of this valuation model may fill in the details by reading these papers.

Valuations based on the price-earnings (PE) ratio and on the PEG ratio (the PE ratio divided by short-term earnings growth) are shown in this section to be special cases of the abnormal growth in earnings valuation model. I show that reverse engineering these ratios to obtain estimates of the expected rate of return may rely on assumptions that are not descriptively valid. I illustrate modifications that may improve these estimates of the expected rate of return.

4.1 The Abnormal Growth in Earnings Valuation Model

Forecasts of book value are required to implement the residual income valuation model. Although our P&G example suggests that these forecasts are relatively easy to obtain via forecasts of earnings and dividends, this may not always be the case. Also, the obvious focus by the investment community on earnings motivates a valuation model based only on earnings forecasts. This model is referred to as the Abnormal Growth in Earnings Valuation Model.

4.2 Formal Derivation of the Abnormal Growth in Earnings Valuation Model

The derivation of the abnormal growth in earnings valuation model follows the steps outlined via Equations (2.6), (2.7), and (2.8), with dividends as the payoff and capitalized next-period earnings as the valuation anchor:

$$V_0^E = \sum_{t=1}^{\infty} \left(\frac{\text{dps}_t}{(1+r_E)^t} \right) \tag{4.1}$$

$$0 = \frac{\text{eps}_1}{r_E} + \frac{\frac{\text{eps}_2}{r_E} - (1+r_E)\frac{\text{eps}_1}{r_E}}{(1+r_E)} + \frac{\frac{\text{eps}_3}{r_E} - (1+r_E)\frac{\text{eps2}}{r_E}}{(1+r_E)^2} + \cdots \tag{4.2}$$

Adding Equations (4.1) and (4.2) yields:

$$V_0^E = \frac{\text{eps}_1}{r_E} + \sum_{t=1}^{\infty} \left(\frac{\frac{\text{eps}_{t+1}}{r_E} + \text{dps}_t - (1+r_E) * \frac{\text{eps}_t}{r_E}}{(1+r_E^t)} \right). \tag{4.3}$$

Rearranging yields:

$$\begin{aligned} V_0^E &= \frac{\text{eps}_1}{r_E} + \sum_{t=2}^{\infty} \left(\frac{\text{eps}_t + r_E \text{dps}_{t-1} - (1+r_E) * \text{eps}_{t-1}}{r_E * (1+r_E)^{t-1}} \right) \\ &= \frac{\text{eps}_1}{r_E} + \sum_{t=2}^{\infty} \left(\frac{\text{agr}_t}{r_E * (1+r_E)^{t-1}} \right) \end{aligned} \tag{4.4}$$

where agr_t is the abnormal growth in earnings for year t. I will discuss the interpretation of this variable in Section 4.4.

4.3 The Connection Between the Abnormal Growth in Earnings Valuation Model and the Residual Income Valuation Model

Notice that the derivation of the abnormal growth in earnings model does not require clean-surplus accounting, thus avoiding the concerns raised by Ohlson (2005), which were outlined in Section 3.7. Ohlson (2005) shows that the residual income valuation model implies the abnormal earnings growth valuation; but the converse does not apply. In other words, the abnormal growth in earnings valuation model is "more robust" from a theoretical viewpoint.[1] However, we will see later that extant empirical estimates of the implied rate of return obtained from the residual income valuation model are likely to be more robust empirically than those obtained by reverse engineering the abnormal growth in earnings valuation model.

4.4 A Simple Example

In order to apply the abnormal growth in earnings valuation model to a set of finite horizon earnings forecasts, the model may be re-written in the following form:

$$V_0^E = \frac{\text{eps}_1}{r_E} + \sum_{t=2}^{T} \left(\frac{\text{agr}_t}{r_E * (1 + r_E)^{t-1}} \right) + \left(\frac{\text{agr}_T (1 + g_{\text{agr}})}{(r_E - g_{\text{agr}}) * r_E * (1 + r_E)^{T-1}} \right) \tag{4.5}$$

and the calculations for P&G are as follows:

	year				
	2007	2008	2009	2010	2011
Earnings per share	3.02	3.45	3.83	4.22	4.60
Dividends per share	1.41	1.54	1.66	1.78	1.90
Abnormal Growth in Earnings		0.30	0.23	0.22	0.19

[1] See Proposition III in Ohlson (2005).

P&G's abnormal growth in earnings for 2008 is calculated as: $3.45 + 0.079 * ($1.41) − 1.079 * ($3.02) = $0.30. The calculation for other years is similar. The intrinsic value of a share of P&G stock is estimated as follows:

$$\begin{aligned} V_0^E &= \frac{3.02}{0.079} + \frac{0.30}{0.079 * 1.079} + \frac{0.23}{0.079 * 1.079^2} + \frac{0.22}{0.079 * 1.079^3} \\ &\quad + \frac{0.19}{0.079 * 1.079^4} + \frac{0.19 * 1.01271}{(0.079 - 0.01271) * 0.079 * 1.079^4} \\ &= \$74.94. \end{aligned}$$

Note that this valuation assumes a rate of change in abnormal growth in earnings beyond the five-year forecast horizon (g_{agr}) of 1.271%, which is the rate such that the intrinsic value remains at $74.94, which was the valuation based on the residual income model. In other words, the abnormal growth in earnings valuation model was reverse engineered to obtain this growth rate.

4.5 What is Abnormal Growth in Earnings?

For the sake of illustration, suppose we only had earnings forecasts for two future periods. We could employ these forecasts to value P&G using the following, two-period, version of the abnormal growth in earnings valuation model:

$$V_0^E = \frac{\text{eps}_1}{r_E} + \frac{\text{agr}_2}{(r_E - g_{\text{agr}}) * r_E}. \tag{4.6}$$

Just as we reverse engineered the residual income valuation model to obtain an estimate of the cost of equity capital, we can reverse engineer the abnormal growth in earnings valuation model to obtain an estimate of this cost of capital. On the other hand, we could accept Bloomberg's estimate of the cost of equity capital and reverse engineer the abnormal growth in earnings model to obtain an estimate of the market's expectation of g_{agr} as follows:

$$\begin{aligned} 55.60 &= \frac{3.02}{0.079} + \frac{0.30}{(0.079 - g_{\text{agr}}) * 0.079} \\ g_{\text{agr}} &= -14.2\% \end{aligned}$$

What does this negative 14.2% growth rate mean?[2] Before answering this question, let us first step back and examine the meaning of agr_{2008} for P&G.

P&G's abnormal growth in earnings from 2007 to 2008 is forecast to be: $3.45 + 0.079 ∗ ($1.41) − 1.079 ∗ ($3.02) = $0.30. Reverse engineering the abnormal growth in earnings valuation model to obtain the change in the abnormal growth in earnings (beyond 2008) that equates a price of $55.60, capitalized earnings of $\frac{\$3.02}{0.079}$ and the 2008 abnormal growth in earnings of $0.30 yields a change in the abnormal growth in earnings of negative 14.2%. The abnormal growth in earnings of $0.30 and the growth from this base at negative 14.2%, are a consequence of GAAP. To see this, we introduce the concept of economic earnings.

4.6 The Concept of Economic Earnings

With an expected rate of return of 7.9%, P&G's expected cum-dividend price at the end of 2007 will be $55.60 ∗ 1.079, or $59.99.[3] Economic earnings for 2007 are expected to be $59.99 − $55.60, or $4.39. After $1.41 of dividends, price per share will drop to $58.58. By the end of 2008, price is expected to increase to $58.58 ∗ 1.079, or $63.21. That is, economic earnings for 2008 are expected to be $4.63.

If accountants were to record economic earnings instead of accounting earnings for P&G, there would be no abnormal growth in earnings ($4.63 + 0.079 ∗ $1.41 − 1.079 ∗ $4.39 = $0.00) for 2008. In this scenario, growth in economic earnings is "normal" inasmuch as cum-dividend earnings grow from 2007 to 2008 at a rate of

[2] Ohlson and Jeuttner-Nauroth (2005) show that the long-run rate of change in abnormal growth in earnings must be positive and less that the cost of capital. But their model does not permit the empirical possibility that the abnormal growth in earnings base on which this growth is built may be so high that future (short-run) growth must be negative in order to justify the market price. It is important to note that, although a long-run growth rate that is positive and less than the cost of capital is a necessary regularity condition, the growth rate that is implicit in versions of this model based on earnings for short forecast horizons is the average of a short-term growth rate (in the P&G example a short-term attenuation in the abnormal growth in earnings) and the very long-term growth rate captured by Ohlson and Jeuttner-Nauroth (2005). Easton (2004) shows that empirical estimates of g_{agr} are often negative.

[3] The Bloomberg estimate of the cost of equity capital is chosen for illustrative purposes only. I am not suggesting that Bloomberg's estimate is either correct or incorrect. This example and the examples in the remainder of this section would follow with other estimates.

7.9%.[4] But, since accounting earnings differs from economic earnings (\$3.02 compared with \$4.39 in 2007 and \$3.45 compared with \$4.63 in 2008), there is nonzero abnormal growth in earnings. In other words, accounting earnings were conservative in 2007; they were less than economic earnings. The positive (\$0.30) abnormal growth in accounting earnings in 2008 means that accounting earnings partially adjust for this conservatism.

4.7 What is Growth in Abnormal Growth in Earnings?

As I have illustrated in Sections 4.4 and 4.5, abnormal growth in earnings is the dollar amount of the difference between cum-dividend earnings in period t (\$3.45 + 0.079 ∗ (\$1.41) in the P&G example) and "normal earnings," conditional on earnings of period $t-1$ (1.079 ∗ (\$3.02) in the P&G example). The estimate of g_{agr}, which is the estimate of the rate of change in abnormal growth in earnings, of negative 14.2% is the geometric average rate at which the abnormal growth in earnings of 30 cents will decrease as accounting earnings eventually "correct" for the short-run difference between accounting and economic earnings in the two-year forecast horizon, 2007 to 2008.[5] The difference between short-run forecasts of accounting earnings (\$3.02 and \$3.45) and expected economic earnings (\$4.39 and \$4.63) determines the abnormal growth in earnings agr_{2008} "base." The abnormal growth in earnings will change from this base at a geometric average rate g_{agr} of negative 14.2% in the future. As an illustration of the relation between agr_{2008} and g_{agr}, suppose that the forecast of earnings for 2008 includes a nonrecurring item of \$0.20. The forecast of earnings if this nonrecurring item had been removed would be \$3.25 instead of \$3.45. This lower earnings forecast implies a much lower agr_{2008} (\$0.10) and a positive g_{agr} of 0.41%.[6]

[4] The "normal" growth in cum-dividend earnings incorporates the dividend irrelevance proposition of Modigliani and Miller (1958), which, in essence, implies in this context that future dividend payments can be invested at the expected rate of return.

[5] This growth reflects the fact that differences between accounting earnings and economic earnings in any one period must be captured in accounting earnings of another period (see Easton et al. (1992) for an elaboration of this point).

[6] The computations are as follows. $\text{agr}_{2008} = 3.25 + 0.079 * 1.41 - 3.02 * 1.079 = 0.10281$ and from Equation (4.6), $55.6 = \frac{3.02}{0.079} + \frac{0.10281}{[(0.079 - g_{\text{agr}}) \times 0.079]}$, that is, $g_{\text{agr}} = 0.41\%$.

4.8 Special Case: PE Ratios

The PE ratio and the PEG ratio, which are often used to compare stocks, are special cases of the two-year abnormal growth in earnings valuation model:

$$V_0^E = \frac{\text{eps}_1}{r_E} + \frac{\text{agr}_2}{(r_E - g_{\text{agr}}) * r_E}. \tag{4.7}$$

If we assume that $\text{agr}_2 = 0$; in other words, if we assume that next-year's forecast of earnings is sufficient for valuation, this relation becomes:

$$V_0^E = \frac{\text{eps}_1}{r_E}. \tag{4.8}$$

In other words, the cost of equity capital may be estimated as the inverse of the forward PE ratio. Reverse engineering this special case of the abnormal earnings valuation model would suggest an expected rate of return on equity capital of 5.4% for P&G, which is too low because the future accounting earnings growth has been erroneously assumed to be zero. Investment professionals have observed this shortcoming and suggested the use of PEG ratios.

4.9 PE Ratios and PEG Ratios

The PEG ratio is equal to the price-earnings ratio divided by an earnings growth rate. Analysts differ in their choice of the form of the price-earnings ratio (that is, price-to-trailing earnings or price-to-forward earnings) and in their choice of the earnings growth rate; which ranges from a one-year historical growth rate to an average expected annual growth rate estimated for several years.

Numerous articles in the popular press describe the pervasiveness of the use of the PEG ratio as a basis for stock recommendations.[7] The PEG ratio and its use in valuation is described on

[7] For example, *Barrons* (November 9, 1998), *Business Week* (March 23, 2001), *Forbes Magazine* (September 2, 2001 and October 28, 2002), *New York Times* (September 17, 2000), *Time Magazine* (April 1, 2001), and *Wall Street Journal* (January 24, 2001 and March 19, 2001). Financial web sites, (for example, http://www.stockselector.com and http://www.fool.com/pegulator) often report PEG ratios and rely on these ratios as a primary basis for stock recommendations. Bradshaw (2004) further elaborates on the extensive use of the PEG ratio in analysts' reports.

http://www.fool.com/school/thegrowthrate.htm and is advocated by well-known Wall Street analyst, Peter Lynch, in his book *One Up On Wall Street.* The arguments for the use of the PEG ratio vary considerably but the essence of these arguments may be summarized as follows.

Use of the price-to-forward earnings (PE) ratio as a basis for stock recommendations relies on the notion that, *ceteris paribus*, a high (low) PE implies a low (high) expected rate of return, supporting a sell (buy) recommendation. However, next period's earnings may not be indicative of the future stream of earnings, and as Lynch ((2000), page 199) observes:

> "A company, say, with an [earnings] growth rate of 12% a year... and a PE ratio of 6 is a very attractive prospect. On the other hand, a company with a growth rate of 6 percent a year and a PE ratio of 12 is an unattractive prospect and headed for a comedown."

He goes on to say:

> "The PE ratio of any company that's fairly priced will equal its [earnings] growth rate.... In general, a PE ratio that's half the growth rate is very positive, and one that's twice the growth rate is very negative. We use this measure all the time in analyzing stocks for mutual funds."

4.10 Stock Recommendations Based on the PEG Ratio

The comparison of the PE ratio and the earnings growth rate as a basis for stock recommendations is captured in the PEG ratio. Consistent with Lynch's (2000) argument, a stock is fairly priced if its PEG ratio is equal to one and analysts would recommend holding the stock. A PEG ratio considerably greater/less than one would support a sell/buy recommendation. To summarize, the essence of the argument for the use of the PEG ratio is that, *ceteris paribus*, a high (low) PEG implies that the PE ratio is high (low) relative to the expected rate of growth in earnings suggesting that the future prospects are expected to worsen (improve), implicitly the expected rate of return is low (high), supporting a sell (buy) recommendation.

Despite the pervasive use of the PEG ratio, its proponents do not provide a model that is based on fundamental valuation theory. The abnormal growth in earnings valuation model may be used as this foundation/model. We will see this shortly.

4.11 The Modified PEG Ratio

Easton (2004) suggests the following modification to the PEG ratio. Consider the special case $g_{\text{agr}} = 0$.[8] That is, $\text{agr}_2 = \text{agr}_3 = \cdots$, and the next period's expected abnormal growth in earnings provides an unbiased estimate of all subsequent periods' abnormal growth in earnings. This special case of Equation (4.6) may be written[9]:

$$P_0 = \frac{\text{eps}_2 + r_E \text{dps}_1 - \text{eps}_1}{r_E^2} \tag{4.9}$$

and

$$r_E = \sqrt{\frac{\text{eps}_2 + r_E \text{dps}_1 - \text{eps}_1}{P_0}}. \tag{4.10}$$

That is:

$$r_E^2 - r_E * \frac{\text{dps}_1}{P_0} - \frac{\text{eps}_2 - \text{eps}_1}{P_0} = 0. \tag{4.11}$$

For P&G:

$$0.101^2 - 0.101 * \frac{1.41}{55.60} - \frac{3.45 - 3.02}{55.60} = 0.$$

That is, the implied expected rate of return on equity capital is 10.1%.[10]

[8] There will be cases where the assumption $g_{\text{agr}} = 0$ is a very reasonable first approximation. For example, consider Honda Motor Company (HMC), which was trading at a price per share of \$80 at the end of its fiscal year (March 31) 2001. Analysts were forecasting earnings for 2002 and 2003 of \$5.50 and \$6.25 and dividends of \$0.50. If Honda's expected rate of return is 10 percent, $\text{agr}_2 = \$6.25 + 0.1(\$0.50) - (1.1)\$5.50 = 0.25$. In this example, $P_0 = \$80 = [\text{eps}_1/r_E] + [\text{agr}_2/r_E^2] = [\$5.50/0.1] + [0.25/0.01]$ and $g_{\text{agr}} = 0$.

[9] We replace intrinsic value V_0^E with market price P_0 because we are interested in reverse engineering to determine the expected rate of return implied by this market price.

[10] This model is used in several recent studies to estimate an implied expected rate of return on equity capital (see, for example, Francis et al. (2005) and Hail and Leuz (2006)).

4.12 The PEG Ratio

As a second special case, assume $g_{\text{agr}} = 0$ and $\text{dps}_1 = 0$, then from Equation (4.6):

$$r_E = \sqrt{\frac{\text{eps}_2 - \text{eps}_1}{P_0}}. \tag{4.12}$$

Under these assumptions, the implied estimate of the expected rate of return is equal to the square root of the inverse of the PEG ratio. To see this, note that:

$$\frac{(\text{eps}_2 - \text{eps}_1)}{P_0} = \frac{\frac{\text{eps}_2 - \text{eps}_1}{\text{eps}_1}}{\frac{P_0}{\text{eps}_1}} = \frac{1}{\text{PEG} * 100}.$$

For P&G:

$$8.8\% = \sqrt{\frac{3.45 - 3.02}{55.60}}.$$

That is, the implied expected rate of return on equity capital is 8.8%. Notice that this is much lower that the expected rate of return implied by the modified PEG ratio because the substantial dividends of $1.41 are ignored.

4.13 The Gode and Mohanram Modification

Gode and Mohanram (2003) also reverse engineer the abnormal growth in earnings valuation model to obtain estimates of the implied expected rate of return. They assume that g_{agr} beyond the earnings forecast horizon is equal to the risk-free rate minus 3%. They also modify the formula for agr_2 as follows:

$$\text{agr}_2 = \frac{\text{eps}_2 + (1 + g_e) * \text{eps}_1}{2} + r_E \text{dps}_1 - (1 + r_{\text{E}}) * \text{eps}_1. \tag{4.13}$$

The argument for this modification is that the growth in earnings per share from year 1 to year 2 may not be indicative of a long-term

Easton (2004) shows that estimates of the implied expected rate of return based on this method are generally biased downward — in other words, the g_{agr} implied by the data is greater than zero.

growth. Since analysts also provide an estimate of short-term earnings growth rate g_e (usually the average rate of growth for years 3 to 5), we may obtain a more reasonable estimate of the short-term growth rate by taking the average of these two estimates. For the P&G example (where analysts were forecasting a 3 to 5 year growth rate of 11.11%) the Gode and Mohanram (2003) estimate agr_2 is:

$$\text{agr}_2 = \frac{\$3.45 + 1.1111 * 3.02}{2} + r_E\$1.41 - (1 + r_E) * \$3.02.$$

Their estimate of the implied expected rate of return is the solution to

$$55.60 = \frac{3.02}{r_E} + \frac{\frac{3.45+1.1111*3.02}{2} + r_E * 1.41 - (1 + r_E) * 3.02}{(r_E - 0.0171) * r_E}.$$

That is, $r_E = 9.7\%$.[11]

The Gode and Mohanram (2003) modification to the calculation of agr_2 may also be applied to the growth rates used in the calculation of the expected rate of return implied by the PEG ratio and by the modified PEG ratio. The argument against this modification is that analysts' long-term growth rate forecasts tend to be very optimistic; it follows that the implied expected rate of return may be too high relative to market expectations.

4.14 Conclusions Regarding Modifications

Although the modifications outlined above may serve to improve estimates of the expected rate of return on equity capital and facilitate a more meaningful ranking of stocks, these estimates are affected by implicit or explicit assumptions about growth beyond the forecast horizon. This suggests the need for a method that reverse engineers the abnormal growth in earnings valuation model to simultaneously obtain estimates of the expected rate of return and the expected rate of growth. I will describe this method in Section 8.

[11] The risk-free rate (return on US Treasury Notes) at the end of 2006 was 4.71%, and hence the assumed rate of change in abnormal growth in earnings a_{agr} is 1.71%.

4.15 Summary

This section derived and illustrated the abnormal growth in earnings valuation model and discussed special cases of this model. The concept of abnormal growth in earnings, which defines short-term earnings growth as the dollar difference between cum-dividend earnings and normal earnings, was illustrated. The critical roles of: (1) this benchmark from which long-run growth occurs; and (2) the associated assumptions about this long-run growth rate when reverse engineering the abnormal earnings growth valuation model, became apparent.

5

Reverse Engineering the Residual Income Valuation Model to Obtain Firm-Specific Estimates of the Implied Expected Rate of Return

Several attempts have been made in the academic literature to obtain firm-specific estimates of the cost of capital. We saw some of these methods in the previous section; each was based on a restricted version of the abnormal growth in earnings valuation model. I will discuss these methods further in this section and introduce and illustrate other methods, each of which are based on the residual income valuation model. This section focuses on the assumptions that have been made to permit the estimation of *firm-specific* estimates. Estimates at the *portfolio level* will be discussed in Sections 6 and 7.

5.1 Reverse Engineering the Residual Income Valuation Model

Claus and Thomas (2001), Gebhardt et al. (2001), and Easton et al. (2002) reverse engineer the residual income valuation model to obtain estimates of the implied expected rate of return on equity. The principal difference between these papers is the treatment of expected rates of growth beyond the (short) forecast horizon (four to five years).

I do not analyze the Botosan (1997) approach to the estimation of the implied expected rate of return on equity capital, which, at first glance appears to be based on the residual income valuation model, because it is, in fact, based on the dividend capitalization model.[1]

5.2 Approaches to the Problem of Growth Rates Beyond the Forecast Horizon

Four approaches regarding the growth rate beyond the forecast horizon are common: (1) assuming that residual income, in Claus and Thomas (2001), or abnormal growth in earnings, in Gode and Mohanram (2003), grow at the same rate for all firms (in both of these papers this growth rate is an estimate of the expected inflation rate); (2) fading the terminal return-on-equity to an industry median return-on-equity as in Gebhardt et al. (2001); (3) simultaneously estimating the expected rate of return and the residual income growth rate implied by the data as in O'Hanlon and Steele (2000) and in Easton et al. (2002); and (4) simultaneously estimating the expected rate of return and the rate of change in abnormal growth in earnings as in Easton (2004), that are implied by the data.[2]

5.3 Advantages/Disadvantages

The advantage of the first two approaches is that they ostensibly provide firm-specific estimates of the implied expected rate of return while the latter approaches only provide estimates of the implied expected rate of return for portfolios of stocks. The disadvantage of the first two

[1] To see this, note that Equations (3.3) and (3.6) are algebraically equivalent. The empirical implication is that, if we use forecasts of terminal (period T) price and we get estimates of book value (and, hence, residual income) from forecasts of dividends, the forecast of earnings (and, hence, residual income) are irrelevant in the valuation. In other words, the estimate of the cost of capital is independent of the forecasts of earnings; Botosan's estimate of the implied expected rate of return is based on the dividend capitalization model rather than on the residual income valuation model.

[2] Several studies have used estimates of the expected rate of return based on a restricted form of the abnormal growth in earnings model in which the rate of change in abnormal growth in earnings is assumed to be zero. This method is outlined in Easton (2004), which shows that the implied estimates of the expected rate of return based on this method are downward biased.

approaches is that the assumed growth rate beyond the short forecast horizon may, and probably will, differ from the growth rate implied by the data. It follows that the implied expected rates of return are likely to be unreliable.

5.4 Gebhardt et al. (2001)

The residual income model, as implemented in Gebhardt et al. (2001), may be expressed as

$$p_0 = \text{bps}_0 + \sum_{t=1}^{11} \frac{(\text{ROE}_t - r_E) * \text{bps}_{t-1}}{(1 + r_E)^t} + \frac{(\text{ROE}_{12} - r_E) * \text{bps}_{11}}{r_E * (1 + r_E)^{11}}, \tag{5.1}$$

where ROE_t is the expected return-on-equity for year t; that is, $\text{eps}_t/\text{bps}_{t-1}$. Expected earnings for the first three years are based on analysts' forecasts, with forecasted book value based on the assumptions that forecasted earnings are clean-surplus and the dividend payout ratio is constant. Gebhardt et al. (2001) assume that beyond year three, expected return-on-equity fades to the historical industry median; then residual income is constant beyond year $t + 12$. The historical industry median return-on-equity is the median over time and across firms for all firms in the same Fama and French (1997) industry classification that have available data in any of the prior nine years.[3]

Returning to the P&G example,

	Year			
	2006	2007	2008	2009
Earnings per share		3.02	3.45	3.83
Dividends per share		1.41	1.54	1.66
Book value per share	20.15	21.76	23.67	25.84
ROE		0.150	0.159	0.162

P&G is in the "consumer goods" industry. The median ROE for this industry, calculated as in Gebhardt et al. (2001), is 13.5% so that the

[3] As in Gebhardt et al. (2001), all observations with negative net income are excluded from the calculation of the industry median return-on-equity.

ROE is assumed to fade linearly over the years 2009 to 2018 as follows:

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
0.162	0.159	0.156	0.153	0.150	0.147	0.144	0.141	0.138	0.135

and the implied expected rate of return is 7.4%.

Pertinent questions regarding the implementation of the Gebhardt et al. (2001) idea of fading the ROE are: Why fade to the industry median return-on-equity? and: What is the appropriate industry comparison group?

5.5 Why Fade to the Industry Median Return-on-Equity?

Gebhardt et al. (2001) base their argument for fading to the industry median return-on-equity on the notion that residual income captures economic rents. They state that "the mean reversion in return-on-equity attempts to capture the long-term erosion of abnormal return-on-equity over time and the notion that, in the long-run, individual firms tend to become more like their peers." But, abnormal return-on-equity captures both: (1) economic rents (positive net present value opportunities — that is, economic value added); and (2) differences between the accountant's measure of the expected rate of return-on-equity-capital (ROE) and the market's expected rate of return; that is, accounting value added.[4]

In view of the conservative nature of accounting in particular, and the difference between GAAP earnings and economic earnings in general, it is improbable that residual income will capture economic rents; rather, residual income will be due to the accounting methods that under-pin the determination of book value and the forecasts of earnings. It follows that abnormal return-on-equity is primarily due to choice of accounting method and will reflect both real growth and a correction for GAAP differences between short-run forecasts of earnings and "economic earnings."

[4] See Easton (2001) for a detailed discussion of this difference.

5.6 What is the Appropriate Industry Comparison Group?

Investment professionals may be sufficiently familiar with a firm and its peers to make a well-informed estimate of the ROE to which the terminal ROE should be faded in a reverse engineering exercise similar to that of Gebhardt et al. (2001). This is, however, much more difficult for researchers who are interested in large samples of observations and who may have little familiarity with the firms that comprise their sample — almost certainly they do not have enough familiarity to subjectively select comparable firms, or, even firms that are truly within the same industry. I provide two examples, both based on companies in the Dow Jones Industrial Average, which illustrate possible problems that researchers may encounter. Of course, determination of the "true" expected ROE is impossible, and judgments regarding the validity of comparable firms will vary.

The first example is Altria Group Inc. Altria Group Inc. is in the industry dubbed "smoke" by Fama and French (1997). At December 2004, Altria was the holding company of Kraft Foods, Philip Morris International, Philip Morris USA, and Philip Morris Capital Corporation. Altria Group was also the largest shareholder in the world's second-largest brewer, SABMiller, with an approximate 33.9% economic interest. Seventeen firms formed the basis of the 87 firm-year observations that would be used to calculate the Gebhardt et al. (2001) industry median ROE. This comparison group includes four American Depositary Receipts (ADRs).

I will not offer a detailed debate about the comparability of the Altria Group and the firms used to calculate the "smoke" industry median ROE; but a few observations are in order. First, one might reason that in view of the similar size, similar legal environment, and similar structure, RJ Reynolds would be the most appropriate comparison firm; RJ Reynolds follows US GAAP, and hence has an ROE that is based on similar accounting principles and, like Altria, RJ Reynolds is not only in the tobacco business but it is also in the food and beverage business. Yet, RJ Reynolds entered the comparison group only four times; in 1999, 2000, 2001, and 2004 with returns-on-equity of 0.21, 0.26, 0.05, and 0.23. These ROEs are in line with the forecasted 2007

ROE for Altria of 0.23 based on I/B/E/S data, and are lower than the median ROE of 0.35 for the 87 observations.[5] Second, the four ADRs are companies that follow UK GAAP, which requires the revaluation of long-lived intangible assets on the balance sheet, while Altria follows US GAAP, under which long-lived tangible assets are generally recorded at historic cost. It follows that ROE is unlikely to be comparable between Altria and the four ADR firms, rendering the median ROE somewhat questionable.

The second example is Microsoft and IBM. It is hard to accept that the 1,338 firms comprising the 4,930 firm-year observations that would be used by a researcher following the Gebhardt et al. (2001) methodology to calculate the industry median ROE for IBM and Microsoft at December 2004 were comparable with these very large well-established firms.[6] One could also debate whether Hewlett-Packard should be excluded (as it was) as a comparable firm.

5.7 Claus and Thomas (2001)

Claus and Thomas (2001) also reverse engineer the residual income valuation model to obtain estimates of the implied expected rate of return. They assume that g_{ri} beyond the earnings forecast horizon is equal to the risk-free rate minus 3%. Their estimate of the implied expected rate of return for P&G is the solution to[7]:

$$\begin{aligned} 55.60 = 20.15 &+ \frac{(3.02 - r_E * 20.15)}{1 + r_E} + \frac{(3.45 - r_E * 21.76)}{(1 + r_E)^2} \\ &+ \frac{(3.83 - r_E * 23.67)}{(1 + r_E)^3} + \frac{(4.22 - r_E * 25.85)}{(1 + r_E)^4} \\ &+ \frac{(4.60 - r_E * 28.28)}{(1 + r_E)^5} + \frac{(4.60 - r_E * 28.28) * (1 + 0.0171)}{(r_E - 0.0171) * (1 + r_E)^5}, \end{aligned}$$

that is, $r_E = 7.8\%$.

[5] RJ Reynolds had negative ROE in the other sample years and, hence, following Gebhardt et al. (2001), these years would not be included in the calculation of the "smoke" industry median ROE.

[6] The number of firms in this comparison group increased by 219 during 2004. These additional firms are unlikely to be comparable with IBM and Microsoft.

[7] The risk-free rate as of June 30, 2006 was 4.71%.

5.8 Growth at $r_f - 3\%$

Both Claus and Thomas (2001) and Gode and Mohanram (2003) assume growth beyond the forecast horizon at the risk-free rate minus 3%. Claus and Thomas' (2001) assumption relates to growth in residual income and Gode and Mohanram's (2003) assumption relates to the rate of change in abnormal growth in earnings. Their rationale is as follows.

Expected residual income will be zero if book values reflect market values. If book values measure input costs fairly, but do not include the portion of market values that represent expected economic rents not yet earned, residual income would reflect those rents. However, the magnitude of these rents at the aggregate market level is likely to be small, and any rents that do emerge are likely to be dissipated over time. But, accounting conservatism leads to the understatement of input costs: on average, assets (liabilities) tend to be understated (overstated). For example, many investments, such as research and development, advertising and purchased intangibles are written off too rapidly in many accounting regimes. As a result, residual income tends to be positive even in the absence of economic rents.

Zhang (2000) shows that there are two important determinants of the difference between ROE and the market's expected rate of return on equity (r_E), which in turn determine the growth in residual income: (1) the long-term growth in investments; and (2) accounting conservatism. Under conservative accounting, expected ROE approaches r_E over time but remains above it; as the difference between ROE and r_E declines, residual income will also decline. However, a countervailing effect is the growth in investments, which increases the base on which residual income is generated.

In their main analyses, Claus and Thomas (2001) assume that the growth due to investment dominates the growth due to accounting conservatism; consequently, they assume that growth in investments will be at the rate of inflation estimated as the nominal risk-free rate minus the real risk-free rate (estimated to be 3%). Gode and Mohanram (2003) use the same rate for the rate of change in abnormal growth in earnings beyond the earnings forecast period.

5.9 Growth Stemming from Accounting Conservatism is Not Zero

Both Claus and Thomas (2001) and Gode and Mohanram (2003) implicitly assume that growth stemming from accounting conservatism is zero beyond the earnings forecast horizon. This assumption may be reasonable regarding earnings in the *very* long-run future, but there are two reasons to question this assumption as a practical matter: (1) we generally only have reliable forecasts for a near-term horizon; and (2) our determination of the implied expected rate of return will be affected by the fact that these short-run earnings forecasts are forecasts of accounting earnings rather than economic earnings. Bear in mind that in Section 4 we saw that, in the P&G example, the rate of change in abnormal growth in earnings beyond the forecast horizon was negative 14.2%; this was due to the very high "base" resulting from the high expected rate of growth in earnings from 2007 to 2008.

5.10 Firm-Specific Estimates are Unlikely to be Meaningful When the Same Growth Rate is Applied to All Firms

Although the method in Claus and Thomas (2001) has been used by others to obtain firm-specific estimates of the implied expected rate of return, the fact that the method uses the same growth rate for all stocks after a short, three-year, forecast horizon suggests that the implied expected rate of return is unlikely to be reliable at the firm-specific level. Claus and Thomas (2001) discuss the reason this is so: expected growth is affected by both the expectation of future economic rents and the conservative nature of accounting; and, the effects of conservative accounting on the short-horizon forecasts of earnings and book values will differ from firm to firm, thus affecting the base from which earnings are assumed to grow in perpetuity. A similar observation applies to the method in Gode and Mohanram (2003).

Daske (2006) observes that the Gode and Mohanram (2003) procedure uses "economically plausible" assumptions and "can be applied to a single firm." I disagree. Although the Gode and Mohanram (2003) assumptions may be plausible at the country level, there is no reason to conclude that their assumption is descriptively valid at the firm level.

5.11 A Model that Fades to the Cost of Capital

Several investment banks implement a version of the residual income valuation model where, in lieu of fading to the industry median, as in Gebhardt et al. (2001), they fade to the cost of equity capital. When ROE is equal to the cost of capital, residual income will be zero; hence, market value and book value will be equal because residual income beyond that point is expected to be zero. Citi, for example, uses this idea in its "Prospects Model," which is based on five years of analysts' earnings forecasts and then the terminal (fifth-year) ROE is faded over 30 years to the cost of capital. Citi inverts this model to obtain estimates of the implied expected rate of return. They then use these returns to screen for stocks with particularly high or low implied expected rates of return. Although this method has intuitive appeal, it relies on the assumption that conservative accounting on the balance sheet will eventually dissipate and book value will eventually equal market value. Feltham and Ohlson (1996) and Zhang (2002) suggest that this assumption will not be reasonable in the presence of growth; whether this is important as a practical matter is unknown and cannot be tested because the issue is whether the difference between prices and book values will converge to zero *in expectation*.

5.12 Summary

The extant methods of estimating the expected rate of return at the firm-specific level have been reviewed in this section. All of these methods rely on assumptions about the expected rate of growth beyond the short earnings forecast horizon. Since these assumptions are critical and, since they may not be reasonable estimates of the market's expectation of growth, the usefulness of the estimates of the expected rate of return is unclear. I will assess the empirical validity of these firm-specific estimates in Sections 8 and 9. Before doing so, I will review methods of simultaneously estimating both the expected rate of return and the expected rate of growth that are implied by market prices and earnings forecasts. The advantage/strength of these methods is that the estimate of the implied expected rate of return is not dependent on assumptions about the expected rate of growth. These estimates, however, may only be obtained for a portfolio of stocks rather than at the firm-specific level.

6

Reverse Engineering the Abnormal Growth in Earnings Valuation Model to Obtain Portfolio-Level Estimates of the Implied Expected Rate of Return

Each of the methods of reverse-engineering accounting-based valuation models described in Sections 4 and 5 may be used to obtain estimates of the expected rate of return for a portfolio (group) of stocks by simply taking an equally-weighted or value-weighted average of the firm-specific estimates for the firms comprising the portfolio. This is, in effect, what is often done when, for example, researchers compare means of firm-specific estimates across groups of stocks. And, as an important aside, this is about all that can be done with the extant estimates because of the measurement error in these estimates (this error will be discussed in Section 9).

In the next two sections, I will discuss three other methods for estimating the expected rate of return for a portfolio of stocks. The clear advantage of these methods is that they simultaneously estimate the expected rate of return *and* the expected rate of growth implied by the data, thus avoiding the need for making inevitably erroneous assumptions about the expected growth rate beyond the earnings forecast horizon.

I will begin this section by describing a method for simultaneously estimating *the rate of change in abnormal growth in earnings* and the expected rate of return implied by market prices and forecasts of earnings for a portfolio of stocks. Then I will show that the assumptions about this rate of increase that are used in extant methods for estimating firm-specific expected rates of return may be flawed.

The next section describes two methods for simultaneously estimating *the expected rate of growth in residual income* and the expected rate of return implied by market prices, book values, earnings, and forecasts of earnings for a portfolio of stocks. Again, I am not primarily interested in the expected rate of growth in residual income. Rather, I will show how commonly invoked assumptions about this growth rate affect the resulting estimates of the implied expected rate of return.

6.1 A Method for Simultaneously Estimating the Rate of Change in Abnormal Growth in Earnings and the Expected Rate of Return

The method for simultaneously estimating the rate of increase in abnormal growth in earnings and the expected rate of return that are implied by market prices and forecasts of earnings is developed in Easton (2004). This method is based on the observation that the finite horizon abnormal growth in earnings valuation model may be expressed as:

$$P_0 = \frac{\mathrm{eps}_1}{r_E} + \frac{\mathrm{agr}_2}{(r_E - g_{\mathrm{agr}}) * r_E}, \tag{6.1}$$

where $\mathrm{agr}_2 = [\mathrm{eps}_2 + r_E * \mathrm{dps}_1 - (1 + r_E) * \mathrm{eps}_1]$.

We can rearrange Equation (6.1) to obtain:

$$\frac{\mathrm{ceps}_2}{P_0} = \gamma_0 + \gamma_1 \frac{\mathrm{eps}_1}{P_0}, \tag{6.2}$$

where $\gamma_0 = r * (r - g_{\mathrm{agr}})$, $\gamma_1 = (1 + g_{\mathrm{agr}})$ and ceps_2 is the forecast of two-period ahead cum-dividend earnings (that is, $\mathrm{eps}_2 + r_E * \mathrm{dps}_1$). The expected rate of return (r_E) is the rate of return that is implied by current prices (P_0), forecasts of earnings (eps_1 and eps_2), and the implied long-run change in the abnormal growth in earnings (g_{agr}).

Although Equations (6.1) and (6.2) are for a single firm, we can write Equation (6.2) as the following linear relation for each firm j:

$$\frac{\mathrm{ceps}_{j2}}{P_{j0}} = \gamma_{j0} + \gamma_{j1} \frac{\mathrm{eps}_{j1}}{P_{j0}}. \tag{6.3}$$

The linear relation between $\frac{\text{ceps}_{j2}}{P_{j0}}$ and $\frac{\text{eps}_{j1}}{P_{j0}}$ in (6.3) suggests that the average (portfolio) expected rate of return (r_E) and the average rate of change in abnormal growth in earnings (g_{agr}) may be estimated from the intercept and the slope coefficients from a linear regression of $\frac{\text{ceps}_{j2}}{P_{j0}}$ on $\frac{\text{eps}_{j1}}{P_{j0}}$ for any portfolio of $j = 1, \ldots, J$ stocks.

Easton (2004) runs the regression:

$$\frac{\text{ceps}_{j2}}{P_{j0}} = \gamma_0 + \gamma_1 \frac{\text{eps}_{j1}}{P_{j0}} + e_{j0}. \qquad (6.4)$$

Notice that there is no error term in Equation (6.3). The error term e_{j0} in Equation (6.4) arises because of the firm-specific random component of the coefficients γ_{j0} and γ_{j1}.[1] The estimates of the coefficients γ_0 and γ_1 may be regarded as the mean of the firm-specific coefficients. It follows that the r_E and g_{agr} implied by these estimates are the estimates for the portfolio of J firms.

6.2 A Word of Caution

Regression (6.4) may be used to obtain an estimate of the expected rate of return implied by any set of prices and forecasts of earnings. For example, if we are interested in determining the effect of earnings quality on the cost of capital we can partition firms into two portfolios — those with high quality disclosure and those with low quality disclosure — and then we can compare the estimates of the cost of capital across the two portfolios. But we should be cautious in using this method; arguably, both the dependent variable and the independent variable in regression (6.4) are measured with error and the regression estimates will be biased.

6.3 Bias in Estimates of the Expected Rate of Return Based on the PEG Ratio

For a group of stocks with the same PEG ratio, the r-square from regression (6.4) will be very close to one. To see this, note that: $\frac{\text{ceps}_2}{P_0} = \frac{1}{\text{PEG}-\text{ratio}} + r_E * \frac{\text{dps}_1}{P_0} + \frac{\text{eps}_1}{P_0}$ and, if all stocks in the portfolio have the

[1] Since $e_{j0} = \gamma_{j0} - \gamma_0 + \frac{(\gamma_{j1} - \gamma_1)\text{eps}_{j1}}{P_{j0}}$, the error term is heteroskedastic, and White (1980) corrections should be made to the standard errors.

same PEG ratio, the variance of 1/PEG-ratio (within the portfolio) will be zero. Since the variance of $r_E * \frac{\mathrm{dps}_1}{P_0}$ will be small relative to the variance of $\frac{\mathrm{eps}_1}{P_0}$, almost all of the variation in $\frac{\mathrm{ceps}_2}{P_0}$ will be explained by variation in $\frac{\mathrm{eps}_1}{P_0}$. Thus, this estimate of the expected rate of return r_E will be very precise. Easton (2004) uses this estimate to determine the bias in the estimate of the expected rate of return based on the PEG ratio and in the estimate based on the method in Gode and Mohanram (2003).

6.4 An Illustration: P&G

Recall that in Section 4 special cases of the abnormal growth in earnings valuation model were reverse engineered to obtain various estimates of the implied expected rate of return: (1) the estimate based on the PE ratio was 5.4% and we noted that this was too low relative to the estimate provided by Bloomberg of 7.9% because the PE ratio does not take account of earnings growth beyond one year; (2) when short-term growth was taken into account via the PEG ratio, this estimate was 8.8%, which was too high (relative to the Bloomberg estimate) because the short-term growth rate (which the PEG ratio, in essence, assumes continues forever) was too high; (3) when expected dividend payments were included in the expected future payoffs, the expected rate of return was even higher (10.1%); and (4) when growth beyond the earnings forecast horizon was assumed to be at the risk-free rate of return minus 3%, the estimate of the expected rate of return was 9.7%. All of these methods implicitly assume a rate of increase in abnormal growth in earnings beyond the two-year earnings forecast horizon. Here we ask the question: What does the data tell us about this rate of growth?

6.5 The Regression-based Estimate for P&G

To illustrate the point in Easton (2004), I gathered I/B/E/S forecast data and market prices for a set of 20 firms having the same PEG ratio as P&G and I ran regression (6.4) to obtain estimates of the implied expected rate of return (8.1%) and the rate of increase in abnormal growth in earnings (−12.1%) for this portfolio of stocks. Recall that: (1) inverting the PEG ratio to obtain an estimate of the expected rate of return implicitly assumes a rate of increase in abnormal growth in earnings of zero; and, (2) Gode and Mohanram (2003) assume a rate of 1.71%. Both of these rates are much higher than the data suggests and, hence, the associated estimates of the expected rate of return are also much higher. Interestingly, the rate implied by the data (8.1%) is quite similar to the Bloomberg estimate.

6.6 An Illustration: Large Sample Evidence of the Effect of Assumptions About Long-Term Growth in Earnings

The aim of Easton (2004) is to highlight the missing parts of a complete model of the relation between prices and the expected future stream of earnings when commonly used ratios — the PE ratio and the PEG ratio — are used to rank stocks. The PE ratio assumes that the future dividends are zero and both the short-term and long-term earnings growth rates are zero. The PEG ratio takes account of expected short-term earnings growth but ignores growth beyond the earnings forecast horizon. Easton (2004) shows that for a large sample of stocks over the years 1994 to 2004, the average rate of increase in abnormal growth in earnings (implicitly assumed to be zero when the PEG ratio is used to rank stocks) is 2.9%, and the resulting under-estimate of the implied expected rate of return is 1.7%. An example of the possible effect of failing to take change in abnormal growth in earnings into account is that we would obtain a much lower estimate of the average expected equity risk premium (average of 3.1% compared with 4.8% when this change in growth is taken into account).

6.7 The Importance of High r-square in the Easton (2004) Regression

Although regression (6.4) has been used in several contexts, it was designed for a particular context, and works well in that context, because the samples are selected such that the regression r-square is very close to one; the context was determination of the bias in estimates of the expected rate of return based on PEG ratios. It makes sense in this context to estimate the regression for portfolios formed on the magnitude of the PEG ratio, with the resultant benefit that the regression r-square is close to one. When this is so, the fact that both the dependent variable and the independent variable in this regression are measured with error does not pose problems. If the r-square differs from one, this regression (and the corresponding reverse regression) can only be used to establish the bounds on the estimate of the expected rate of return.[2]

6.8 An Example: The DJIA as of December 31, 2004

For the DJIA firms at December 31, 2004, the estimates of the coefficients (t-statistics), γ_0 and γ_1, in regression (6.4) are 0.0008 (0.32) and 1.0905 (28.02) and, hence, the estimate of the expected rate of return is 9.9%. The coefficients from the reverse regression:

$$\frac{\text{eps}_{jt+1}}{P_{jt}} = \gamma_0^R + \gamma_1^R \frac{\text{ceps}_{jt+2}}{P_{jt}} + u_{jt}^R \tag{6.5}$$

are 0.0014 (0.63) and 0.8854 (28.02). Since $\gamma_0^R = \frac{r_E*(r_E - g_{\text{agr}})}{1+g_{\text{agr}}}$, and $\gamma_1^R = \frac{1}{1+g_{\text{agr}}}$, the implied expected rate of return is 13.9%.

The Easton (2004) regression (6.4) and the reverse regression (6.5) establish that the estimate of the expected rate of return implied by the prices and forecasts of earnings for these DJIA stocks lies between 9.9% and 13.9%. Note that the magnitude of the range of estimates of the regression coefficients (and, hence, the range of the estimates of the implied expected rate of return) are a function of the regression r-square — $\gamma_1^R = \frac{\gamma_1}{R^2}$. It follows that the range will be large if the regression r-square is small; and the range will be close to zero if the r-square is close to one (which is the case, by construction, in Easton (2004).

[2] For example, like Easton (2004), Daske (2006) forms portfolios based on the PEG ratio but the r-squares in his regressions are much lower than one (0.904 and 0.839) because his sample size is smaller and hence the PEG ratios differ considerably within his sub-samples. Berger et al. (2006) also form portfolios based on the PEG ratio. Although they do not report regression r-squares, they are likely to be close to one and, therefore, they can be reasonably confident in their estimates of the implied expected rate of return.

6.9 Summary

The Easton (2004) method (summarized by regression (6.4)) may be used to estimate the expected rate of return that is implied by market prices and forecasts of earnings for a group of stocks if the regression r-square is high; otherwise the range of implied expected rates of return may be considerable.

The expected growth rates (in abnormal growth in earnings) implied by the data appear to be much lower than the rates assumed in the extant (firm-specific) estimates of the expected growth rates. Since errors in the estimates of the expected growth rate will lead to errors in estimates of the expected rate of return, the estimates of these firm-specific expected rates of return are likely to have considerable error. Further, if the assumed growth rates are too high, the estimates of the expected rates of return will also be too high.

7

Reverse Engineering the Residual Income Valuation Model to Obtain Portfolio-Level Estimates of the Implied Expected Rate of Return

In this Section, I introduce two methods for estimating the implied expected rate of return that are based on the residual income valuation model: (1) based on prices, book values, and *forecasts* of earnings; and (2) based on prices, book values, and *current* earnings. Like the estimates introduced in Section 6, the advantage of these methods is that the implied estimate of the expected rate of return is based on a growth rate that is implied by the data rather than on an assumed growth rate (as in Gebhardt et al. (2001) and Claus and Thomas (2001)). In the latter part of this section, I will illustrate the effect of these growth rate assumptions on estimates of the equity market premium.

7.1 Simultaneously Estimating the Rate of Growth in Residual Income and the Expected Rate of Return that are Implied by Market Prices, Book Value, and Forecasts of Earnings

The method for simultaneously estimating the rate of growth in residual income and the expected rate of return that are implied by market prices, book values, and forecasts of earnings is developed in

Easton et al. (2002). This method is based on the observation that the finite horizon residual income valuation model:

$$P_t = \text{bps}_t + \frac{(\text{eps}_{t+1} - r_E \text{bps}_t)}{r_E - g_{ri}} \tag{7.1}$$

may be re-written as

$$\frac{\text{eps}_{t+1}}{\text{bps}_t} = \gamma_0 + \gamma_1 \frac{P_t}{\text{bps}_t}, \tag{7.2}$$

where $\gamma_0 = g_{ri}$ and $\gamma_1 = r_E - g_{ri}$. This relation, derived for an individual stock, may be re-expressed for a group of observations via the following (regression) relation:

$$\frac{\text{eps}_{jt+1}}{\text{bps}_{jt}} = \gamma_0 + \gamma_1 \frac{P_{jt}}{\text{bps}_{jt}} + \mu_{jt}. \tag{7.3}$$

The regression coefficients, γ_0 and γ_1, represent an average of the firm-specific γ_{0j} and γ_{1j} coefficients and the cross-sectional variation in these coefficients creates the regression residual. Easton et al. (2002) describe this regression in detail.

We can estimate regression (7.3) for any group of stocks to obtain estimates of γ_0 and γ_1 and, hence, we can obtain estimates of the rate of growth g_{ri} and the expected rate of return r_E implied by the market prices, book values, and forecasts of earnings for these stocks.

Notice that this regression is set up with ROE rather than the price-to-book ratio as the dependent variable. The reason for this form of the regression is that the forecast of earnings is measured with error and should be included in the dependent variable (rather than the independent variable) in order to avoid measurement error bias in the estimates of the regression coefficients. The measurement error may be due to: (1) analysts' forecasts of earnings are (usually) used as proxies for market expectations; (2) the forecasts of earnings are assumed to be a good summary of the payoffs on which investors focus when determining the price they are willing to pay for the stock; and/or (3) forecasts of dividends (used to forecast future book value and future ROE) may not be the market expectations of dividends.

7.2 Earnings Aggregation

Regression (7.3), which permits the determination of the expected rate of growth in residual income and the expected rate of return from the estimates of the regression coefficients, is necessarily based on a single-period forecast of earnings (that is, eps_{jt+1}).[1] At first glance this seems unsatisfactory in view of the fact that in many settings we have forecasts of earnings for several future periods. But, since earnings may be summed over time, a time interval t to $t+1$ may be of any length ranging from a quarter if we have earnings forecasts for just one quarter, to many years if we have several years of forecasts.

Easton et al. (2002) have forecasts of earnings for four years into the future. Thus, the numerator in the dependent variable in regression (7.2) is aggregate four-year earnings; the intercept γ_0 is an estimate of the four-year residual income growth rate $[(1+g_{ri})^4 - 1]$, from which the annual rate of growth g_{ri} may be determined and the slope coefficient γ_1 is an estimate of the difference between the four-year rate of return and the four-year growth rate $[(1+r_E)^4 - (1+g_{ri})^4]$ from which the implied expected annual rate of return r_E may be calculated.

As Easton et al. (1992) observe, dividend payments over a long earnings forecast horizon must be taken into account when calculating aggregate earnings because these dividends may be re-invested to yield future earnings. In other words, payment of dividends in an early period displaces earnings in a future period. It follows that the payoff of interest to investors is aggregate cum-dividend earnings, which, for four periods may be determined as follows:

$$\sum_{t=1}^{4} \text{eps}_t + \sum_{t=1}^{3} \{1 + r_E\}^{4-t} - 1 * \text{dps}_t$$

7.3 Example of Earnings Aggregation: P&G

The forecasts of earnings and dividends for P&G may be used to illustrate the calculation of aggregate four-year forecasted cum-dividend

[1] This, single-period form permits the determination of two estimates (g_{ri} and r_E) based on two regression parameters (γ_0 and γ_1). That is, we have exact identification.

earnings as used by Easton et al. (2002):

	eps_t	dps_t	Earnings on dividends
2007	3.02	1.41	$1.41 * (1.12^3 - 1) = 0.57$
2008	3.45	1.54	$1.54 * (1.12^2 - 1) = 0.39$
2009	3.83	1.66	$1.66 * (1.12^1 - 1) = 0.20$
2010	4.22	1.72	$1.78 * (1.12^0 - 1) = 0.00$
	14.52		$= 1.16$

That is, aggregate cum-dividend earnings are \$15.68 = \$14.52 + \$1.16.

7.4 The ETSS Iterative Procedure

Calculation of aggregate cum-dividend earnings requires an estimate of the implied expected rate of return r_E (12% in the P&G example in Section 7.3). Yet the aim of Easton et al. (2002) is to estimate this rate of return. To deal with this apparent circularity, Easton et al. (2002) begin by assuming that the displacement of future earnings due to the payment of dividends is 12% based on the assumption that if these dividends had stayed in the firm they would have earned a return which is approximately equal to the historic rate of return on the market. The regression then yields an implied estimate of the expected rate of return, which, in turn, is used as the revised rate for re-investment of the dividends. This iterative procedure is continued until further iterations result in no further revision to the estimates of either the implied expected rate of return or the implied residual income growth rate.

7.5 An Illustration: Large Sample Evidence of the Effect of Assumptions About Long-Term Growth in Residual Income

The aim of Easton et al. (2002) is to provide a method for simultaneously estimating the growth rate and the expected rate of return implied by the data. Simultaneous estimation is necessary because assumptions about the growth rate will inevitably affect the estimate of the implied expected rate of return. Easton et al. (2002) illustrate the importance of their method by comparing their estimate of the equity risk premium with the estimate of the equity risk premium in: (1) Gebhardt et al. (2001), whose assumption about the long-term growth rate is implicit in their assumption that the ROE fades to the industry median ROE and; (2) Claus and Thomas (2001) who assume that residual income will grow at the risk-free rate minus 3%.

Using essentially the same data as Gebhardt et al. (2001) and Claus and Thomas (2001), Easton et al. (2002) estimate an equity premium of 4.8%, which is much higher than the Gebhardt et al. (2001) estimate of between 2% and 3% and the Claus and Thomas (2001) estimate of less than 3%. Apparently the assumed rates of growth in Gebhardt et al. (2001) and Claus and Thomas (2001) are too low.

7.6 The Trade-off Between Using Just One Quarter or Just One Year of Earnings and Using all Available Forecast Data

If data is available for several periods into the future, the argument for using all of these data is clear, particularly in view of the fact that the method accommodates multi-period forecasts. So: Why throw data away? The argument against using all of the data rests on the observation that analysts' long-run forecasts tend to be less accurate than their short-run forecasts. The key question, which is, indeed, difficult to answer is: Which (future) earnings data best summarize the payoffs of interest to shareholders (and potential shareholders) when they are valuing the stock? If the answer to this question is — very short-run forecasts — then, quarterly earnings may be sufficient (though one must be aware of seasonality). If the answer is — forecasts over a long horizon — then we may choose to use all of the available forecast data (though we must be aware that the forecast error and the optimistic bias in these forecasts increase with forecast horizon).

7.7 Simultaneously Estimating the Rate of Growth in Residual Income and the Expected Rate of Return that are Implied by Market Prices, Book Value, and Current Earnings

The method for simultaneously estimating the rate of growth in residual income and the expected rate of return that are implied by market prices, book values, and current earnings is derived in Easton (2006) and Easton and Sommers (2007). This method is an adaptation of an idea put forward by O'Hanlon and Steele (2000).

This method is based on the observation that the finite horizon residual income valuation model may be expressed as follows:

$$P_t = \mathrm{bps}_t + \frac{(\mathrm{eps}_t - r_E \mathrm{bps}_{t-1}) * (1 + g'_{ri})}{r_E - g'_{ri}}. \tag{7.4}$$

This relation may be re-expressed as:

$$\frac{\mathrm{eps}_t}{\mathrm{bps}_{t-1}} = \delta_0 + \delta_1 \frac{P_t - \mathrm{bps}_t}{\mathrm{bps}_{t-1}}, \tag{7.5}$$

where $\delta_0 = r_E$, $\delta_1 = \frac{r_E - g'_{ri}}{1 + g'_{ri}}$.

In a manner analogous to Easton et al. (2002) and Easton (2004), Equation (7.5) may be used as the basis for a regression and we can obtain estimates of the expected rate of return and the expected rate of growth in residual income from the regression parameter estimates. This method has the obvious advantage that it relies on realized earnings rather than analysts' forecasts and, thus, may, in principle, be applied to any portfolio of stocks — even those not followed by analysts.

7.8 A Key Issue is the Implicit Assumption that the Accounting Data Summarize the Payoffs About Which the Investor is Concerned When Determining the Value of the Stock

Although the residual income valuation model and the abnormal growth in earnings valuation model are theoretically very sound, they are infinite horizon models. Reducing them to finite horizon models places the emphasis in valuation on short-run payoffs, forecasts of those payoffs, and an estimate of growth beyond the forecast horizon. The methods derived in Easton et al. (2002), Easton (2004), and Easton (2006) provide means of estimating the growth beyond the forecast horizon that is implied by the price, book value, and earnings data, but therein lies the problem with all of the estimates of the implied expected rate of return; these estimates are only as good as the data on which they rely. The key issue here is that the implicit assumption is that the accounting data (book value, earnings, and earnings forecasts) summarize the payoffs about which the investor is concerned when determining the price. This leads to the question: Which earnings should be used in the valuation models?

7.9 Which Earnings?

Which earnings? The answer is: the earnings that best summarize the expected future stream of payoffs to investment in the stock. This is core/sustainable/permanent earnings. Among the various earnings data available to us, those that are most likely closest to core earnings are those provided by analysts who generally remove one-time items in an attempt to bring attention to earnings that are more likely to be sustainable. But, this conclusion is not at all clear cut and all earnings data must be viewed with some caution.

If we are inverting a valuation model that is based on current earnings, the earnings data that are most likely to be the best summary of future expected payoffs are the “actual” earnings data provided by analysts; if these data are not available, and we are relying on large data bases such as Compustat, we might use earnings before one-time items (at least, earnings before extraordinary and special items). Again, we must be cautious in interpreting the results. As with all analyses, we will have more confidence in our conclusions if they are supported by several different sets of empirical analyses.

7.10 A Need for Caution

To underscore the need for caution, consider observations where actual earnings, and/or forecasts of earnings and/or book values are negative.

Just as we would not use price-earnings or price-book multiples to value these firms, we are unlikely to obtain meaningful estimates of the expected rate of return based on negative earnings or negative book value data. But, we cannot just eliminate these observations because we will then be looking at a sample of, generally, more healthy firms, and our inferences will be limited to firms in this biased sample.

In some applications there will be no need to eliminate firms with negative earnings. For example, in each of the regression methods outlined in this and the previous chapter, the regression can be based on the entire distribution of earnings data and we will (still) obtain meaningful estimates even if some of the observations are negative. That said, it is clear that a large proportion of loss observations will lead to meaningless estimates of the expected rate of return (the reason, simply put, is that these losses are not a meaningful anchor for valuation). Little attention is given to this issue in the literature; more work needs to be done. A possible solution is the use of value-weighted regressions.

7.11 Value-Weighted Estimates of the Implied Expected Rate of Return

Almost every study that uses accounting-based estimates of the implied expected rate of return, implicitly, if not explicitly, gives equal weight to all observations. Such weighting will be appropriate in some studies. Francis et al. (2004), for example, compare the difference between the implied expected rates of return across samples with different accounting attributes. The focus of their study is on average differences as it should be; value-weighting would lead to results that were dominated by accounting attributes of large firms.

Nevertheless, value-weighting will be more appropriate in many studies. Perhaps the best example is the estimation of the equity risk premium, which is a central part of three well-known studies based on analysts' earnings forecasts by Gebhardt et al. (2001), Claus and Thomas (2001), and Easton et al. (2002). These studies give equal weighting to all stocks. Yet, estimating the market-wide equity risk premium is more meaningful if stocks are weighted by their market capitalization. In the equally weighted analyses in the papers referred to above, small stocks will have an undue effect on the estimate of the market return.[2] In order to avoid these undue influences, and to provide an estimate of the equity risk premium that is more representative of the risk premium for the market portfolio, Easton and Sommers (2007) repeat all of their analyses weighting each of the observations by market capitalization.[3]

7.12 Summary

This section presented methods for simultaneously estimating the expected rate of return and the expected rate of growth based on market prices, book values, current earnings, and forecasts of earnings. The importance of careful consideration of loss observations, value- or equal-weighting, and the choice of the earnings variable to be used in the regression-based methods was discussed.

Although estimates based on the methods discussed in this section inevitably have shortcomings, some of which were discussed in this section and more of which will be discussed in Section 10, they are the best that researchers and investment professionals have at this time. Refinements to these methods will be discussed in Sections 11, 12, and 13.

[2] Smaller firms tend to have a much greater proportion of losses (the proportion of losses decreases monotonically from 17.64% for the decile of smallest firms in, for example, the Easton and Sommers (2007) sample to 1.65% for the decile of largest firms).

[3] Easton and Sommers (2007) perform value-weighted analyses using PROC REG in SAS with weight equal to market capitalization.

8

Methods for Assessing the Quality/Validity of Firm-Specific Estimates

In this section, we examine two approaches to assessing the validity/reliability of firm-specific estimates of the expected rate of return on equity capital. Both are based on intuitively appealing ideas. The first method asks the question: Do the estimates of *ex ante* expected return explain *ex post* realized return? The second method, which is more common in the literature, asks the question: What is the correlation between the estimates of the expected rate of return and commonly used risk proxies?

8.1 The Motivation for Estimating Accounting-based Estimates of the Expected Rate of Return at the Firm Level

Firm-specific estimates of the cost of capital are required for many reasons, including valuation, stock portfolio choices, and capital budgeting. *Ex post*, return-based estimates have "proven disappointing"; for example, Gebhardt et al. (2001) observe that, after extensive testing of the CAPM and three-factor based industry costs-of-capital, Fama and French (1997) conclude that these cost-of-capital estimates are "unavoidably imprecise." If they are "imprecise" at the industry level, they are poor, indeed, at the firm-specific level. Of course, lack of precision of *ex post* estimates says nothing about lack of precision of *ex ante* estimates. We will see, in this section, that versions of these *ex ante* firm-specific estimates in the extant literature are also imprecise.

8.2 Do the Estimates of *ex ante* Expected Return Explain *ex post* Realized Return?

Although, at first glance, the question — Do the estimates of the *ex ante* expected rate of return explain realized return? — seems reasonable, there is a considerable literature that argues that this is not so. I will briefly review this literature, and then I will discuss a method that deals with the concerns raised therein.

8.3 Correlated Omitted Variables Bias

The majority of studies in the empirical asset-pricing literature evaluate expected return proxies via their association with realized returns. However, arguments and evidence in Elton (1999) and Fama and French (2002) support the conclusion that realized returns are biased and noisy measures of expected returns. These authors show that "information surprises," which cause realized returns to differ from expected returns, do not cancel out over time or across firms.[1] If these information surprises are correlated with expected returns, the simple regressions of realized returns on expected return proxies will yield spurious inferences because of bias due to correlated omitted variables.

[1] Elton (1999) states (p. 1199): "*The use of average realized returns as a proxy for expected returns relies on a belief that information surprises tend to cancel out over the period of a study and realized returns are therefore an unbiased measure of expected returns. However, I believe there is ample evidence that this belief is misplaced.*" Fama and French (2002) provide evidence that suggests the abnormally large equity premium observed during the post-war era was attributable to information surprises that took the form of consistent downward revisions in expected future discount rates.

8.4 Using Realized Return as a Measure of Validity is at Odds with the Motivation for Using Accounting-based Estimates

A key reason for using accounting-based estimates of the expected rate of return (particularly in a research context) is that realized returns are noisy and biased. This implies that, if researchers want to use realized returns to evaluate an accounting-based estimate, they must develop a research design that controls for the bias and noise in realized returns. One such method is developed and illustrated by Easton and Monahan (2005). This method: (1) is based on the fact that realized returns have three components, one of which is expected returns; and (2) takes account of the fact that, as a practical matter, each of these components will be measured with error.

8.5 The Components of Realized Returns

Vuolteenaho (2002) demonstrates that firm i's realized, continuously compounded return for year $t+1$, r_{it+1}, can be decomposed into three components: (1) expected return, er_{it+1}; (2) changes in expectations about future cash flows (cash flow news, cn_{it+1}); and (3) changes in expectations about future discount rates (return news, rn_{it+1}). That is

$$r_{it+1} \approx er_{it+1} + cn_{it+1} - rn_{it+1}, \tag{8.1}$$

where return expectations, er_{it+1}, are formed at the beginning of year $t+1$, while the variables cash flow news, cn_{it+1}, and return news, rn_{it+1}, reflect changes in expectations during year $t+1$.

The intuition behind this relation is simple; price may be viewed as the sum of expected cash flows discounted to a present value using the expected rate of return as the discount factor. It follows that change in price (that is, return) is equal to the expected rate of return plus the unexpected rate of return. And the unexpected rate of return has two components: (1) the present value of the effect of news on expectations about future cash flows; and (2) the effect of news on the expected rate of return, which is given a negative sign because, *ceteris paribus*, increases in future discount rates lead to a decrease in price and, hence, realized return is negatively related to expected return (discount rate) news.

Notice that: (1) Equation (8.1) is based on a tautology; realized return is equal to the sum of expected return and unexpected return and unexpected return has a cash flow news (numerator) component and a return news (denominator) component; and (2) since Equation (8.1) reflects the effect of changes in expectations about future cash flows and the effect of changes in expectations about future discount rates on realized returns, it provides a direct means of dealing with Elton's (1999) argument that information surprises cause realized returns to be a biased and noisy measure of expected returns.

Elaborating on point (2); if changes in expectations about future cash flows and/or discount rates are associated with contemporaneous expected returns, the coefficient on expected returns will be affected by correlated omitted variables bias. This is quite likely. For example, an explanation for the equity premium puzzle is that during the postwar period the United States (and other western nations) experienced an extraordinary run of "good luck."[2] Thus, the expected future rate of return required by investors as compensation for holding the market portfolio steadily declined. In other words, economy-wide rn_{it+1} was negative; which, as per Equation (8.1), caused the *realized* equity premium to be consistently larger than expected.[3] This, in turn, led to higher than expected realized returns on individual stocks. Additionally, the magnitude of the bias at the individual stock level was arguably increasing in the covariance between a stock's return and the return on the market portfolio. It follows that: (1) changes in expectations about future discount rates, that is, rn_{it+1}, were correlated with both realized and expected returns, that is, r_{it+1} and er_{it+1}; and (2) the

[2] The "equity premium puzzle" is that, historically, the equity premium (the difference between the return on an investment in the stock market index and the risk-free rate of return) has been too high compared to theoretical models, other markets, and estimates from surveys of academics and investment professionals. See Chapter 21 of Cochrane (2001) for a discussion of the equity premium puzzle. The discussion under the heading *Luck and a Lower Target* on pages 460 through 462 is particularly relevant.

[3] Fama and French (2002) provide specific evidence of this phenomenon.

coefficient on er_{it+1} is biased if rn_{it+1} is omitted from a regression of realized return on an estimate of expected return.[4]

8.6 A Method for Evaluating Estimates of Expected Returns

Easton and Monahan (2005) base their method for analyzing the estimates of expected rate of return on the Vuolteenaho (2002) return decomposition. It is evident from Equation (8.1) that if the components of realized returns are measured without error, the estimates of the slope coefficients in a regression of realized returns on expected returns, cash flow news, and return news will be equal to one. Hence, one means of evaluating a method for estimating the expected rate of return is to test the difference between the estimate of the coefficient on expected return and one. Unfortunately, these tests do not lead to clear-cut inferences because the cash flow news and return news variables are also measured with error.

8.7 All Components of Realized Returns are Measured with Error

Easton and Monahan's (2005) method recognizes the fact that all right-hand side variables in a regression based on Equation (8.1) are measured with error. They develop an approach that isolates the portion of the bias in the estimate of the coefficient on expected returns that is solely due to the measurement error in expected returns; which is the only variable of interest in the return decomposition. This method allows unbiased inferences based on the association between realized returns and estimates of the expected rate of return even if realized returns are biased and noisy. The Easton and Monahan's (2005) method is a refinement of the approach discussed in Garber and Klepper (1980) and Barth (1991). Detailed discussion of the method is beyond the

[4] A similar argument can be made for the inclusion of cn_{it+1} in the regression. In particular, if changes in expectations about future cash flows are correlated with investment opportunities, which, in turn, are correlated with expected returns, cn_{it+1} will be correlated with both realized and expected return. Berk et al. (1999) develop a model in which firms' optimal investment choices are associated with expected returns.

scope of this survey. The template, which may be used to compare the measurement error in any set of proxies for the expected rate of return, is detailed in the Easton and Monahan's (2005) paper and Appendix B thereof.

8.8 Correlations with Realized Return as the Method for Evaluating Expected Return Proxies

Guay et al. (2005) use correlations with realized returns as their method for evaluating estimates of the expected rate of return. The crucial difference between Easton and Monahan (2005) and Guay et al. (2005) is the inclusion of cash flow news and return news proxies in the former method. Since the evidence presented in Guay et al. (2005) is based on simple regressions of realized return on the expected return proxies, the associations they document are likely to be biased representations of the relation between the expected return proxies and true expected return. Easton and Monahan (2005) provide evidence that this bias is considerable.

8.9 Evaluation Based on the Regression of the Estimates of the Expected Rate of Return on Commonly Used Risk Proxies

Several studies (for example, Gebhardt et al. (2001), Gode and Mohanram (2003), and Botosan and Plumlee (2005)) rank measures of expected returns by comparing the relation between the expected return proxies and factors that are commonly used as proxies for risk (for example, CAPM beta, equity market value, leverage, etc.). But, using correlation with risk proxies as a measure of the validity of estimates of the expected rate of return is at odds with the motivation for using accounting-based estimates.

A key motivation for using firm-specific, accounting-based estimates of the expected rate of return is as follows. The extant theoretical asset-pricing literature has failed to develop a well accepted model of the factors that cause the expected rate of return to vary across firms. So, practitioners who wish to estimate the expected rate of return and researchers who want to study the properties of the expected rate of return proxy or who want to use it as a control variable, etc., are concerned about using proxies based on theoretical models. One way of circumventing these concerns is to use an accounting-based proxy. This approach is only valid, however, if the accounting-based proxy is related to the underlying construct of interest. But, and this is key, given that the theoretical models are questionable, it is illogical to use measures based on these models (for example, CAPM beta) to evaluate the validity of an accounting-based proxy.

It follows that using correlation with risk proxies as a measure of validity is at odds with the motivation for using accounting-based estimates. If the "theory-based" proxies are good enough, then the accounting-based proxies are unnecessary; assessing their validity is moot. On the other hand, if the accounting-based proxies are necessary, they are necessary because the theory-based proxies are lacking; which, in turn, implies they are of limited usefulness for evaluating construct validity. Also, note that, if the reason for deriving accounting-based proxies is that the constructs suggested by theory are not empirically observable, or if these constructs can only be measured with error, they are seriously lacking as a basis for evaluating the construct validity of the accounting-based proxies. All the same, given the popularity of this method of evaluation in the accounting literature, I discuss it a little more.

8.10 The Regression of the Firm-Specific Estimate of the Return Premium on Risk Proxies

The main method in Gebhardt et al. (2001), Gode and Mohanram (2003), and Botosan and Plumlee (2005) for evaluating firm-specific estimates of the expected rate of return is based on a regression of the firm-specific equity premium (that is, the estimate of the expected rate of return minus the risk-free rate of return) on a large set of risk proxies. Two statistics are used to evaluate/compare the estimates of the expected rate of return: (1) the regression r-square; the estimate of the expected rate of return for which the regression r-square is highest is considered to be the best estimate; and (2) the signs, magnitude and significance of the regression coefficients; for example, a good estimate of the expected rate of return would be one for which the estimate of the coefficient on beta is significantly positive and the estimate of the coefficient on size is significantly negative.

8.11 Shortcomings of the Regression Approach

The regression approach has several shortcomings in addition to being at odds with the motivation for using accounting-based risk proxies. First, reliance on r-square requires that the researcher make the implicit assumption that the risk factors evaluated are, indeed, risk factors, that they are measured without error, and that they are an exhaustive set, all of which are unlikely. Second, since risk proxies are noisy at best, a high r-square may reflect no more than a correlation between noise in expected rate of return and noise in the risk proxies, rather than a correlation between true expected rate of return and true risk. Third, a high r-square may be a spurious effect of the way that the particular estimate of the expected rate of return is obtained; Botosan and Plumlee (2005) note this shortcoming. Fourth, estimates of the regression coefficients (and their significance) may be affected by the way that the particular estimate of the expected rate of return is obtained.

8.12 Illustration of Spurious Effects

To illustrate the third and fourth points, notice that when Botosan and Plumlee (2005) add expected earnings growth (that is, $\frac{(\text{eps}_5 - \text{eps}_4)}{|\text{eps}_4|}$) as an additional explanatory variable in their regression of expected rate of return estimated via the following formula:

$$r_E = \sqrt{\frac{\text{eps}_5 - \text{eps}_4}{P_0}}.$$

where eps_t is analysts' forecast of earnings for period t, the regression r-square increases from 23.1% to 73.8% making this estimate clearly the best in terms of r-square.[5] Also, the t-statistic on the estimate of the coefficient on the earnings growth variable is 31.28, which is, by far, the highest t-statistic in their paper; yet this result is obviously a reflection of the fact that this independent variable (earnings growth) is the

[5] See Botosan and Plumlee (2005), Tables 4 and 5.

main ingredient in the calculation of the dependent variable (the estimate of expected rate of return). Botosan and Plumlee (2005) note this point; it should, however, be boldly underscored because such spurious effects are likely for most (perhaps all) of the estimates. For example, Botosan and Plumlee (2005), Easton and Monahan (2005), and Easton (2006) report that cross-sectional variation in the estimate of the expected rate of return, obtained via the method in Gebhardt et al. (2001), is primarily due to cross-sectional variation in the book-to-market ratio and the industry ROE; this is not surprising given the way that the Gebhardt et al. (2001) estimate is calculated. In light of these spurious influences, which will differ across methods of estimating the expected rate of return, it is not clear what can be learned from regressions of these estimates on risk proxies.

8.13 The Role of Correlations with Risk Proxies

The fact that correlations between risk proxies and estimates of the expected rate of return may be a spurious effect of the method used to calculate the proxies does not mean that they should be disregarded in the assessment of these estimates. Rather, it means that these correlations should be interpreted with extreme caution. For example, Botosan and Plumlee (2005) observe that the estimate of the expected rate of return which has the least measurement error according to the method in Easton and Monahan (2005) is negatively related to beta and to the standard deviation of returns. Of course, as Botosan and Plumlee (2005) observe, this evidence should not be disregarded; it underscores Easton and Monahan's (2005) observation that all of the estimates (even this one) are very poor.

8.14 The Importance of Focusing on Measurement Error

Botosan and Plumlee (2005) observe that all methods that assess the validity of estimates of the expected rate of return are vulnerable to measurement error in the proxies (for example, the expected rate of return proxies in Botosan and Plumlee (2005) and the cash flow news and return news proxies in Easton and Monahan (2005)) included in the regression. Although this is partially correct, three points must be noted. First, the method in Easton and Monahan (2005) is designed to specifically deal with measurement error in all three of the independent variables in their regression. Second, measurement error is a key concern in Easton and Monahan (2005) and thus must be addressed when evaluating the proxies. Finally, as long as measurement error remains the *Achilles' Heel* in estimating the expected rate of return, it should be one of the focuses of future research on these estimates. Easton and Monahan (2005) begin this research and they evaluate some methods of dealing with measurement error; these methods will be discussed in Section 11.

8.15 Summary

This section examines two approaches to assessing the validity/reliability of firm-specific estimates of the expected rate of return on equity capital: (1) based on explanatory power for realized returns; and (2) based on correlations with commonly used risk proxies. Reasons why the second of these methods is unlikely to be meaningful as a practical matter are provided and the importance of controlling for correlated omitted variables in the first method is stressed. Use of the second method will be illustrated in Section 9.

9

Extant Firm-Specific Estimates are Poor

In this section, I examine the quality/validity of extant firm-specific estimates of the expected rate of return on equity capital. Unfortunately, the news is bad; the firm-specific estimates are quite poor, and thus unreliable. I hasten to add, however, that this is not a reason to abandon the use of these estimates. The lack of reliability is a reflection of the fact that the research literature is in its infancy; there is much opportunity for research that has the aim of improving these measures (some suggestions are made in later sections).

9.1 Comparison with the Risk-Free Rate and Other Descriptive Statistics

Some descriptive statistics taken from Easton and Monahan (2005) are provided in Table 9.1. The column titled $less\_r_f$, shows the percentage of observations that are less than the risk-free rate. Not surprisingly, realized return is less than the risk-free rate for 43.5% of the observations, providing a simple demonstration of the lack of validity of realized return as a measure of the validity of estimates of the expected rate of return.

Table 9.1 Realized returns and estimates of the expected rate of return.

	Mean	Std	$less\_r_f$	5th	25th	50th	75th	95th
Realized return	0.096	0.366	0.435	−0.551	−0.093	0.122	0.315	0.631
r_{pe}	0.088	0.034	0.310	0.041	0.065	0.083	0.107	0.152
r_{peg}	0.110	0.032	0.119	0.066	0.090	0.106	0.126	0.169
r_{mpeg}	0.122	0.032	0.026	0.081	0.100	0.116	0.137	0.181
r_{gm}	0.129	0.033	0.012	0.086	0.107	0.124	0.145	0.189
$r_{\Delta\text{agr}}$	0.128	0.029	0.005	0.094	0.110	0.122	0.138	0.178
r_{ct}	0.120	0.032	0.020	0.077	0.098	0.115	0.138	0.180
r_{gls}	0.109	0.031	0.105	0.063	0.089	0.107	0.126	0.163

r_{it+1} is the realized for year $t + 1$. r_{pe} is the expected return estimate imputed from the price to forward earnings model. r_{peg} is the expected rate of return implied by the PEG ratio. r_{mpeg} is the expected rate of return implied by the modified PEG ratio. r_{gm} and $r_{\Delta\text{agr}}$ are the expected return estimates imputed from Gode and Mohanram (2003) and Easton (2004), respectively. r_{ct} and r_{gls} are the expected return estimates imputed from Claus and Thomas (2001) and Gebhardt et al. (2001) implementation of the residual income valuation model.

The median estimate of the expected rate of return based on the PE ratio, r_{pe}, is 8.3%, which is considerably less than the median realized return of 12.2%. Also, as shown in the column titled $less\_r_f$, 31% of the firm-years in the Easton and Monahan (2005) sample have values of r_{pe} below the risk-free rate. These results suggest that r_{pe} is a downward biased measure of expected return. It is important to note, however, that these results do not provide evidence about the cross-sectional association between r_{pe} and true expected returns; this evidence is provided via the Easton and Monahan (2005) analyses and presented later in this section.[1]

As discussed in Section 4, analysts suggest that the adjustment to the PE ratio provided by taking short-term earnings growth into account will provide a better means of ranking stocks. Consistent with this argument, the median estimate of the expected rate of return based on the PEG ratio, r_{peg}, is higher — 10.6% — than the median estimate based on the PE ratio. Including dividends in the expected pay-off and calculating the expected rate of return implied by the modified PEG ratio, r_{mpeg}, causes the median estimate to rise to 11.6%.

[1] Given the expected risk premium on a stock is rarely less than zero, a high value of $less\_r_f$ suggests that the *average* of the expected return proxy is a poor measure of *mean* expected returns. However, $less\_r_f$ is not informative about the cross-sectional characteristics of the proxy (that is, bias does not imply noise); a large number of estimates less that the risk-free rate is not *prima-facie* evidence that an expected return proxy is unreliable.

The estimation procedure used by Gode and Mohanram (2003), which relies on the assumption that abnormal growth in earnings increases after year $t + 2$ at the risk-free rate minus 3% and the method used by Easton (2004), which estimates the rate of change in abnormal growth in earnings implied by the data, lead to estimates of increases in abnormal growth in earnings that are, on average, positive. Hence, the median estimate of the expected rate of return based on the Gode and Mohanram (2003) method, r_{gm}, (12.4%) and the median estimate based on the Easton (2004) method $r_{\Delta\mathrm{agr}}$ (12.2%) exceeds the median value of r_{mpeg}.

The median estimates of the expected rate of return based on the residual income valuation model — Claus and Thomas (2001), r_{ct}, and Gebhardt et al. (2001), r_{gls} — are 11.5% and 10.7%, respectively.

9.2 Correlation with Realized Returns

Table 9.2, also taken from Easton and Monahan (2005), includes the correlations among realized returns and several expected return proxies. Pearson (Spearman) correlations are shown above (below) the diagonal. We will focus on the Spearman correlations; the Pearson correlations lead to similar inferences.

There is a significant positive correlation between realized return and two of the expected return proxies: r_{ct} (0.073, t-statistic of 2.35) and r_{gls} (0.061, t-statistic of 1.95). None of the correlations between the remaining expected return proxies and realized returns is statistically different from zero at the 0.05 level. Three of the correlations are negative. These negative correlations imply that the cash flow news and return news components of realized returns reflect more than random measurement error, which only causes attenuation bias and has no affect on the sign of the correlation.[2] These correlations support the arguments made by Easton and Monahan (2005) that true cash flow news and true return news are correlated with the expected return proxies. Hence, in order to avoid drawing spurious inferences due to omitted correlated variables bias, it is crucial that researchers control

[2] This point is discussed in detail in Easton and Monahan (2005).

Table 9.2 Correlations: Realized returns and the expected return proxies.

	r_{it+1}	r_{pe}	r_{peg}	r_{mpeg}	r_{gm}	$r_{\Delta\mathrm{agr}}$	r_{ct}	r_{gls}
r_{it+1}		0.048	−0.032	0.013	−0.006	−0.010	0.050	0.057
		(1.16)	(−1.40)	(0.54)	(−0.34)	(−0.52)	(1.68)	(2.03)
r_{pe}	0.056		0.384	0.537	0.339	0.325	0.713	0.599
	(1.31)		(18.98)	(15.73)	(14.93)	(17.56)	(38.29)	(33.13)
r_{peg}	−0.028	0.386		0.892	0.880	0.866	0.591	0.415
	(−1.13)	(19.48)		(44.39)	(37.33)	(26.11)	(33.64)	(23.05)
r_{mpeg}	0.023	0.577	0.860		0.956	0.817	0.664	0.394
	(0.85)	(18.41)	(38.84)		(60.30)	(20.10)	(39.26)	(19.52)
r_{gm}	−0.003	0.351	0.843	0.936		0.811	0.567	0.278
	(−0.13)	(13.87)	(31.81)	(47.21)		(18.89)	(30.02)	(11.25)
$r_{\Delta\mathrm{agr}}$	−0.015	0.360	0.910	0.807	0.795		0.498	0.331
	(−0.68)	(19.89)	(101.45)	(38.93)	(32.16)		(20.54)	(14.84)
r_{ct}	0.073	0.713	0.620	0.724	0.610	0.573		0.428
	(2.35)	(40.22)	(37.09)	(59.88)	(28.21)	(38.55)		(14.13)
r_{gls}	0.061	0.605	0.471	0.451	0.317	0.418	0.470	
	(1.95)	(38.42)	(28.48)	(25.16)	(12.12)	(24.07)	(17.86)	

r_{it+1} is the realized for year $t+1$. r_{pe} is the expected return estimate imputed from the price to forward earnings model. r_{peg} is the expected rate of return implied by the PEG ratio. r_{mpeg} is the expected rate of return implied by the modified PEG ratio. r_{gm} and $r_{\Delta\mathrm{agr}}$ are the expected return estimates imputed from Gode and Mohanram (2003) and Easton (2004), respectively. r_{ct} and r_{gls} are the expected return estimates imputed from Claus and Thomas (2001) and Gebhardt et al. (2001) implementation of the residual income valuation model.

for variation in cash flow news and returns news when assessing the validity of estimates of the expected rate of return.

9.3 The Measurement Error Variance of the Estimates of the Expected Rate of Return

Easton and Monahan (2005) develop and describe a method for ranking proxies for the expected rate of return based on their measurement error variance. Readers interested in conducting an investigation of the validity/quality of various estimates of the expected rate of return should read the details of the method in Easton and Monahan (2005). I will cover only the key ingredients of the analyses.

First, recall the Vuolteenaho (2002) return decomposition:

$$r_{it+1} \approx er_{it+1} + cn_{it+1} - rn_{it+1}. \tag{9.1}$$

This implies that, if expected returns, cash flow news, and return news are measured without error, the coefficients on these components in a regression of realized returns on each of these components will be one.

Easton and Monahan (2005) develop a method that focuses on, and deals with, the fact that each of these components is measured with error. Their key regression is

$$\begin{aligned} \upsilon^M_{Cit+1} &= \delta_{0t+1} + \delta^M_{1t+1} \times \varepsilon^A_{1it+1} + \delta_{2t+1} \times \varepsilon^A_{2it+1} \\ &\quad + \delta_{3t+1} \times \varepsilon^A_{3it+1} + \mu_{it+1}, \end{aligned} \tag{9.2}$$

where υ^M_{Cit+1} is the difference between firm i's realized return for year $t+1$ and the sum of the empirical measures of its components $\upsilon_{Cit+1} = r_{it+1} - \widehat{er}_{it+1} - \widehat{cn}_{it+1} - \widehat{rn}_{it+1}$ modified to remove the covariance between the true expected return and the sum of true cash flow news and true return news. Notice that υ_{Cit+1} equals the combined measurement error in each of the empirical proxies for each of the components of returns; ε^A_{1it+1}, ε^A_{2it+1}, and ε^A_{3it+1} are the adjusted errors from a regression of one of the proxies on the remaining two (for example, ε^A_{1it+1} is the adjusted residual from a regression of $\widehat{er}_{it+1}$ on $\widehat{cn}_{it+1}$ and $\widehat{rn}_{it+1}$).

Each regression coefficient in Equation (9.2) measures the relation between the error in a particular proxy and the combined error in all the proxies. For example, the coefficient δ^M_{1t+1} on ε^A_{1it+1}, which is the variable of interest, is the variance of the measurement error in the expected return proxy, minus: (1) the covariance between true expected return and the sum of true cash flow news and true return news; and (2) the covariance between the measurement error in the expected return proxy and the sum of true cash flow news and true return news.

Easton and Monahan (2005) observe that, while there is a reason to believe the covariance between the true expected return and the sum of true cash flow news and true return news is not equal to zero, it involves only the true values, which implies it is constant across expected return proxies. It follows that, if differences across expected return proxies in the covariance between the measurement error in the expected return proxy are relatively small, which is a reasonable assumption, differences in the estimates of the regression coefficient, δ^M_{1t+1}, will be primarily due to differences in the measurement error variances of the expected return. The key point here is that the expected return proxy that has the lowest measurement error variance (that is, the proxy that yields the lowest δ^M_{1t+1}) is the best proxy.

9.4 Ranking of the Methods for Estimating the Expected Rate of Return

The results of estimating Equation (9.2) for each of methods of estimating the expected rate of return that are analyzed by Easton and Monahan (2005) are shown in Table 9.3. Before proceeding with a discussion of the regression coefficients, it is interesting to note that Equation (9.2) explains a considerable portion of the cross-sectional variation in the combined measurement error in the estimates of expected returns (υ_{Cit+1}).[3] For example, the r-square for the regression based on r_{gls} is 0.91. This implies the return decomposition developed by Vuolteenaho (2002) provides a useful characterization of the components of realized returns.

The estimate of the expected rate of return with the lowest estimate of δ_1^M is the method based on Claus and Thomas (2001), r_{ct}, (0.0003, t-statistic of 1.25). However, the coefficient on r_{ct} is only slightly less than the estimate of the coefficient δ_1^M on r_{pe} (0.0005, t-statistic of 1.42),

Table 9.3 The estimates of the regression coefficients.

Model	δ_0	δ_1^M	δ_2	δ_3	R^2
PE	0.161	0.0005	0.132	1.214	0.94
	(5.33)	(1.42)	(3.65)	(6.36)	
PEG	0.189	0.0012	0.136	2.098	0.96
	(6.26)	(5.92)	(4.01)	(7.89)	
Modified PEG	0.153	0.0008	0.139	2.093	0.96
	(4.02)	(3.76)	(4.03)	(7.85)	
Gode and Mohanram	0.162	0.0010	0.142	2.284	0.96
	(4.90)	(5.31)	(4.08)	(8.32)	
Easton	0.203	0.0008	0.143	1.712	0.96
	(6.16)	(5.02)	(4.30)	(8.71)	
Claus and Thomas	0.087	0.0003	0.106	1.130	0.93
	(1.98)	(1.25)	(2.91)	(7.30)	
Gebhardt, Lee and Swaminathan	0.239	0.0004	0.150	0.552	0.91
	(7.91)	(1.61)	(4.02)	(7.77)	

Regression: $\upsilon^M_{Cit+1} = \delta_{0t+1} + \delta^M_{1t+1} \times \varepsilon^A_{1it+1} + \delta_{2t+1} \times \varepsilon^A_{2it+1} + \delta_{3t+1} \times \varepsilon^A_{3it+1} + \mu_{it+1}$.
The table contains estimates of the regression coefficients; t-statistics are in parentheses.

[3] Easton and Monahan (2005) report that the means (medians) of υ_{Cit+1} for the expected return proxies are: $r_{\text{pe}}\,0.09(0.03)$, $r_{\text{peg}} - 0.01(0.01)$, $r_{\text{mpeg}} - 0.02(-0.02)$, $r_{\text{gm}} - 0.05(-0.03)$, $r_{\Delta\text{agr}} - 0.03(-0.01)$, $r_{\text{ct}} - 0.07(-0.03)$, and $r_{\text{gls}}\,0.02(0.01)$. These amounts suggest that, for several of the expected return proxies, the average (median) combined measurement error is considerable.

and the difference between these two coefficients is not statistically significant. Moreover, the coefficient on r_{pe} is smaller than each of the coefficients on the remaining proxies except r_{gls}, and the coefficient on r_{gls} is not statistically different from the coefficient on r_{pe}. The estimates of the coefficient δ_1^M are significantly positive for all of the other estimates of the expected rate of return suggesting significant measurement error variance.

9.5 Summary

This section summarizes the Easton and Monahan (2005) analyses of the extant firm-specific estimates of the implied expected rates of return. The news is bad: the simplest estimate, based on the PE ratio, which has the most restrictive (least reasonable) assumptions *ex ante*, yields an estimate of expected returns that contains no more measurement error than the remaining estimates. The good news is that there is much room for improvement of these measures. I will make some suggestions in Sections 10 and 11.

10

Bias in Estimates of the Expected Rate of Return Due to Bias in Earnings Forecasts

In Section 9, we discussed studies of the validity of *firm-specific* estimates of the implied expected rate of return. None of these studies addresses bias, that is, the *average* nonzero difference between the rates implied by analysts' forecasts and the market expectation of the rate of return, which these studies purport to measure.

The analysts' forecasts of earnings that are used in the literature to derive accounting-based estimates of the expected rate of return tend to be optimistically biased, particularly as they are usually measured a year in advance of the earnings announcement.[1] It follows that the expected rates of return implied by these forecasts will be upward biased; Easton and Sommers (2007) show that this bias is statistically and economically significant.[2] This section focuses on the extent of the bias; means of mitigating the bias will be discussed in Section 11.

[1] Optimistic bias in analysts' earnings forecasts is well-established in the literature; see, for example, O'Brien (1988); Mendenhall (1991); Brown (1993); Dugar and Nathan (1995); and Das et al. (1998). Forecasts made well in advance tend to be much more optimistic than those made closer to the earnings announcement; see Richardson et al. (2004).

[2] Claus and Thomas (2001) observe that the optimistic bias in analysts' forecasts will bias their estimate of the equity premium upward. Williams (2004) also makes this point in his discussion of Botosan et al. (2004).

10.1 Bias Matters

It is possible that the bias in analysts' forecasts and hence the likely bias in estimates of expected rates of return may be affected by the factor that researchers are investigating. For example, it is possible that analysts' forecasts for firms under one regime (say, firms that use accounting based on domestic accounting standards) may be more optimistic than analysts' forecasts for firms under a different regime (say, firms that use accounting based on international accounting standards).[3] These optimistic forecasts may bias the estimate of the expected rate of return upward for some firms, potentially leading to the (possibly erroneous) inference that the cost of capital is higher for these firms.

Easton and Sommers (2007) show that, consistent with the extant literature, the analysts' forecasts that are most-often used to obtain accounting-based estimates of the expected rate of return, tend to be optimistic, leading to implied expected rates of return that are, on average, biased upward by 2.84%. Comparing this bias with the estimates of the expected equity premium based on these data (3% or less in Claus and Thomas (2001); between 2% and 3% in Gebhardt et al. (2001); and 4.8% in Easton et al. (2002); suggests that there may be no premium at all! The bias obviously matters!

10.2 An *ex ante* Measure of Optimism

The extant literature on analysts' optimism/pessimism generally compares forecasts of earnings with realizations of the earnings that are forecasted. This provides an *ex post* measure of optimism. The primary analysis in Easton and Sommers (2007) is a comparison of the expected rate of return implied by current market prices and analysts' earnings forecasts of next period's earnings with the expected rate of return implied by these prices and current earnings. Since this comparison is done at the time the forecast is made, rather than after the realization, it provides an *ex ante* measure of the effect of optimism/pessimism.

[3] There is considerable evidence of differences in bias across regimes. For example, Das and Saudagaran (1998) show that analysts' earnings forecasts are less optimistic with respect to cross-listed firms than they are for domestic firms. Capstaff et al. (1998) find evidence that analysts' forecasts are more biased for UK firms than for German firms.

This *ex ante* comparison is interesting for two reasons. First, what matters is the bias at the time the forecasts are made (that is, the bias at the date of the estimation of the implied expected rate of return). Second, unlike *ex post* measures of optimism/pessimism, this measure is not affected by events that occur between the forecast date and the time of the earnings realization.[4]

10.3 Bias is the Difference Between Estimates based on Forecasts of Earnings and Estimates based on Earnings Realizations

The method used for estimating the expected rate of return that is implied by prices, current book values, and *forecasts* of earnings and the method for estimating the expected rate of return that is implied by prices and *current accounting data* were described in Section 6. Easton and Sommers (2007) develop these methods to unravel the affects of bias. Their estimates of the implied expected rate of return are based on three sets of earnings data: (1) analysts' forecasts of next year's earnings; (2) realized earnings for the current year; and (3) perfect foresight forecasts of next year's earnings; that is, next year's actual earnings. Comparing the estimates based on forecasts to the estimates based on actual earnings leads to two determinations of the bias when estimates of the market expected rate of return are based on analysts' forecasts of earnings. In each case, bias is the difference between estimates based on forecasts of earnings and estimates based on earnings realizations.

10.4 *Ex ante* and *ex post* Measures of Bias

An *ex ante* measure of bias is obtained by comparing the estimates of the implied expected rate of return based on analysts' forecasts with estimates based on current earnings realizations. This measure is *ex ante* inasmuch as it relies on information available at the time of the earnings forecast. The *ex post* measure compares estimates formed using

[4] An obvious recent example of such an event is the tragedy of the terrorist attack of September 11, 2001. This event, which was not foreseen by analysts, would almost certainly have made their forecasts overly optimistic with the benefit of hindsight.

analysts' forecasts with estimates based on perfect foresight of next-period earnings realizations.[5]

10.5 ***Ex ante*** Determination of the Effect of Bias

The *ex ante* determination of the effects of bias on estimates of the expected rate of return is based on a comparison of the estimate of the expected rate of return determined using the Easton et al. (2002) method of analysis of I/B/E/S forecasts (which is, arguably, upward biased because the earnings forecasts are, on average, optimistic) and the estimate of the expected rate of return using the method in Easton (2006) based on current earnings (where there is, arguably, no bias in the earnings numbers). That is, the *ex ante* bias is the difference between the estimate of the expected rates of return obtained via the following regressions:

$$\frac{\text{eps}_{jt+1}^{\text{IBES}}}{\text{bps}_{jt}} = \gamma_0 + \gamma_1 \frac{P_{jt}}{\text{bps}_{jt}} + \mu_{jt}, \tag{10.1}$$

where $\text{eps}_{jt+1}^{\text{IBES}}$ is the I/B/E/S forecast of earnings for year $t + 1$, and

$$\frac{\text{eps}_{jt}}{\text{bps}_{jt-1}} = \delta_0 + \delta_1 \frac{P_{jt} - \text{bps}_{jt}}{\text{bps}_{jt-1}} + \zeta_{jt}, \tag{10.2}$$

where eps_{jt} is I/B/E/S "actual" earnings for year t.

Since eps_{jt} is the only pay-off used in estimating the implied expected rate of return based on Equation (10.2), this estimate is not affected by analysts' optimism unless that optimism is shared by the market and captured in P_{jt}. It follows that the difference between the estimate of the expected rate of return based on analysts' forecasts in Equation (10.1) and the estimate based on current earnings in Equation (10.2) is an *ex ante* estimate of bias introduced when using analysts' forecasts to estimate the markets' expected rate of return.

[5] There may be factors other than analysts' optimism affecting each of these measures of bias; but, since other factors affecting the *ex ante* measure would not affect the *ex post* measure (and vice-versa), obtaining similar results based on both measures suggests that the effect of other factors is minimal. I elaborate on this point later in this section.

10.6 *Ex post* Determination of the Effect of Bias

Easton and Sommers (2007) obtain an *ex post* measure of the bias in the estimate of the expected rate of return by comparing the estimate of the expected rate of return based on I/B/E/S analysts' forecasts in Equation (10.1) with the expected rate of return based on perfect foresight forecasts of earnings (in other words, future earnings realizations); that is, Easton and Sommers (2007) replace $\text{eps}^{\text{IBES}}_{jt+1}$ in Equation (10.2) with earnings realizations for period $t{+}1$, denoted as $\text{eps}^{\text{PF}}_{jt+1}$. Of course, this *ex post* comparison, like prior studies of bias in analysts' forecasts, will be affected by events having an effect on earnings, which happen between the time of the forecast and the date of the earnings announcement.

10.7 *Ex ante* and *ex post* Comparison

In the *ex post* comparison of expected rates of return, unforeseen events are *omitted* from the market price but included in $\text{eps}^{\text{PF}}_{jt+1}$. On the other hand, in the *ex ante* comparison, expectations of future events are not included in eps_{jt} but are implicitly *included* in the market price. Since there is no obvious reason to expect a correlation between the information omitted from price in the analyses based on Equation (10.1) and the information included in price but excluded from earnings in the analyses based on Equation (10.2), the two methods provide alternative, independent estimates of the bias. Easton and Sommers (2007) obtain similar estimates using either method.

10.8 Empirical Estimate of the *ex ante* Bias

The mean estimate of the implied expected rate of return obtained from regression (10.1) based on earnings forecasts for a large sample of firms followed by I/B/E/S over the years 1992 to 2004 (see Easton and Sommers (2007) for more detail) is 9.43%, while the mean estimate of the implied expected rate of return from regression (10.2) based on actual earnings is 6.59%. The difference between these two estimates (2.84%) is a measure of the effect of bias in analysts' forecast of earnings on bias in estimates of the implied expected rate of return.

An implication of the observation that expected rates of return based on analysts' forecasts tend to be higher is that caution should be taken when interpreting the meaning of the rate of return that is implied by analysts' earnings forecasts; if, as is often the case in the extant literature, it is used as an estimate of the cost of capital, this estimate is likely upward biased.

10.9 Empirical Estimate of *ex post* Bias

The mean estimate of the expected rate of return implied by perfect foresight forecasts is 6.68%. The difference between this estimate and the estimate based on the I/B/E/S forecasts (9.43%) is the *ex post* estimate of the bias in estimates of the implied expected rate of return (2.75%).

10.10 Which Earnings are Related to Prices? Does the Market See Through the Forecast Bias?

The maintained hypothesis in the Easton and Sommers (2007) analysis of bias is that the earnings numbers that best capture the market's expectations that are built into prices are actual earnings (either current earnings or perfect foresight forecasts of future earnings). These two estimates, which are not expected to contain bias, are very similar. In the *ex post* comparison of expected rates of return, unforeseen events are *omitted* from the market price but included in the actual (perfect foresight) future earnings. On the other hand, in the *ex ante* comparison, expectations of future events are not included in current earnings but are almost inevitably *included* in the market price. The similarity of the implied estimates of the expected rate of return based on the two actual earnings numbers supports the maintained hypothesis; the market sees through the optimistic bias in the analysts' forecasts.

Further evidence consistent with the notion that the market sees through the optimistic bias is the fact that, consistent with Richardson et al. (2004), Easton and Sommers (2007) report that the forecast error (that is, the difference between the forecast of earnings and actual earnings) declines almost monotonically as the forecast horizon decreases from approximately 12 months ahead of the earnings announcement date to just before the earnings announcement date. And, the associated implied expected rate of return based on earnings forecasts and prices also decreases almost monotonically to 6.47% just before year $t+1$ earnings are announced. That is, the expected rate of return implied by analysts' forecasts declines to the *ex ante* estimate of the expected rate of return implied by accounting earnings at date t. Again these results suggest that the market at date t sees through the optimistic bias in the analysts' forecasts of earnings for period $t+1$.

10.11 Summary

Analysts' forecasts tend to be optimistically biased and, in turn, estimates of the expected rate of return implied by these forecast are upward biased. Methods of mitigating the effects of this bias are presented in Sections 11 and 12.

11

Dealing with Shortcomings in Firm-Specific Estimates

In Section 9, we discussed studies of the validity of *firm-specific* estimates of the implied expected rate of return. In light of the fact that the extant firm-specific estimates are poor and unreliable, the obvious questions to ask are: How do we deal with the shortcomings? How can we improve upon these estimates? In this section, we will discuss four methods of dealing with the shortcomings and we will discuss some directions for future research that could lead to the improvement in the accuracy or validity of these firm-specific estimates.

In Section 10, we saw that bias in estimates of the expected rate of return is economically and statistically significant when estimates are based on I/B/E/S data; which are the most commonly used data.[1] Bias is the average error in the estimates of the expected rate of return. This error is, on average, positive (in other words, the estimates are biased upward); analysts' forecasts tend to be optimistic. Since bias is the average error, many of the methods of dealing with error in firm-specific

[1] The Easton and Sommers (2007) paper, which documents this result, is based on I/B/E/S data. The observation that analysts' forecasts, including ValueLine and Zack's, both of which are used in the literature, are also optimistically biased strongly suggests that there will also be upward bias in estimates based on these data.

estimates may also be used to mitigate bias. Frankel and Lee (1998) provide an example; although their modeling of forecast errors via a regression of forecast errors on the book to price ratio, sales growth, analysts' optimism and analysts' forecasts of the long-term earnings growth rate could be used to estimate errors at the firm-specific level, their emphasis is on reducing the effects of bias — that is, reducing the average error.[2]

11.1 Methods for Mitigating the Effects of Measurement Error

The standard econometrics textbook suggestions for dealing with errors in variables are: (1) grouping; and (2) use of instrumental variables. I will discuss these methods in the context of estimates of the expected rate of return. I will also provide examples of sets of data where the errors in variables problem is likely to be less severe; researchers may seek out these samples though it is important to be aware of possible sample selection bias. Finally, and possibly most importantly, I will suggest ways of reducing the error in firm-specific estimates.

Several extant studies rely on an average of estimates of the expected rate of return obtained from various methods of reverse engineering the residual income valuation model and/or the abnormal growth in earnings valuation model. Note, however, that this averaging is unlikely to yield superior estimates because all of these methods are based on the same forecasts of earnings and error in the forecasts is most likely the primary source of measurement error; Easton and Monahan (2005) provide evidence that supports this conclusion.

11.2 Grouping

The aim of grouping a set of firm-specific observations and drawing inferences based on the average for the group is that averaging may remove firm-specific error; this will mitigate an "errors in variables" problem if the error is randomly distributed with zero mean. Extant studies that rely on means and medians of many firm-specific estimates

[2] The Frankel and Lee (1998) idea is discussed later in this section.

of the expected rate of return take advantage of this averaging effect. Note also that the regression methods (which are based on groups of observations) discussed in Sections 6 and 7 may also mitigate the effects of firm-specific measurement error as long as the regressions are estimated with the variables that are measured with error as the dependent variable (rather than as independent variables).

11.3 Variables that May be Used to Form Groups

The classic purpose of grouping of observations is to form groups where the within group variation in the true expected rate of return is minimized and the variation in the true expected rate of return across groups is maximized. The shortcoming of this method is that its effectiveness is limited by our ability to find proxies that will facilitate the formation of groups with homogeneous risk characteristics; further, if we had very good proxies it is not clear why we would need the accounting-based estimates of the expected rate of return. Nevertheless, grouping may result in some improvement if the risk proxy at least serves to reduce the within group variation and to increase the across group variation.

11.4 Empirical Evidence of the Effects of Grouping

Easton and Monahan (2005) group observations each year into sets of ten, based on variables that have been used in the literature as indicators of firm-specific risk (including CAPM beta, market capitalization, the ratio of equity book value to equity market value, the standard deviation of past returns, and industry type). They find that grouping does not appear to substantially reduce the measurement error variance for their estimates of the expected rate of return. They obtain similar results for portfolios of twenty observations. Easton and Monahan (2005) note it is possible that the use of even larger portfolios may lead to a significant reduction in measurement error. However, since they do not have sufficient degrees of freedom to reliably evaluate this assertion, they cannot make definitive statements about the reliability of expected return proxies for larger portfolios. Furthermore, they cannot assess the accuracy of estimates of the expected rate of return that are specifically designed for large portfolios of observations (such as the estimates obtained from the regression methods discussed in Sections 6 and 7).

11.5 Instrumental Variables

The instrumental variables procedure used to mitigate errors-in-variables problems in the context of estimates of the expected rate of return is as follows. The estimate of the expected rate of return is regressed on instruments that are assumed to be correlated with true expected return but uncorrelated with the measurement error. It follows that, if this assumption is empirically valid, the fitted values from this regression will be purged of measurement error.

11.6 Variables that May be Used as Instruments

As with grouping, the shortcoming of the instrumental variables method in the context of estimates of the expected rate of return is that its effectiveness is limited by our ability to find proxies that are correlated with the true expected rate of return but uncorrelated with the measurement error. And, if we had very good proxies it is not clear why we would need the accounting-based estimates of the expected rate of return. Nevertheless, instrumental variables may mitigate the measurement error problem; whether or not this will occur can only be answered by further empirical analyses.

11.7 Empirical Evidence of the Effectiveness of Instrumental Variables

Easton and Monahan (2005) use CAPM beta, market capitalization, the ratio of equity book value to equity market value, the standard deviation of past returns, and industry type as instrumental variables. They find that the fitted values from the regression of the estimates of the expected rate of return on these instruments have lower measurement error variances than the raw estimates of the expected rate of return. Despite this improvement, their evidence continues to suggest that the estimates of the expected rate of return are poor.

11.8 The Errors in Variables Problem May be Less Severe for Some Subsets of the Data

The errors in variables problem may be less severe for some subsets of the data; researchers may seek out these samples though it is important to be aware of possible sample selection bias, which may lead to spurious inferences or results and inferences that may not apply for a larger sample. The literature suggests several possible sub-samples.

11.9 The Relevance of the Vast Literature on Analysts' Forecast Errors

Although the research literature on analysts' forecasts is vast and the literature that reverse engineers accounting-based valuation models to obtain estimates of the implied expected rate of return relies on these analyst forecast data, this later reverse-engineering literature has made little reference to the earlier analysts' forecasts literature. Connecting these two research areas is likely to be a fruitful direction for future research; to the extent we know the determinants of analysts' forecast errors, we may be able to remove (or, at least, reduce) the effects of these errors.

11.10 Sub-samples Where the Error and/or Bias May be Less

I will consider just a few examples from the earnings forecast literature. La Porta (1996) and Frankel and Lee (1998) provide evidence that analysts' earnings forecasts errors are correlated with the magnitude of their estimate of the long-term earnings growth rate. Consistent with this evidence, Easton and Monahan (2005) show that there is a positive association between the reliability of the estimates of the expected return they evaluate and the magnitude of analysts' estimate of the long-term earnings growth rate.

Brown (1997) provides evidence that analysts' forecast errors are smaller for: (1) S&P 500 firms; (2) firms with large market capitalization, large absolute value of earnings forecasts, and large analyst following; and (3) firms in certain industries. Brown (2001, 2003) shows that past forecast accuracy may be used to predict future forecast accuracy. These studies suggest sub-samples where errors and/or bias in estimates of the expected rate of return may be less.

11.11 Reducing the Error and/or Reducing the Effects of the Error: An Example

As an example of the way that evidence from the literature on analysts' forecast errors may be used to predict (and hence mitigate the effects of) analysts' forecasts errors, consider the evidence that analysts' tend to be slow ("sluggish") in updating their earnings forecasts (see, for example, Lys and Sohn (1990) and Abarbanell (1991)); the evidence of this sluggishness is that revisions in analysts' forecasts tend to be correlated with past returns. The implication is that the prices used to invert accounting-based valuation models will implicitly contain information that is not in the forecasts.

11.12 Methods for Dealing with, So-called, "Sluggish" Forecasts

Guay et al. (2005) suggest three means of mitigating the effects of measurement error arising from sluggishness: (1) form portfolios based on past returns and use the median error from the portfolio of firms with similar recent returns; (2) use a price obtained some time before the earnings forecast date in the calculation of the implied expected rate of return; and (3) calculate the predicted value from a regression of forecast errors on various firm characteristics (one of which is lagged returns) and subtract this error from the forecasted earnings before calculating the implied expected rate of return.

The first two approaches are somewhat specific to sluggishness as the source of error. The latter, introduced to the earnings forecast literature by Ali et al. (1992) has much more general application. Caution must be exercised when applying the first two methods.

11.13 Critique of Methods

Use of the portfolio median error relies on the implicit assumption that the median return is not affected, at least as much as individual observations, by sluggishness. Note however, that if portfolios are formed on past returns, high (positive or negative) return portfolios are likely to over-weight observations for which sluggishness is more likely to affect forecast errors so that the sluggishness may not be removed at all. Nevertheless, there may be improvement in the accuracy of the estimates of the implied expected rate of return. Guay et al. (2005) use correlations with realized returns to gauge this effectiveness but they do not control for the correlated omitted variables, which Easton and Monahan (2005) argue is imperative. It would be interesting to see whether the portfolio median errors do better when ranked using the Easton and Monahan (2005) method.

The idea of using prices that lag the earnings forecast is: these prices will not contain information that has not been taken into account in forming the (sluggish) analyst forecast. But this introduces another form of error; unless the researcher precisely matches the price date with the date that the information used by analysts became available, he/she will either choose a price that is too late (that is, the effects of sluggishness are not completely dealt with) or he/she will choose a price that is too early, in which case earnings will contain information that is not in price. Nevertheless, the effectiveness of this method is an empirical question, which may be answered via the Easton and Monahan (2005) method.

11.14 Reducing the Forecast Error by the Predicted Value from a Regression of Forecast Errors on Various Firm Characteristics

Ali et al. (1992) observe that lagged forecast errors are predictive of future forecast errors; this observation motivates their method for reducing forecast errors, by: (1) determining the predicted forecast error as the fitted value from a regression of forecast error on lagged forecast error; and then (2) adjusting the earnings forecast by this amount. Others have used the idea behind this method. For example, Frankel and Lee (1998) model forecast errors via a regression of forecast errors on the book to price ratio, sales growth, analysts' optimism and analysts' forecasts of the long-term earnings growth rate. Similarly, Guay et al. (2005) obtain the predicted value from a regression of forecast errors on various firm characteristics (one of which is lagged returns) and subtract this error from the forecasted earnings before calculating the expected rate of return implied by the forecast. The Ali et al. (1992) method has a great deal of merit. It is likely that future attempts to estimate expected rates of return based on analysts' forecast will build on this work.

11.15 Combining Time-Series Forecasts and Analysts' Forecasts

A large early literature (see, for example, Brown and Rozeff (1978), Collins and Hopwood (1980), Fried and Givoly (1982), Makridakis and Winkler (1983), Givoly and Lakonishok (1984), Brown et al. (1987), Conroy and Harris (1987), Stober (1992), and Peters (1993a,b) examine and debate the effectiveness of combining several forecasts of earnings compared with the use of a single forecast. Combinations of forecasts from time-series models, from models involving several financial statement items, and analysts' forecasts out-perform analysts' forecasts in some samples. The overarching aim in all of these papers is to identify the forecast that is best in a particular research setting. Revisiting these research ideas with a focus on improving estimates of the expected rate of return may be fruitful.

11.16 Summary

The deficiencies (measurement error and bias) in extant estimates of the expected rate of return implied by prices and accounting data are clear. Overcoming these deficiencies provides many opportunities for future work.

I have argued that Easton and Monahan (2005) is the method that should be used to determine whether attempts to mitigate the effects of forecast errors work. I expect that much work can be done to either improve on the Easton and Monahan (2005) method or to develop alternative methods.

12

Methods for Determining the Effect of a Phenomenon of Interest on the Cost of Capital

This section describes a method for determining the effect of a characteristic of interest (such as disclosure quality, regulatory regime, cross-listing, earnings attributes, internal control weaknesses, etc.) on the cost of capital. The analysis compares estimates of the implied expected rate of return (a proxy for the cost of capital) across groups of stocks, which differ in the factor of interest. The method also allows introduction of control variables to deal with differences in factors other than the main factor.

12.1 Examples of Phenomena Studied in the Extant Literature

The emphasis in much of the research literature is on determining the effect of a phenomenon of interest on the cost of capital. Some examples from a long list of papers include Botosan (1997) examining the effect of disclosure quality on the cost of capital; Daske (2006) examining the effect of adopting IFRS or US-GAAP on the cost of capital; Dhaliwal et al. (2005) examining the effects of dividend taxes on the cost of capital; Francis et al. (2005) examining the effects of incentives for voluntary disclosure on the cost of capital; Francis et al. (2005) examining the effects of earnings attributes on the cost of capital; Hail and Leuz (2006) examining the effects of legal institutions and regulatory regime on the cost of capital; and Hribar and Jenkins (2004) examining the effects of accounting restatements on the cost of capital.

12.2 The Most Common Methodology

The method used in the vast majority of these studies is based on a regression of firm-specific estimates of the cost of capital, obtained via the reverse-engineering procedures discussed in earlier sections, on the variables of interest; for example, Hail and Leuz (2006) include measures of disclosure regulation, securities regulation, legal environment, equity market development, and flow of funds into the market and risk and country control variables. This method depends heavily on the validity of the estimates of the cost of capital that form the dependent variable. As we saw in Section 9, these estimates are poor; for most extant firm-specific estimates, the effect of measurement error is overwhelming. But, the question of interest in most of these studies is whether there is difference in the cost of capital among groups of stocks. Thus, firm-specific estimates are unnecessary.

12.3 A Method for Comparing Expected Rates of Return Across Groups of Stocks

The method discussed in this section does not rely on firm-specific estimates. Rather it facilitates a focus on differences in the cost of capital among groups of stock, which differ in the attribute of interest. This method is a straight-forward extension of the methods in Easton et al. (2002) and Easton (2006).

The method is as follows. The effect of the characteristic of interest on the implied expected rate of return may be estimated via the following dummy-variable regressions, based on Easton et al. (2002):

$$\frac{\mathrm{eps}_{jt+1}}{\mathrm{bps}_{jt}} = \gamma_0 + \gamma_1 \frac{P_{jt}}{\mathrm{bps}_{jt}} + \gamma_2 D + \gamma_3 D \frac{P_{jt}}{\mathrm{bps}_{jt}} + \upsilon_{jt} \tag{12.1}$$

and based on Easton (2006):

$$\frac{\text{eps}_{jt}}{\text{bps}_{jt-1}} = \delta_0 + \delta_1 \frac{P_{jt} - \text{bps}_{jt}}{\text{bps}_{jt-1}} + \delta_2 D + \delta_3 D \frac{P_{jt} - \text{bps}_{jt}}{\text{bps}_{jt-1}} + \zeta_{jt}, \qquad (12.2)$$

where D is a dummy variable equal to one for the group of firms with the characteristic of interest (for example, a cross-listed firm, or a firm adopting IFRS, or a firm with disclosure quality above the median), zero otherwise. Recall that $\gamma_0 = g$ and $\gamma_1 = (r_E - g)$, so that the sum of these coefficients is an estimate of the expected rate of return. Since γ_2 captures the difference in g across the two sets of observations and γ_3 captures the difference in $(r_E - g)$ across the two sets of observations, the sum of the coefficients γ_2 and γ_3 captures the effect of the characteristic of interest on r_E, the estimate of the implied expected rate of return. It follows that the effect of the characteristics of interest on the implied expected rate of return may be "backed out" of the estimates of the coefficients γ_2 and γ_3. Similarly, estimates of the effect of the characteristics of interest on the implied expected rate of return may be backed out of δ_2 and δ_3.

12.4 Controlling for Effects Other than the Effect of Interest

Most studies add risk factors and other variables to ensure that the observed differences in the implied expected rates of return are, indeed, due to the phenomenon of interest. This may be meaningful. For example, if the firms in one group are much larger than the firms in another group, one may wish to ensure that this size difference is not driving the results. On the other hand, it is important to ensure that these controls do not "throw the baby out with the bath water"; if we control for all known risk factors, then one could reasonably ask: What is the additional risk difference that is captured by the variable of interest? Have we found a new risk proxy? Or: Might one reasonably expect the risk inherently captured by the variable of interest to be correlated with (and theoretically related to) the risk proxies? In short, it is not always clear there is a need to control for (other) risk factors, despite the fact that this has become almost standard methodology.

Note the troublesome circularity here. Researchers have chosen to use accounting-based estimates of the expected rate of return because of the shortcomings of alternative proxies — particularly variables that have been shown to be empirically correlated with "abnormal returns" (such as beta, size, book-to-market, momentum) — and yet they use these proxies to control for all other likely risk factors.

12.5 Introducing Controls in the Dummy Variable Regression

Controls may be introduced into the dummy variable regressions either as additional dummy variables or interaction terms. There are numerous ways by which this can be done. I will discuss just the basic idea.

12.6 Additional Dummy Variables or Interaction Terms

To illustrate, if one group of observations is comprised of firms that are larger than those in the other group and we wish to ensure that firm size is not driving the results, we would add firm size in the regression in the following manner:

$$\frac{\text{eps}_{jt+1}}{\text{bps}_{jt}} = \gamma_0 + \gamma_1 \frac{P_{jt}}{\text{bps}_{jt}} + \gamma_2 D + \gamma_3 D \frac{P_{jt}}{\text{bps}_{jt}} + \gamma_4 \text{adjsize}_{jt} + \gamma_5 \frac{\text{adjsize}_{jt} * P_{jt}}{\text{bps}_{jt}} + e_{jt}, \tag{12.3}$$

where adjsize_{jt} is the adjusted size of firm j at time t. The adjustment, could, for example, be subtraction of the mean size from all observations (that is, mean centering). Under this specification the sum of the coefficients γ_2 and γ_3 captures the effect of the characteristic of interest on the estimate of the implied expected rate of return for the average-size firm.[1]

[1] This method was suggested by Sanjay Bissessur. Other risk proxies could be added in a manner similar to the way we have added size.

12.7 Matched-Sample Design

Another way of attempting to ensure that portfolio differences in estimates of the implied expected rate of return are not due to factors other than the factor of interest is to use a matched-sample design. For example, consider the research question: Does accounting-based fraud affect the expected rate of return on investment? One might reasonably argue that fraud tends to be concentrated in particular industries (those with declining profitability, for example) and in firms of similar size. One might also argue that there are "spillover" effects of fraud. For example, WorldCom's apparent superior performance during the years of its fraud may have had spillover effects on the market's perception of AT&T and Sprint.

These arguments suggest that two matched samples are necessary in this research study: (1) matched on industry, size, and on the time period of the fraud; and (2) matched on industry where no frauds have been detected, size, and the time period of the fraud. I will not delve into details of the matching procedure; ironing out these details is by no means trivial and we must always add the caveat that the conclusions will rely heavily upon the validity/closeness of the matching.[2]

12.8 The Firm as Its Own Control

Often in studies of the effect of a factor of interest on the cost of capital, the firms in the sample may be used as their own control; the estimate of the implied expected rate of return in an earlier period may be compared with the estimate of the cost of capital after a change (such as change from domestic to foreign GAAP or cross-listing). It is important, however, to attempt to ensure that the change over time is due to the factor of interest. This generally involves a matched-sample design in which the change over time in the implied expected rate of return for the matched firms is the estimate of the change that would have happened independent of the factor of interest.

[2] A shortcoming of the matched sample design is that the samples are no longer random, limiting the ability to generalize the results to the whole population.

12.9 Matching and the Firm as Its Own Control: The Dummy Variable Regression

Let us return to the study of firms that have been accused of accounting fraud. For the sake of simplicity, let us focus on the fraud firms and the matched sample of firms for which there is no spillover effect; adding the matched sample of spillover firms is easy to do but this adds unnecessary complication to the depiction of the dummy variable regression.

I would set up the regression as follows:

$$\frac{\text{eps}_{jt}}{\text{bps}_{jt}} = \gamma_0 + \gamma_1 \frac{P_{jt}}{\text{bps}_{jt}} + \gamma_2 D_{\text{during}} + \gamma_3 D_{\text{during}} \frac{P_{jt}}{\text{bps}_{jt}} + \gamma_4 D_{\text{fraud}} + \gamma_5 D_{\text{fraud}} \frac{P_{jt}}{\text{bps}_{jt}} + \gamma_6 D_{\text{during}} D_{\text{fraud}} + \gamma_7 D_{\text{during}} D_{\text{fraud}} \frac{P_{jt}}{\text{bps}_{jt}} + e_{jt}, \tag{12.4}$$

where $D_{\text{during}} = 1$ if the observation is in the period of the fraud, 0 if prior to the fraud; and $D_{\text{fraud}} = 1$ if the observation is for a firm accused of fraud, 0 otherwise.

In this dummy variable regression, the interpretation of the regression coefficients is as follows:

- $\gamma_0 + \gamma_1$ is the estimate of the implied expected rate of return for nonfraud firms in the period prior to the fraud. It is the benchmark;
- $\gamma_2 + \gamma_3$ is the change in the implied expected rate of return for the nonfraud firms from the period prior to the fraud to the period of the fraud;
- $\gamma_4 + \gamma_5$ is the difference in the implied expected rate of return between the fraud firms and the nonfraud firms in the period prior to the fraud; and
- $\gamma_6 + \gamma_7$ is the incremental implied expected rate of return for the fraud firms during the fraud period; incremental to the implied expected rate of return for these firms in the prior period and for the nonfraud firms in the

fraud period. This is the estimate that is likely to be of most interest.

12.10 Expected Growth Rates are Determined by the Data

Easton (2006), using the portfolio methods discussed in Section 7, demonstrates that growth rates implied by the data differ considerably from growth rates assumed in the literature. Further, he demonstrates that descriptively invalid growth rate assumptions may lead to incorrect conclusions about differences in cost of capital across groups of stocks. A strength of the method described in this section is that differences in implied expected growth rates and differences in the implied expected rate or return are estimated simultaneously in the empirical model; in other words, both the growth rates and the expected rates of return are those implied by the data.

12.11 Summary

Work on the portfolio-based approach to estimation of the implied expected rate of return has only just begun. The regression-based approach of Easton et al. (2002) and Easton (2006) is new. Much work is yet to be done. Some concerns with this approach, which is the basis of the methods discussed in this section, and some suggestions for refinements and extensions will be provided in the next section. Some attempts have been made to modify this method to obtain firm-specific estimates of the cost of capital (see for example, Huang et al. (2005) and Ogneva et al. (2007)). These early attempts are certainly worthwhile, particularly in light of the serious short comings of extant firm-specific measures as highlighted by Easton and Monahan (2005) with regard to accounting-based estimates and by Fama and French (1997, 2002) with regard to historical return-based estimates.

13

Data Issues

This section describes data issues that are often encountered when estimating the rate of return implied by accounting data and market prices. These issues are often over-looked. In this section, I will discuss ways of dealing with these issues. Failing to deal with these issues will introduce errors and biases into the estimates of the expected rate of return and may lead to spurious inferences. These issues will arise when using most sources of analysts' earnings forecasts; I/B/E/S forecasts for P&G are used in this section as an illustration.

13.1 Misalignment of Prices, Book Values, and Earnings Forecasts

Consider estimates of the expected rate of return obtained by reverse engineering the residual income valuation model:

$$P_t = \text{bps}_t + \frac{\text{eps}_{t+1} - r_E \text{bps}_t}{r_E - g_{ri}}.$$

Notice that prices and book values enter this model on the same date (date 0) and future earnings are earnings for the period that begins at date 0 and ends at date 1. This point may seem trite in the context of the model but it is very important when we are gathering prices, book values, and earnings forecast data with the goal of estimating an implied expected rate of return. As a practical matter, we may wish to value the stock (or we may wish to obtain an implied expected rate of return) at *any* date; for example, we may wish to see how the implied expected rate of return changes around an event of interest (for example, around an interest rate change, which may affect all stocks at the same date, or around the announcement of an internal control weakness, which will affect different stocks at different dates). Yet book value is known or forecasted for discrete points in time (generally quarterly), and earnings forecasts are generally provided at discrete points in time (for example, I/B/E/S issues monthly forecasts on Thursday before the third Friday of the month and ValueLine issues forecasts at quarterly intervals on a rotating basis and in general each firm is covered in a report every 13 weeks with a different set of firms covered each week).

13.2 An Example: P&G

The following data are illustrative of data typically used in the literature that reverse engineers accounting-based valuation models to obtain estimates of the implied expected rate of return (earlier data for this company and from I/B/E/S, for example, was used by Gebhardt et al. (2001), Claus and Thomas (2001), and Easton et al. (2002)).

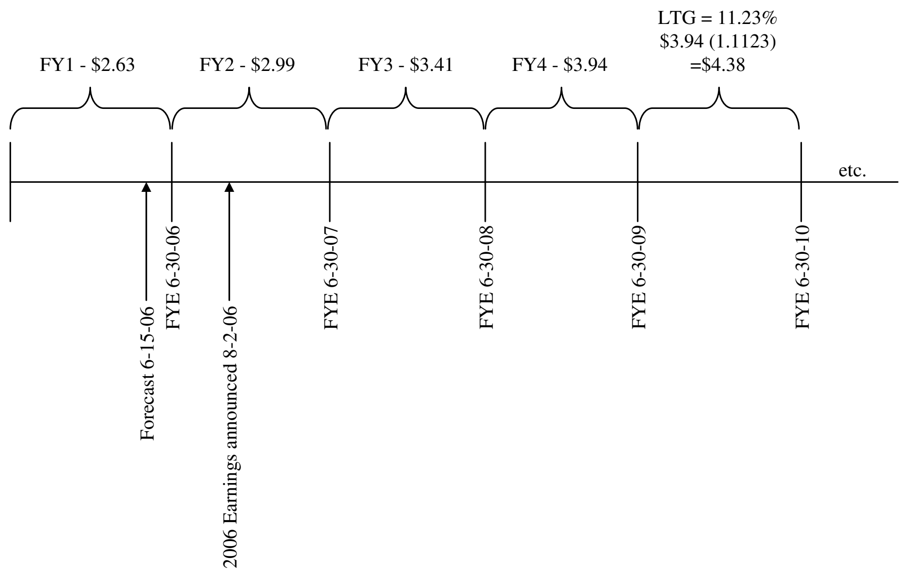
The I/B/E/S earnings forecasts for Proctor and Gamble provided on June 15, 2006 were:

FY0: actual earnings for year ending 6-30-2005	\$2.66
FY1: forecast of earnings for year ending 6-30-2006	\$2.63
FY2: forecast of earnings for year ending 6-30-2007	\$2.99
FY3: forecast of earnings for year ending 6-30-2008	\$3.41
FY4: forecast of earnings for year ending 6-30-2009	\$3.94
LTG: forecast of annual earnings growth rate over the business cycle beginning 6-30-09	11.23%

Similar data are provided for other firms, although for many firms only FY0, FY1, FY2, and LTG are available. In this latter circumstance, FY3 and FY4 are generally obtained by growing FY2 at LTG.

13.3 A Close Look at the Time-Line for These Forecasts

The time-line for these P&G forecasts is



Note that the forecasts are assumed to reflect expectations at the date the analysts made the forecasts, June 15, 2006. In most reverse-engineering applications we will generally (by no means, always) take a price that incorporates these expectations (say, the price at the close of trade on the next day, June 16, 2006). But, what earnings and book value data should be used?

13.4 The Earnings Forecast May be for a Fiscal Period that has Ended

P&G's 2006 earnings were announced on August 2, 2006. FY1 (that is, the, so-called, forecast for this August 2, 2006 announcement of fiscal year earnings) is the forecast for the year ending June 30, 2006, which is just 15 days after the forecast is made; the important point being that most of the year has passed. To underscore this point note that

I/B/E/S announced a FY1 forecast on July 14, 2006; this is a forecast of earnings for a year that ended 14 days before the forecast. Are these forecasts, which are for a year that has either passed or is partially, sometimes almost completely, passed, ever useful in valuation? The answer is, surely, yes, because these earnings forecasts will be a focus of attention of the market when valuing the stock; I will show how these forecasts should be incorporated in the valuation. Yet it must be noted that the increase in value represented by the earnings has already accrued. It follows that this earnings pay-off should not be discounted in a residual income or abnormal earnings growth valuation formula; this has often been done in the literature.

13.5 Book Value will not be Known Until the Earnings Announcement Date

The assumption that book value is calculable once earnings are known is reasonable for most intents and purposes. It follows that the initial book value anchor in the residual income valuation model could reasonably be calculated by adding earnings to book value from the previous year and subtracting net transactions with shareholders (dividends plus stock repurchases minus new stock issues). Errors are introduced because the forecasted earnings: (1) rarely, if ever, include "dirty surplus" or "comprehensive income" items, though adjustments for the large items such as change in the foreign currency translation reserve and change in the value of securities that are marked-to-market may be made using readily available data from, for example, Compustat; and (2) analysts tend to forecast earnings before one-time items, yet book value will be affected by these items; an approximation for these items may be possible using Compustat data if one is prepared to assume that these items might reasonably have been expected or known (at least on average) by the market.

13.6 Forecasted Book Value as the Anchor

Easton et al. (2002) and Easton and Sommers (2007) address the issue of book value not being known until the earnings announcement date (or more generally book value not being known at the valuation date), by calculating a forecast of book value from the forecast of earnings following a procedure that is similar to the above method; that is, they add forecasted earnings to beginning-of-year book value, subtract net transactions with shareholders, and adjust for dirty surplus and one-time items.

13.7 One Option: Calculate Implied Expected Rates of Return based on Forecasts Obtained at Year End and based on Year-End Prices

For some applications, it may be reasonable to limit the analyses to prices and forecasts that are taken near the fiscal year end. The advantage of this is simplicity because prices, book values, and forecast periods are more or less aligned.

For example, Easton et al. (2002) limit their analyses to firms with December fiscal-year end. They use fiscal-year-end prices, I/B/E/S earnings forecasts obtained as near as possible to the end of December (the Thursday before the third Friday) and they extrapolate book value forward using prior year book values, forecasts of earnings for the fiscal year that is about to end and dividends obtained from Compustat (they also check the sensitivity of their results to using "perfect foresight" forecasts of book values — that is, reported book values). They describe their sample selection procedure via the following example.

For observations in 1995, the December I/B/E/S forecasts became available on the 14th day of the month. These data include forecasts for a fiscal year ending 17 days later (that is, December 31, 1995) and either an earnings forecast for each of the fiscal years ending December 31, 1996 and 1997 (that is, eps_{t+1} and eps_{t+2}) or the forecast for the fiscal year ending December 31, 1996 (that is, eps_{t+1}) and a forecast of growth in earnings per share for the subsequent years. Easton et al. (2002) use the actual forecasts for the subsequent year (in this example, 1997) as their proxy for eps_{t+2} when they are available. When actual forecasts are not available, they use I/B/E/S forecasts of growth in earnings as the basis for developing their proxy for eps_{t+2}.

13.8 Disadvantages of Using Reverse Engineering based on Prices at a Particular Point in Time

The disadvantages of restricting the sample to December year-end firms is that this may result in some bias and/or the interest of the researcher may be in firms with predominantly non-December year ends (for example, many retail firms would not be included in a December year-end sample). Also, researchers and investment professionals may be interested in the value of the firm or the implied expected rate of return at *any* particular date. In the next section, I outline a procedure for addressing these issues. I use the P&G example.

13.9 Determining Virtual Forecasted Book Values and Virtual Forecasted Earnings at any Date: The Method Proposed by Daske et al. (2006)

The idea of developing virtual book values and virtual earnings is proposed by Daske et al. (2006). The aim of this method is to facilitate daily estimation of the implied expected rate of return using only information that is publicly available at the estimation date. The basic idea involves four modifications: (1) calculate the "virtual" forecast of earnings for the portion of the year ending at the estimation date; (2) calculate the "virtual" book value of equity at the estimation date by adding to last year's book value the intra-year "virtual" profit accumulated to that date and subtracting actual dividends paid between the end of the prior fiscal year and the estimation date; (3) calculate the forecast of "virtual" earnings for the remainder of the fiscal year; and (4) discount on a daily basis so that discounting takes account of the exact time between the end of the fiscal (earnings accumulation) period and the estimation date.

13.10 An Example: P&G

In order to illustrate the method, suppose we want to determine the implied expected rate of return at the end of the trading day, January 13, 2008, when P&G stock closed at a price of $70.29. The most recent ValueLine forecasts were available on January 4, 2008.

These forecasts were:

Year ending	Earnings per share ($)	Dividends per share ($)	Book value per share ($)
6-30-2008	3.48	1.54	34.24
6-30-2009	3.90	1.69	36.45
6-30-2010	4.33	1.85	38.93
6-30-2011	4.75	1.90	41.78

Recall that P&G has a fiscal year end date of June 30; book value per share taken from the most recent annual report (dated June 30, 2007) was $32.30.

13.11 Estimating Earnings to the Estimation Date

The calculation of earnings for the portion of the year ending at the estimation date recognizes that earnings early in the year beget earnings later in the year[1]:

$$\begin{aligned}\text{eps}_{\text{July1, 2007 to Jan 13, 2008}} &= \text{bps}_{2007}\left[\left(1+\frac{\text{eps}_{2008}}{\text{bps}_{2007}}\right)^{\frac{\#\text{ofdays(FYEtoED)}}{365}}-1\right]\\ &= \$32.30\left[\left(1+\frac{\$3.48}{\$32.30}\right)^{\frac{197}{365}}-1\right]\\ &= \$1.83.\end{aligned}$$

Of course, this is just one way of calculating the earnings. It is the method that fits well with use of annual forecasts, but could be modified if quarterly forecasts are available. The fine-tuning associated with compounding the earnings within the forecast period may be unnecessary (perhaps even invalid; this would be so if earnings followed seasonal patterns as is often the case), and a simple average (in the case of P&G:$3.48 $* \frac{197}{365} =$ $1.88) may be equally reasonable. The method could be refined to account for seasonal patterns by, for example, assuming that past observed patterns are expected to reoccur in the subject year.

[1] The number of days between the fiscal year end (June 30, 2007) and the estimation date (January 13, 2008) is 197 days.

13.12 Estimating Virtual Book Value

Virtual book value of equity at the estimation date is calculated by adding virtual earnings and subtracting dividends paid to that date; these data may be, in general, obtained from the quarterly Compustat data base and/or from the CRSP daily price files. For P&G:

$$\begin{aligned}\text{bps}_{\text{Jan}\,13,08} = {} & \text{bps}_{2007} + \text{eps}_{\text{July}\,1,2007\ \text{to}\ \text{Jan}\,13,2008} \\ & - \text{dps}_{\text{July}\,1,2007\ \text{to}\ \text{Jan}\,13,2008}\end{aligned}$$

Since P&G paid dividends of $0.35 on July 18, 2007 and October 17, 2007, the calculation is

$$\$33.43 = \$32.30 + \$1.83 - \$0.70.$$

13.13 Estimating Earnings for the Remainder of the Fiscal Period

The calculation of earnings for the remainder of the fiscal period for P&G is straight forward:

$$\begin{aligned}\text{eps}_{\text{Jan}\,13,2008\ \text{to}\ \text{June}\,30,2008} &= \text{eps}_{08} - \text{eps}_{\text{July}\,1,2007\ \text{to}\ \text{Jan}\,13,2008} \\ \$1.65 &= \$3.48 - \$1.83.\end{aligned}$$

13.14 Discount Daily

Discounting may be done on a daily basis so that discounting takes account of the exact time between the end of the estimation date and the end of the fiscal period. The general formula is as follows:

$$\begin{aligned}P_{\text{ED}} = \text{bps}_{\text{ED}} &+ \left(\frac{\left(\text{eps}_{\text{EDtoFYE}} - \left[(1+r_E)^{\frac{\#\text{days(EDtoFYE)}}{365}} - 1\right]\text{bps}_{\text{ED}}\right)}{(1+r_E)^{\frac{\#\text{days(EDtoFYE)}}{365}}}\right) \\ &+ \sum_{t=1}^{T}\left(\frac{\text{eps}_t - r_E\text{bps}_{t-1}}{(1+r_E)^{\frac{\#\text{days(EDtoFYE)}+365t}{365}}}\right) \\ &+ \left(\frac{(\text{eps}_T - r_E\text{bps}_{T-1}) * (1+g_{ri})}{(r_E - g_{ri}) * (1+r_E)^{\frac{\#\text{days(EDtoFYE)}+365(T-1)}{365}}}\right)\end{aligned}$$

For P&G (assuming $g_{ri} = 4.4\%$):

$$\begin{aligned}
\$70.29 &= \$33.43 + \left(\frac{\left(\$1.65 - \left[(1 + r_E)^{\frac{168}{365}} - 1 \right] \$33.43 \right)}{(1 + r_E)^{\frac{168}{365}}} \right) \\
&\quad + \left(\frac{(\$3.90 - r_E \$34.24)}{(1 + r_E)^{\frac{533}{365}}} \right) + \left(\frac{(\$4.33 - r_E \$36.45)}{(1 + r_E)^{\frac{898}{365}}} \right) \\
&\quad + \left(\frac{(\$4.75 - r_E \$38.93)}{(1 + r_E)^{\frac{1263}{365}}} \right) \\
&\quad + \left(\frac{(\$4.75 - r_E \$38.93) * (1 + 0.044)}{(r_E - 0.044) * (1 + r_E)^{\frac{1263}{365}}} \right) \\
r_E &= 8.17\%.
\end{aligned}$$

13.15 An Alternative: Adjust Prices

Another means of dealing with the issue of the misalignment of prices, book values, earnings and forecasts of earnings is to impute a virtual price in the model. This method is often used in practical valuation applications and is documented in the literature (for example, in Easton and Sommers (2007)). Price at the fiscal period end-date is replaced with observed price on the estimation date discounted at the (unknown) expected rate of return to the fiscal period end date.

In the P&G example:

$$\begin{aligned}
\$70.29/(1 + r_E)^{\frac{197}{365}} = \$32.30 &+ \frac{(\$3.48 - r_E \$32.30)}{(1 + r_E)} \\
&+ \frac{(\$3.90 - r_E \$34.24)}{(1 + r_E)^2} \\
&+ \frac{(\$4.33 - r_E \$36.45)}{(1 + r_E)^3} \\
&+ \frac{(\$4.75 - r_E \$38.93)}{(1 + r_E)^4}
\end{aligned}$$

$$+\frac{(\$4.75 - r_E\$38.93)}{(r_E - 4.4\%) * (1 + r_E)^4}$$
$$r_E = 8.2\%$$

13.16 Summary

This section describes methods of dealing with data issues and ways of estimating the cost of capital at any point in time. These issues will arise when using most sources of analysts' earnings forecasts.

14

Some Thoughts on Future Directions

The literature on reverse-engineering accounting-based valuation models has come a long way in a very short time, but we have a long way to go. Estimates of firm-specific implied rates of return appear to be quite poor. The challenge is to improve the estimates. The question is How?

14.1 Other Sources of Earnings Forecasts: The Data

In view of the fact that most studies have been based on I/B/E/S forecasts, it is tempting to look to other sources, such as ValueLine or Zack's, taking the view that there is, as yet, no evidence that estimates based on these forecasts suffer the same short-comings as estimates based on I/B/E/S. This argument has been made in several studies but it is without foundation; it is likely that when subjected to rigorous testing via methods such as Easton and Monahan (2005), estimates based on these data sources will also be found wanting.

Another approach has been to avoid use of earnings forecasts, and to, instead, rely on analysts' forecasts of dividends and prices as in Brav et al. (2005). It would be surprising if these methods out-performed the accounting-based estimates when subjected to rigorous analysis; nevertheless, the proof will be in the pudding.

14.2 Mitigating Errors and Bias

The vast literature on analysts' forecasts provides a wealth of opportunities for mitigating/reducing the effects of errors in analysts' forecasts. Much of this literature has focused on obtaining better estimates of the market earnings expectations but the use of the better estimates has been limited (for example, to obtain a better measure of the surprise in the announcement of earnings). Reverse-engineering accounting-based valuation models provides a new, and important, context.

14.3 Refocus on Operations

I began this survey with a focus on the operations of the firm and I showed how: (1) the residual operating income model may be used to value the firm; and (2) we can reverse-engineer the residual operating income model to obtain estimates of the implied cost of capital for the firm (otherwise known as the cost of capital for operations).

All of the methods of estimating the cost of equity capital at the portfolio level could be applied to estimating the cost of capital for operations. We would need estimates of net operating profit after tax (NOPAT) and net operating asset (NOA). Nissim and Penman (2001) provides a template for calculating these items from Compustat data. Backing forecasts of NOPAT and NOA out of analysts' forecasts will pose challenges, but these challenges are becoming less and less daunting as analysts' provide forecasts of more and more data other than earnings.

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