How Low is the Equity Risk Premium? Evidence from Imputed Earnings Forecasts

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The U.S. equity risk premium using historical estimates of stocks and bonds is 6 to 8 percent. However, research has suggested that the risk premium should be much lower. An important stream of literature in this respect is using analysts' earnings forecasts and reverse engineering the residual income valuation model to impute risk premium. The use of analysts' earnings forecasts leads to an upward bias of the estimated risk premium. In this study, we implement methodology to measure equity risk premium without using analysts' earnings forecasts. Our results provide evidence supporting a close to zero risk premium.

INTRODUCTION

The equity discount rate, or equity cost of capital, is one of the central measures in accounting and finance. It is at the heart of a corporation's decision making and investors' valuation. Because the use of an improper discount rate can lead to an improper firm valuation and a poor investment decision, it is not surprising that numerous research papers have attempted to determine how a firm's accounting or finance information influences its equity discount rate. However, the issue of what equity risk premium (hereafter called the 'risk premium') should be used to determine a proper discount rate is unsettled. Research using historical estimates of stocks and bonds from Ibbotson Associates indicate a high average U.S. equity risk premium in the range of 6 to 8 percent (Ibbotson SBBI, 2011). Nevertheless, recent academic research in the accounting and finance areas has suggested that a proper risk premium is clearly lower, somewhere between 1.0 percent and 5.5 percent (e.g., Claus and Thomas, 2001; Gebhardt et al., 2001; Easton et al., 2002; Fama and French, 2002; Baginski and Wahlen, 2003; Gode and Mohanram, 2003; Easton, 2004).[1] One strand of this literature determines the equity discount rate (hence risk premium) by reversing the residual income valuation (RIV) model (e.g., Claus and Thomas, 2001; Gebhardt et al., 2001; Easton et al., 2002). In these studies, the equity discount rate is computed by equating the difference between a firm's current stock price and book value with the present value of the firm's expected future abnormal earnings, using analyst' earnings forecasts to proxy for the market's expectation of firms' future earnings. However, the reliability and validity of estimates from the RIV model using analysts' forecasts are questioned by later research (Easton and Monahan, 2005; Botosan and Plumlee, 2005; Guay et al., 2011) from two perspectives. First, it is widely known that analysts' earnings forecasts are inaccurate and biased (Richardson et al., 2004; Easton and Sommers, 2007). So analysts' forecasts are incapable of being unbiased proxies for the market's expectation of firms' future earnings. Second, estimation of the expected rate of return can be sensitive to the assumed (or estimated) growth rate of abnormal earnings beyond the forecast horizon (g), and previous literature either provides limited guidance about the selection of the assumed g (Claus and Thomas, 2001; Gebhardt et al., 2001) or offers little justification for the reasonableness of the estimated g (Easton et al., 2002; Easton and Sommers, 2007).

In this paper, without using analysts' earnings forecasts as the proxy for the market's expectation of firms' future earnings, we develop a new approach to estimate the equity risk premium using the following steps. First, we first reverse engineer the RIV model using stock price and the book value per share of common equity to impute EPS forecasts on an individual firm basis. In other words, we find expected future EPS embedded in the current stock price of a firm. Second, we compare the imputed EPS forecasts to corresponding actual EPS numbers to find the forecast errors, which are accumulated over varying windows ranging from one year to five years. Third, we estimate the risk premium by finding the assumed risk premium in the RIV model for which the average cumulative forecast error is zero.[2]

This paper's approach to determining the implied risk premium is different from the approaches used in previous studies. In previous studies, researchers reversed engineered the RIV model and solved for the discount rate (and thus the risk premium) by using analysts' earnings forecasts. However, numerous studies have shown that analysts' earnings forecasts are biased, especially the forecasts made well before actual earnings announcements (Richardson et al., 2004; Bradshaw et al., 2012) and long-term forecasts (Dechow et al., 2000; Bradshaw et al., 2012), which are widely used in research that reverse engineers the RIV model to solve for the discount rate. Furthermore, the existence of negative analysts' earnings forecasts can be problematic, and thus they are often eliminated in prior studies. Moreover, analysts' forecasts are unavailable for many firms. The research design in this paper circumvents these problems because it does not depend on analysts' forecasts.

The RIV model equates the difference between a firm's current stock price (market value) and book value per share (book value) with the present value of expected future abnormal EPS (abnormal earnings).[3] With respect to the prior literature, knowing the stock price and the book value per share, a researcher can use analysts' EPS forecasts to impute the discount rate and hence the risk premium.[4] However, the larger the analyst forecast, the higher the discount rate needed to equate the present value of expected future abnormal EPS with the difference between the stock price and book value per share. Therefore, if analysts' forecasts are upward biased, the discount rate and the risk premium will be upward biased as well.

In this paper, by reverse engineering the RIV model, we obtain imputed future abnormal EPS based on the stock price, the book value per share, assumed growth rates in abnormal EPS, and an estimated discount rate (by using an assumed risk premium). The imputed future abnormal EPS is then converted into (raw) EPS using the definition of abnormal earnings. In this study, we use a five-year forecast horizon to estimate EPS. Also, we use three different assumptions of the annual short-term growth in abnormal EPS (0 percent, 3 percent, and 10 percent) over the forecast horizon and two different assumptions of the long-term abnormal EPS growth in perpetuity after the forecast horizon (0 percent and 3 percent). Along with the growth rate assumptions, we use different estimated discount rates based on four assumed risk premiums (0 percent, 2 percent, 4 percent, and 7 percent) to impute the firm's future earnings (forecasts) to find forecast errors. Intuitively speaking, a higher risk premium and hence higher discount rate on-average requires higher EPS to equate the present value of future abnormal EPS with the difference between current stock price and book value per share. Therefore, a seven percent risk premium, for example, would on-average lead to a much higher imputed EPS than that from a zero percent risk premium. We determine the implied equity risk premium to be the one associated with the discount rate that equates the imputed EPS with the actual EPS (produces a model forecast error of zero). For example, if we find that approximately halfway between the risk premiums of 2 percent and 4 percent, the average model forecast error is near zero, we conclude that the implied risk premium is approximately 3 percent.

Our results show that the model forecast errors are close to zero when the risk premium is assumed to be zero percent and the long-term abnormal EPS growth rate in perpetuity is 3 percent. Even when the risk premium is as low as 2 percent, the average forecast errors are strongly positive, meaning that the earnings necessary to support the 2 percent risk premium are much higher than the actual earnings realizations. This implies that a 2 percent risk premium is too high. As to the assumptions of growth rates of abnormal future EPS, we need to apply the 3 percent long-term growth rate because at a 0 percent long-term growth rate (long-term abnormal EPS is constant), the forecast errors remain positive. Variations in the short-term growth rates in abnormal EPS, on the other hand, have only a small impact on the forecast errors.

These findings suggest that the risk premium is close to zero under the assumption that abnormal EPS for a firm will grow at 3 percent after the forecast horizon and in perpetuity. This long-term growth rate is consistent with the historical inflation rate. The estimated risk premium of close to zero is in line with findings in the economics literature (Mehra and Prescott, 1985; McGrattan and Prescott, 2000; McGratton and Prescott, 2003; Mehra, 2003).

We also conduct a supplementary analysis in which forecast error is defined as the difference between the imputed EPS forecast and the *analysts'* EPS forecast. Based on this supplementary analysis, we find that the upward bias in analysts' EPS forecasts leads to an upward bias in the risk premium in the magnitude of 2 to 3 percent, which is consistent with the findings in Easton and Sommers (2007). Several extant studies (e.g., Claus and Thomas, 2001; Gebhardt et al., 2001; Easton et al., 2002) using the RIV model with analysts' earnings forecasts to estimate the risk premium find it to be around 3 percent. If the 2.84 percent upward bias (due to analysts' forecasts optimism) implied in Easton and Sommers (2007) is eliminated, the 3 percent risk premium would be adjusted to a close to zero risk premium, which is consistent with the findings of our study.

To alleviate the concern that we only use the RIV model, we conduct an additional test by using an earnings growth model developed by Ohlson (2005) from the framework in Ohlson and Juettner-Nauroth (2005). The findings suggest that the risk premium is only a little above zero (around 1 percent), which provides further support for the close to zero risk premium.

In summary, the results from this paper provide additional evidence that the risk premium is well below Ibbotson Associates' estimate of around seven percent (Ibbotson SBBI, 2011). Further, this study shows that the risk premium is lower than risk premium estimates derived from reverse engineering the RIV model using analysts' forecasts (e.g., Claus and Thomas, 2001; Gebhardt et al., 2001; Easton et al., 2002), which are likely biased upward due to analyst forecast optimism. In addition, the 3 percent long-term growth rate applied to reverse engineer the RIV model in our study is consistent with the historical inflation rate, which makes it less likely to incur reliability and validity concerns (Easton and Monahan, 2005; Botosan and Plumlee, 2005; Guay et al., 2011).

The paper proceeds as follows. In the next section, we briefly review some relevant studies that attempt to shed light on the risk premium. Following this, we describe the RIV model, including the version of the model used in this study. Next, we explain the research design used in this paper. Then we report the results and supplementary tests. This is followed by a summary and the conclusions.

BACKGROUND

The magnitude of the equity risk premium has been a controversial topic in the accounting and finance literatures due to its importance in determining firms' discount rates. Mehra and Prescott (1985) find a large discrepancy in the estimation of the equity risk premium from two sources. One uses security return and consumption growth information from 1889 to 1978, and finds that relative risk aversion and the variance of the growth rates in consumption indicate that the risk premium is at a maximum of 0.4 percent. The other source uses the difference between the real return on the S&P 500 and the real return on relatively riskless securities over the same time period, and finds the risk premium to be 6.18 percent. Mehra and Prescott (1985) conclude that this is an 'equity premium puzzle.' Mehra (2003) revisits the Mehra and Prescott (1985) framework, makes a few additional assumptions, and concludes that 1.4

percent can be considered an upper limit for the risk premium. McGrattan and Prescott (2003) find that the historical difference between equity and debt returns during the time period between 1880 and 2002 is less than one percent after considering taxes, regulatory constraints, and diversification costs. Thus, the authors claim there is no equity premium puzzle.[5]

On the other hand, one strand of literature relies on realized return and uses asset pricing models, such as the CAPM model, the Fama-French three factor model, and other multiple factor models, to compute expected rates of return (Sharpe, 1964; Lintner, 1965; Bower et al., 1984; Goldenberg and Robin, 1991; Fama and French, 1993; Bower and Schink, 1994; Elton et al., 1994; Fama and French, 1995). These studies are based on the assumption that information surprises tend to cancel out over the period of study and realized returns are therefore unbiased estimates of expected returns (Elton, 1999). However, the estimates generated from average realized returns are disappointing (Elton, 1999; Gebhardt et al., 2001). Fama and French (1997) conclude that these estimates are "unavoidably imprecise" due to the following factors. First, it is not clear which of those asset pricing models should be used. For example, the CAPM model is not regarded as a good description of expected returns, the Fama-French three factor model is argued to be empirically oriented while lacking a theoretical foundation, and there is no consensus about which other multifactor model is the most appropriate proxy for cost of capital (Fama and French, 1997). Second, none of those asset pricing models has precise risk loading estimates or factor risk premiums. These methods provide a wide range of market equity risk premiums - from less than zero to more than 10 percent (Gebhardt et al., 2001).

The imprecision of the estimates of expected rates of return generated from realized returns stimulates the development of methods using forward-looking information, and the "implied-cost-of capital" approach is developed under such a circumstance (Botosan, 1997; Botosan and Plumlee, 2002; Claus and Thomas, 2001; Gebhardt et al., 2001; Easton et al., 2002; Easton, 2004). The "implied-cost-of-capital" approach uses analysts' forecasts to proxy for the market's expectation of a firm's future earnings and reverse engineers the RIV model to obtain the implied expected rate of return.

There are a number of studies that reverse engineer the RIV model using analysts' forecasts to impute the discount rate and hence the risk premium.[6] For example, using a sample from 1985 to 1998, Claus and Thomas (2001) estimate an average risk premium to be 3.4 percent. They consider this to be an upper bound because they do not adjust for optimism in analysts' forecasts and consider their average long-term abnormal earnings growth estimate of 5.04 percent to be optimistic.[7] Similar to Claus and Thomas, Gebhardt et al. (2001) find an implied risk premium to be around 2 to 3 percent over the period 1979 to 1995. Using the same methodology in Gebhardt et al. (2001), Gode and Mohanram (2003) estimate an average risk premium of 3.2 percent over the period 1984 to 1998.[8] In addition, using a sample from 1990 to 1998, Baginski and Wahlen (2003) find an average risk premium of 2.7 percent assuming that the long-term growth rate in abnormal earnings is 3 percent, which is the approximate historical inflation rate.

Easton et al. (2002) reverse engineer the RIV model using analysts' forecasts to simultaneously estimate the risk premium and the long-term abnormal earnings growth rate in perpetuity. They find an average risk premium of 5.3 percent and an average estimated long-term growth rate of 10.1 percent. The results in Easton et al. (2002) imply that a very optimistic long-term abnormal earnings growth rate is necessary to support a risk premium as high as 5 percent.[9]

Following methodology in Easton et al. (2002), Easton and Sommers (2007) simultaneously estimate the discount rate and the long-term abnormal earnings growth rate. Easton and Sommers (2007) also estimate the difference between 1) discount rates estimated using the form of the RIV model in Easton et al. (2002), which applies analysts' earnings forecasts, and 2) discount rates estimated using an adaptation of the RIV model methodology found in O'Hanlon and Steele (2000). This method incorporates recent past earnings realizations, which are not affected by analysts' optimism. They find that the equally-weighted implied discount rate based on analysts' forecasts is on average 2.84 percent higher than the implied discount rate based on earnings realizations, and the implied risk premium based on earnings realizations is only 1.35 percent.

While most studies reverse engineering the RIV model utilize analysts' earnings forecasts to proxy for the market's expectation of firms' future earnings, there are some exceptions. For example, Hou et al.

(2012) use earnings forecasts from a cross-sectional model to proxy for cash flow expectations and estimate the implied cost of capital for a large sample of firms over 1968-2008. They find that the equally-weighted risk premium is 5.25 percent over the ten-year Treasury bond rate but the value-weighted risk premium is only 1.01 percent over the Treasury bond rate. Another exception is Lacina and Ro (2013), which reverse engineer the RIV model to impute EPS forecasts. The imputed EPS forecasts are then compared to analysts' EPS forecasts in terms of accuracy, bias, and ability to explain future earnings growth. Lacina and Ro (2013) also provide preliminary evidence that the risk premium may be lower than commonly believed. Furthermore, Allee (2011) reverse engineers the RIV model using forecasts based on the past time series of earnings. He finds that for firms with analyst following, the mean (median) risk premium over the two-year constant-maturity treasury rate is 4.10 to 5.10 percent (2.90 to 3.90 percent). However, for firms without an analyst following, the corresponding mean (median) risk premium is 8.10 to 9.30 percent (5.30 to 6.40 percent).

THE RIV MODEL

The RIV model from Ohlson (1995) and others is:

$$V_0 = B_0 + \sum_{t=1}^{\infty}(X_t - rB_{t-1})/(1+r)^t, \tag{1}$$

where V_0 (B_0) is the intrinsic value (book value) of a firm's common equity at time 0, X_t is expected earnings for future period t, and r is the discount rate. Abnormal earnings (X_t^a) for a given period t equals $X_t - rB_{t-1}$. The book values for period t are updated according to the clean surplus relation, where $B_t = B_{t-1} + X_t - D_t$, with D_t representing dividends (less capital contributions).

In practice, valuation using the RIV model needs to be implemented over a finite horizon. Assuming a finite horizon T for the RIV model and that a firm's current market price P_0 is an approximation to V_0, the following is derived:

$$P_0 - B_0 = \sum_{t=1}^{T} X_1^a(1+g)^{t-1}/(1+r)^t + X_1^a(1+g)^{T-1}/(r-g^*)(1+r)^T; \qquad \text{(RIMTV)} \tag{2}$$

where X_1^a is the abnormal earnings for period t = 1 in a forecast horizon of T periods, expected to grow at the rate g in the forecast horizon. The second term on the right hand side of RIMTV equation (2) is the firm's terminal value, equal to the present value of the beyond forecast horizon capitalization of period T abnormal earnings, where period T abnormal earnings is $X_1^a(1+g)^{T-1}$. Model (2) assumes that abnormal earnings grow at g* after the forecast horizon in perpetuity.[10]

RESEARCH DESIGN

Sample

The sample consists of firms traded on U.S. stock exchanges (NYSE, AMEX, and NASDAQ) with primary SIC codes between 1000 and 5999, in the *Compustat* quarterly industrial (PST) and research files. The sample period is from March 1986 to December 2004. The sample firm quarters are required to have the necessary *Compustat* accounting data for this study and actual EPS on *I/B/E/S*.[11] We include only firms with December year-ends (Easton et al., 2002; Easton and Sommers, 2007), and firm quarters with negative book values of common equity are eliminated. The maximum number of usable observations (firm quarters) for the sample is 54,891.

We follow Lacina and Ro (2013) to impute firms' future earnings, and then compare the imputed future earnings with the actual earnings to determine the implied equity risk premium. First, the procedure includes making assumptions about an in-horizon short-term growth rate (which is set at 0 percent, 3 percent, or 10 percent), a beyond horizon long-term growth rate (0 percent or 3 percent), and a risk premium (0 percent, 2 percent, 4 percent, or 7 percent). These assumptions correspond to 24 assumption combinations. Second, with each assumption combination, we impute individual firms' future earnings over five different forecast windows - Year +1, Year+1 to +2, Year +1 to +3, Year +1 to +4, and Year +1 to +5.[12] Third, for each assumption combination, firm quarter, and forecast window, the obtained imputed earnings are compared with actual earnings to determine the forecast error. Then, for each assumption combination, the errors from the firms are summarized and the mean and median values of errors are obtained for each forecast window. Fourth, for each assumption combination and forecast window, we use interpolation to determine the approximate risk premium at which the mean (median) forecast error is zero. This is our implied risk premium.

Discount Rates

In our methodology, the discount rates are estimated based on four assumed risk premiums: 0 percent, 2 percent, 4 percent, and 7 percent. Our assumptions of risk premiums are based on the following reasons. A 0 percent risk premium is selected because that is the risk premium in the risk-free discount rate. Since recent research that reverse engineers the RIV model has found implied risk premiums of between 2 percent and 4 percent (e.g., Claus and Thomas, 2001; Gebhardt et al., 2001; Baginski and Wahlen, 2003; Gode and Mohanram, 2003), we also assume risk premiums of 2 percent and 4 percent. Further, since historical stock and bond returns indicate a risk premium of between 6 percent and 8 percent, we assume a risk premium of 7 percent. As a proxy for the risk-free rate, we use an average of composite yields in all three-year, actively traded Treasury securities (updated weekly) for the final full week of the base month. This information is available on an Internet website from the Federal Reserve (Federal Reserve, 2010). When the assumed risk premium is non-zero, we estimated a firm's discount rate using the risk-free rate with the standard CAPM at of the end of the base month for which the RIV model is estimated and the firm's future EPS are imputed.[13]

A *monthly* discount rate is used to impute future EPS month by month. The monthly discount rate is calculated as: $r_m = (1 + r_a)^{1/12} – 1$, where r_m (r_a) is the monthly (annual) discount rate based on the Treasury yield rate or, if a positive risk premium is applicable, the estimated CAPM discount rate.

Estimating Future Dividends and Book Values

In implementing the RIV model, it is necessary to estimate future dividends per share and future book values of equity per share when future raw earnings need to be calculated with imputed abnormal earnings.[14] We estimate future dividends per share using historical cash dividends per common share, which is cash dividends (*Compustat* quarterly data item #16) divided by the number of common shares outstanding (*Compustat* quarterly data item #61). The dividends per share are adjusted for stock splits and stock dividends to coincide with the per share amount at the end of the base month. To estimate a firm's future dividend for each month in the forecast horizon, we calculate a monthly average historical dividend per share (the base month dividend) by dividing the sum of current fiscal quarter dividends and the preceding three fiscal quarter dividends by 12 (months).[15] If the dividend for any of the four quarters is unavailable on *Compustat*, then the expected future monthly dividend per share is set to zero. The estimated dividend per share is then updated for each month in the 60 month forecast horizon as follows: $d_t = (d^*)(1 + MD_g)^t$, where d_t is the estimated dividend per share for future month t (t = 1 to 60) in the horizon, d* is the base month dividend estimate, and MD_g is the estimated monthly dividend growth rate.[16]

The RIV model also requires current and future book values of equity. We use the base month book value of common equity per share, which is common equity – total (*Compustat* quarterly data item #59) divided by the number of common shares outstanding, as the starting point for estimating future book values based on the clean surplus relation. Adjustments are made for stock dividends and stock splits to coincide with the per share amount at the end of the base month.

Imputing Future Earnings

EPS forecasts for five years (Year +1 through Year +5) are imputed. To impute a firm's EPS for each future year, we first impute its monthly abnormal EPS. The abnormal EPS of the first month in the horizon uses the observed P_0 and B_0 as starting inputs in the RIV model. We then impute the monthly abnormal EPS for each following month (two to sixty) in the 60-month forecast horizon. After imputing the abnormal EPS for each month in the horizon, the raw EPS number is calculated for each month. Then we determine annual raw EPS forecasts. The following details the procedures.

Future Periodic Abnormal EPS

From RIMTV equation (2), we estimate a firm's abnormal EPS for the first month in the sixty month forecast horizon as:

$$x_1^a = (P_0 - B_0) \Big/ \left(\sum_{t=1}^{T} (1+g_m)^{t-1}(1+r_m)^{-t} + (1+g_m)^{T-1}(r_m - g_m^*)^{-1}(1+r_m)^{-T} \right), \tag{3}$$

where g_m is the monthly growth rate of abnormal EPS in the forecast horizon (short-term growth rate), g_m^* is the monthly growth rate in abnormal EPS beyond the forecast horizon and in perpetuity (long-term growth rate), and the horizon T = 60.[17] We use annual short-term growth rates of 0 percent, 3 percent, and 10 percent and annual long-term growth rates of 0 percent (constant abnormal EPS) and 3 percent. Annual short-term growth rates are converted into monthly growth rates as follows: $g_m = (1 + g_a)^{1/12} - 1$, where g_m (g_a) is the assumed monthly (annual) growth in abnormal EPS. The 3-percent annual long-term growth rate is converted in the same manner.

The long-term abnormal EPS growth rate in perpetuity is affected by various factors. On the one hand, accounting conservatism and inflation can increase the long-term growth rate. Therefore, as in Baginski and Wahlen (2003), we assume a 3-percent annual long-term or perpetual growth rate because it approximates the historical inflation rate. On the other hand, a reduction in economic rents as a firm matures and as more competitors enter into the industry can lead to the reduction in the firm's long-term growth rate and even possibly drive it equal to or below zero. Thus, we also assume a 0 percent long-term growth rate.[18] One advantage of using a 0 percent long-term growth rate is that no observation is dropped due to the restriction (discussed later) that the discount rate should be larger than or equal to the long-term growth rate.

The abnormal EPS values for subsequent months in the horizon (t = 2 to 60) are estimated as:

$$x_t^a = x_{t-1}^a (1 + g_m). \tag{4}$$

When $P_0 < B_0$, the calculation of (3) will produce a negative value of x_1^a. Since g_m and g_m^* are only applicable to positive levels of abnormal earnings, we estimate equation (3) assuming that g_m and g_m^* are equal to zero for cases in which $P_0 < B_0$.[19] This pertains to about 15 percent of the observations.

Imputing Future Annual EPS

After estimating a firm's abnormal EPS (x_t^a) for month t, the abnormal EPS equation is rearranged to calculate future raw EPS as follows:

$$x_t = x_t^a + r_m B_{t-1}. \tag{5}$$

As previously mentioned, future EPS are imputed for the base months of December, March, June, and September. Annual EPS is determined at time 0 (the end of the base month). If the base month is December, the Year +1 EPS forecast is the sum of the first twelve monthly forecasts (which pertain to the months of January through December of Year +1), or $\sum_{t=1}^{12} x_t$. When the base month is March, the actual earnings for the first quarter are already available. Therefore, the Year +1 EPS forecast is calculated as the sum of the first quarter actual EPS on *I/B/E/S* plus the sum of the first nine monthly forecasts (which apply to the months of April through December of Year +1), $\sum_{t=1}^{9} x_t$, imputed as of the end of March. If the first quarter actual EPS is unavailable, then the Year +1 forecast is not calculated for the March base month. This process is repeated for the June and September base months.[20] The EPS forecasts for Years +2 to +5 are determined in a similar fashion. If a firm's base month is December, the Year +2 forecast is the sum of the 13th monthly forecast through the 24th monthly forecast, or $\sum_{t=13}^{24} x_t$. The Year +3 forecast is the sum of the 25th monthly forecast through the 36th monthly forecast, or $\sum_{t=25}^{36} x_t$, and so on for the Year +4 and Year +5 forecasts. When the base month is March, the first nine monthly forecasts are used in determining the Year +1 forecast. Thus, the Year +2 forecast is the sum of the 10th monthly forecast through the 21th monthly forecast, or $\sum_{t=10}^{21} x_t$. The Year +3 forecast is the sum of the 22nd monthly forecast through the 33rd monthly forecast, or $\sum_{t=22}^{33} x_t$, and so on for the Year +4 and Year +5 forecasts. The same process applies to the other base months.

Analysts' Earnings Forecasts

Analysts' EPS forecasts are used to demonstrate the following two points: 1) That the summary statistics of analysts' forecasts shows that analysts' forecasts are significantly upward biased and 2) that the upward bias in analysts' forecasts leads to larger risk premiums when analysts' forecasts are used as the proxy for the market's expectation of the firm's future earnings in reverse engineering the RIV model. The analysts' forecasts used are the *I/B/E/S* annual median consensus analysts' EPS forecasts, which reflect continuing operations.[21] Forecasts are adjusted to a basic EPS format if they are expressed otherwise. In addition, analysts' forecasts are adjusted for stock splits and stock dividends as of the end of the base month. The *I/B/E/S* consensus analysts' forecasts are released between the 14th and the 20th of a particular month. Therefore, since the end of quarter months (December, March, etc.) are used as the base months to impute EPS using the RIV model, the consensus analysts' EPS forecasts made during the next month (e.g. January, April, July, and October) are used.[22]

We require the tests using analysts' forecasts to have an annual consensus analysts' EPS forecast for the current year (Year +1).[23, 24] Annual consensus analysts' EPS forecasts are available on *I/B/E/S* for up to five years. If no analyst forecast is available for a particular future year and the last available forecast for the previous years is non-negative, the (initially) unavailable forecast is estimated by compounding the most recently available annual consensus analysts' EPS forecast at the median consensus analysts' long-term earnings growth rate projection available on *I/B/E/S*.

Forecast Error

For each firm quarter, forecast error is measured as the cumulative signed forecast error, which is the accumulated difference between the forecast and the corresponding actual EPS, as follows (firm and time subscripts suppressed):

$$\text{Error} = \sum_{\text{Year}=+1}^{S} (F - A)/P, \qquad (6)$$

where Error is the cumulative bias from EPS forecasts, F is the imputed EPS forecast, A is the corresponding actual EPS from *I/B/E/S*, and P is the firm's common stock price at the end of the base month. For each firm quarter, the forecast errors are accumulated from Year +1 to Year S, where S = +1,…,+5. Therefore, the shortest time frame used is Year +1 only and the longest window over which the individual year forecast errors are accumulated is Year +1 to Year +5. We use cumulative forecast errors because for a given observation, forecast errors may fluctuate depending on the year in the forecast horizon (+1,…,+5).

A higher (lower) discount rate on-average causes a higher (lower) imputed EPS forecast.[25] Thus, if Error (i.e., model forecast error) is positive, then the implication is that the discount rate and therefore the assumed risk premium are too high, ceteris paribus. On the other hand, a negative model forecast error conveys that the discount rate is too low, ceteris paribus.

RESULTS

Summary Statistics

Table 1 gives the summary statistics. There are 54,891 firm quarters for which stock price, book value, equity beta, the risk-free rate, and at least one analyst forecast are available. The distribution of the book value of common equity is skewed, with a median value of $87.116 million but a mean value of $400.170 million. In Table 1, the top one percent of price-to-book (PB) ratio values are winsorized to mitigate the excessive influence of outliers. The mean (median) P/B ratio is 3.290 (2.026). The variable RiskPrem0 is the three-year Treasury security rate, which is the risk-free proxy used in the paper. RiskPrem0 has a mean (median) value of 5.4 (5.7) percent, and Beta has a mean (median) value of 1.274 (1.137). Therefore, the average systematic risk for the sample firm observations as measured by beta is slightly above the normal beta of 1.0. RiskPrem2, RiskPrem4, and RiskPrem7 are the discount rates calculated using the risk-free discount rate, beta, and risk premiums of 2 percent, 4 percent, and 7 percent, respectively.

TABLE 1
SUMMARY STATISTICS

Variable	N	Mean	Median	Standard Deviation
Book value (in millions)	54,891	400.170	87.116	1481.000
PB ratio	54,891	3.290	2.026	4.076
RiskPrem0	54,891	0.054	0.057	0.019
Beta	54,891	1.274	1.137	0.887
RiskPrem2	54,886	0.080	0.080	0.023
RiskPrem4	54,854	0.105	0.105	0.036
RiskPrem7	54,699	0.144	0.140	0.060
AnErr-Year +1	34,894	0.017	0.002	0.056
AnErr-Year +2	26,836	0.032	0.015	0.078
AnErr-Year +3	17,781	0.041	0.027	0.084
AnErr-Year +4	13,639	0.052	0.040	0.093
AnErr-Year +5	10,832	0.062	0.052	0.105

Book value is the end of base month book value of common stockholders' equity. The PB ratio is the price-to-book ratio, calculated as the end of base month common stock price divided by the end of base month book value per share, which is measured by dividing book value by the common shares of stock outstanding. PB ratios are winsorized at the 99 percent level (to truncate the top one percent outliers). Both of the aforementioned variables are calculated using Compustat information. RiskPrem0 is the risk-free discount rate for the final full week in the base month, and is calculated as the average of composite yields on all three-year, actively traded treasury securities and is available on http://www.federalreserve.gov/releases/h15/data.htm. Beta is calculated using the CAPM model and the CRSP value-weighted market return for the sixty months prior to the base month. RiskPrem2, RiskPrem4, and RiskPrem7 are expected rates of return calculated using Beta, the risk-free discount rate, and risk premiums of 2 percent, 4 percent, and 7 percent, respectively. Negative values of RiskPrem2, RiskPrem4, and RiskPrem7 are eliminated. AnErr represents the signed errors of analysts' earnings per share (EPS) forecasts. Year +1 is the first (current) year in the forecast horizon, and Year +2 through Year +5 are the years thereafter. Analysts' EPS forecasts are the median consensus analysts' EPS forecasts reported on the I/B/E/S summary files for the month following the base month. Actual EPS values are also from the I/B/E/S summary files. Signed analyst forecast error is calculated as the analyst EPS forecast minus actual EPS, deflated by the base month stock price.

Table 1 also shows the signed consensus analysts' EPS forecast errors for each year in the forecast window, for sample observations with one or more qualifying analysts' forecasts. Signed analyst forecast error is computed as the consensus analyst EPS forecast minus actual EPS, deflated by base month stock price. For each of the five years, the top and bottom one percent errors are eliminated. The results show that forecast errors are positive on average for each future year, indicating that analysts' forecasts are biased upward. This bias increases over the forecast horizon. For Year +1 (the current year), the median bias is not large, with a median (mean) error of 0.2 percent (1.7 percent) of stock price. However, as the forecast horizon increases, the forecast error goes much higher. In Year +5, the median (mean) error is 5.2 percent (6.2 percent) of stock price. To illustrate the magnitude of the Year +5 analysts' EPS forecast error, if a firm's stock price is $20, then an EPS forecast error percentage of 5.2 percent implies an EPS forecast error of $1.04, which is large. The results in Table 1 show that consensus analysts' EPS forecasts clearly have a positive bias, which would bias the discount rate upward if the discount rate were to be imputed using the RIV model with analysts' forecasts.

Imputed Earnings Forecast Errors

Constant Long-Term Abnormal EPS

Table 2 shows the forecast errors from equation (6) using imputed EPS from RIMTV equation (2) with constant long-term abnormal EPS (no growth in abnormal EPS after the 60-month forecast horizon). The number of base month observations drops from the maximum of 54,891 for a number of reasons. First, Year +1 model EPS forecasts for the base months March, June, and September are made when prior quarter(s) during Year +1 have ended. Therefore, they require actual quarterly EPS from *I/B/E/S*, which is not available for every firm and quarter combination. Second, the calculation of the forecast error in equation (6) requires actual annual EPS from *I/B/E/S* for each year in the forecast window. However, actual annual EPS is not always available. Third, for more recent sample years, forecast errors can only be calculated for shorter forecast windows. Fourth, for each combination of risk premium and short-term growth rate, an observation with the highest or lowest one percent model forecast error for any year in the forecast window is eliminated to control for the effect of outliers. Thus, for example, a firm quarter cannot have a forecast error in the top or bottom one percent in any of the years +1 through +5 for its forecast error to be calculated over the Year +1 to Year +5 window.

TABLE 2
CUMULATIVE SIGNED ERRORS OF IMPUTED EPS FORECASTS, WITH ZERO LONG-TERM GROWTH IN ABNORMAL EPS

	RiskPrem0			RiskPrem2			RiskPrem4			RiskPrem7		
	Short-term Growth			Short-term Growth			Short-term Growth			Short-term Growth		
Year & Statistics	0%	3%	10%	0%	3%	10%	0%	3%	10%	0%	3%	10%
Year +1												
Mean	0.024	0.022	0.019	0.040	0.037	0.033	0.055	0.052	0.046	0.079	0.075	0.067
Median	0.006	0.004	0.001	0.019	0.017	0.012	0.032	0.029	0.023	0.052	0.048	0.040
Std. Dev.	0.073	0.072	0.072	0.077	0.076	0.076	0.083	0.082	0.081	0.095	0.093	0.091
N	47,132			47,127			47,102			46,979		
Years +1 to +2												
Mean	0.050	0.045	0.037	0.092	0.086	0.074	0.136	0.128	0.113	0.204	0.194	0.174
Median	0.023	0.017	0.007	0.063	0.056	0.042	0.103	0.095	0.078	0.165	0.154	0.134
Std. Dev.	0.144	0.143	0.143	0.153	0.152	0.151	0.167	0.166	0.163	0.197	0.194	0.189
N	35,970			35,979			35,955			35,894		
Years +1 to +3												
Mean	0.068	0.061	0.047	0.141	0.131	0.112	0.217	0.206	0.182	0.339	0.325	0.295
Median	0.042	0.034	0.018	0.111	0.100	0.080	0.181	0.169	0.143	0.291	0.276	0.245
Std. Dev.	0.205	0.204	0.203	0.222	0.220	0.217	0.248	0.245	0.240	0.304	0.299	0.290
N	27,621			27,638			27,632			27,587		
Years +1 to +4												
Mean	0.080	0.071	0.053	0.186	0.174	0.150	0.301	0.286	0.255	0.490	0.472	0.434
Median	0.058	0.048	0.029	0.159	0.147	0.121	0.266	0.250	0.218	0.435	0.418	0.376
Std. Dev.	0.273	0.272	0.270	0.297	0.295	0.290	0.336	0.332	0.324	0.423	0.417	0.404
N	21,418			21,432			21,433			21,402		
Years +1 to +5												
Mean	0.087	0.077	0.057	0.232	0.219	0.191	0.394	0.378	0.343	0.670	0.650	0.606
Median	0.072	0.061	0.039	0.208	0.194	0.167	0.356	0.339	0.302	0.596	0.574	0.534
Std. Dev.	0.349	0.348	0.346	0.381	0.378	0.373	0.437	0.432	0.423	0.570	0.563	0.547
N	16,719			16,735			16,746			16,734		

The residual income valuation model from which future earnings per share (EPS) are imputed is RIMTV assuming a terminal value based on a constant abnormal earnings stream beyond the sixty-month forecast horizon. RiskPrem0, RiskPrem2, RiskPrem4, and RiskPrem7 are discount rates calculated using Beta, the risk-free discount rate, and risk premiums of 0 percent, 2 percent, 4 percent, and 7 percent, respectively. Negative values of RiskPrem2, RiskPrem4, and RiskPrem7 are eliminated. The percentages are the growth rates per year of abnormal earnings assumed within the forecast horizon. Actual EPS values are from the I/B/E/S summary files. All EPS are basic earnings per share, adjusted for stock dividends and splits. Year +1 is the first year in the forecast horizon, and Year +2 through Year +5 are the years thereafter. Cumulative signed forecast error is calculated as imputed model EPS forecast minus actual EPS, deflated by base month stock price, accumulated over time periods ranging from Year +1 only to Year +1 through Year +5.

The results in Table 2 show that the cumulative signed forecast errors of imputed earnings (calculation shown in equation (6)) are always positive.[26] A positive forecast error suggests that the imputed EPS is larger than the corresponding actual EPS so that a lower discount rate (i.e., a lower risk premium) is necessary to bring the forecast error down to zero. For RIMTV equation (2), a higher short-term growth rate in abnormal EPS implies lower short-term EPS (such as for years +1 to +5) because abnormal EPS after the 60th month and in perpetuity would be larger. Therefore, the lowest errors occur when the risk premium is the lowest (0 percent) and the short-term growth rate is the highest (10 percent). However, the errors are still slightly or moderately positive under those assumptions. The median (mean) error ranges from 0.1 (1.9) percent of stock price for Year +1 to 3.9 (5.7) percent of stock price for the

Year +1 to Year +5 window. Therefore, even when abnormal EPS is assumed to grow as high as 10 percent over the 5 years and then remain constant at the end-of-horizon level in perpetuity, a 0 percent risk premium is not enough to bring the forecast error to zero or below. As expected, the model forecast errors become larger as the risk premium increases. When the risk premium is assumed to be 7 percent, which is close to the traditionally acknowledged historical risk premium measure from Ibbotson Associates (Ibbotson SBBI, 2011), the forecast errors are very high. For example, when the short-term growth rate is 10 percent and the risk premium is 7 percent, the median Year +1 to Year +4 forecast error is 37.6 percent, or an average of 9.4 percent of stock price on an annual basis. For a firm with a stock price of $20, a 9.4 percent forecast error would mean an EPS forecast error of $1.88.

Table 2 also shows that changing the short-term growth assumption has only a slight impact on the forecast errors; this impact is much less than that from changing the risk premium assumption. For instance, under a zero risk premium for the Year +1 to Year +4 window, when the short-term growth rate is increased from 3 percent to 10 percent, the median forecast error decreases by 1.9 percent of stock price. This is only 0.48 percent on an annual basis. Also, the forecast errors just change moderately across the five forecast windows for positive risk premiums and only slightly across those windows for the zero risk premium assumption. For example, assuming a zero risk premium and a three percent short-term growth rate, the mean (median) errors are 2.2 (0.4) percent, 4.5 (1.7) percent, 6.1 (3.4) percent, 7.1 (4.8) percent, and 7.7 (6.1) percent for the five forecast windows. However, on an annual basis, these errors are 2.20 (0.40) percent, 2.25 (0.85) percent, 2.03 (1.13) percent, 1.78 (1.20) percent, and 1.54 (1.22) percent for the Year +1 through Year +1 to Year +5 windows, respectively. Thus, it appears that survivorship bias does not have a major influence on the findings.

Positive Long-Term Abnormal EPS Growth Rate

Table 3 shows the forecast errors from equation (6) using imputed EPS from RIMTV equation (2) with a 3 percent annual long-term growth in abnormal EPS.[27] First, the number of observations is lower than in the case of constant long-term abnormal EPS shown in Table 2 because the theory behind RIMTV equation (2) requires the discount rate to be higher than the long-term growth rate in abnormal EPS, which leads to the dropping of observations with discount rates less than 3%. Second, we do not show the imputed (model) forecast errors for a 0 percent short-term growth rate assumption because a forecast of a 0-percent short-term growth rate with a 3 percent long-term growth rate in abnormal EPS does not make intuitive sense for firms in general.

TABLE 3
CUMULATIVE SIGNED ERRORS OF IMPUTED EPS FORECASTS, WITH THREE PERCENT LONG-TERM GROWTH IN ABNORMAL EPS

	RiskPrem0		RiskPrem2		RiskPrem4		RiskPrem7	
	Short-term Growth		Short-term Growth		Short-term Growth		Short-term Growth	
Year & Statistics	3%	10%	3%	10%	3%	10%	3%	10%
Year +1								
Mean	0.015	0.013	0.032	0.028	0.047	0.042	0.071	0.064
Median	-0.001	-0.003	0.011	0.008	0.024	0.019	0.044	0.037
Std. Dev.	0.068	0.068	0.076	0.076	0.082	0.081	0.093	0.090
N	40,420		46,181		46,420		46,441	
Years +1 to +2								
Mean	0.026	0.020	0.071	0.062	0.114	0.101	0.183	0.164
Median	-0.001	-0.008	0.039	0.028	0.079	0.065	0.142	0.123
Std. Dev.	0.132	0.132	0.151	0.150	0.165	0.162	0.194	0.189
N	32,432		35,399		35,543		35,549	
Years +1 to +3								
Mean	0.027	0.019	0.102	0.088	0.179	0.159	0.302	0.274
Median	-0.002	-0.011	0.068	0.052	0.139	0.117	0.251	0.222
Std. Dev.	0.196	0.196	0.218	0.216	0.244	0.238	0.298	0.289
N	26,968		27,521		27,486		27,422	
Years +1 to +4								
Mean	0.022	0.011	0.130	0.111	0.246	0.219	0.437	0.401
Median	-0.004	-0.016	0.098	0.078	0.207	0.179	0.378	0.341
Std. Dev.	0.264	0.263	0.291	0.287	0.328	0.321	0.414	0.401
N	21,347		21,397		21,357		21,312	
Years +1 to +5								
Mean	0.012	-0.000	0.159	0.137	0.322	0.291	0.600	0.558
Median	-0.007	-0.021	0.131	0.108	0.279	0.249	0.524	0.482
Std. Dev.	0.339	0.338	0.372	0.368	0.425	0.417	0.557	0.541
N	16,676		16,713		16,691		16,671	

The residual income valuation model from which future earnings per share (EPS) are imputed is RIMTV assuming a terminal value based on a 3 percent annual growth in abnormal earnings beyond the sixty-month forecast horizon. RiskPrem0, RiskPrem2, RiskPrem4, and RiskPrem7 are discount rates calculated using Beta, the risk-free discount rate, and risk premiums of 0 percent, 2 percent, 4 percent, and 7 percent, respectively. Negative values of RiskPrem2, RiskPrem4, and RiskPrem7 are eliminated. The percentages are the growth rates per year of abnormal earnings assumed within the forecast horizon. Actual EPS values are from the *I/B/E/S* summary files. All EPS are basic earnings per share, adjusted for stock dividends and splits. Year +1 is the *first* year in the forecast horizon, and Year +2 through Year +5 are the years thereafter. Cumulative signed forecast error is calculated as imputed model EPS forecast minus actual EPS, deflated by base month stock price, accumulated over time periods ranging from Year +1 only to Year +1 through Year +5.

A comparison of tables 2 and 3 indicates that the imputed (model) forecast errors are lower for a 3 percent annual long-term growth rate than constant (zero growth) long-term abnormal EPS. This makes sense because a 3 percent long-term abnormal EPS growth rate in perpetuity in RIMTV equation (2) means higher long-term EPS and lower near-term (such as Year +1 to Year +5) EPS relative to the case of constant long-term abnormal EPS in perpetuity. Lower near-term imputed EPS are generally associated with less upward bias error when actual EPS is subtracted (equation (6)). Even though near-term EPS is lower for a 3 percent long-term growth rate than that of 0 percent, the median model forecast errors are mostly positive and become negative only when the assumed risk premium is 0 percent (RiskPrem0).[28] Estimated risk premiums can be interpolated using median model forecast errors for a 0 percent risk premium and a 2 percent risk premium. The Year +1 median forecast error assuming a 10 percent annual short-term growth rate gives an approximate risk premium of just 0.55 percent, or [0 – (-0.003)]/ [0.008 – (-0.003)]* (0.02 – 0). Also, assuming a 10 percent short-term growth rate, the median errors give interpolated risk premiums of 0.44 percent, 0.35 percent, 0.34 percent, and 0.33 percent for the forecast windows of years +1 to +2, years +1 to +3, years +1 to +4, and years +1 to +5, respectively. Again, the model forecast errors become more positive as the risk premium increases and reach very high levels when the risk premium is 7 percent. As in the case of constant long-term abnormal EPS in Table 2, varying the short-term growth rate has only a small impact on model forecast errors, especially when the risk premium is 0 percent.

Based on previous discussion in this paper, the 3 percent long-term growth rate, which is the approximate historical inflation rate, is likely reasonable since it is consistent with the inflation rate.[29] Also, the short-term assumption that a firm's abnormal EPS will grow at 10 percent for the next five years is likely optimistic. By and large, it appears that the assumption of a 10 percent short-term growth rate combined with a 3 percent long-term growth rate is slightly biased toward optimism. Using these upwardly biased RIMTV growth assumptions, larger discount rates (hence risk premiums) would bring the forecast errors to be zero. As shown in table 3, even under such circumstances, the model forecast errors are close to zero only when risk premium is zero.

ADDITIONAL TESTS

Effects of Firm Size

As discussed earlier, Easton and Sommers (2007) find that the optimism in analysts' forecasts increases the risk premium by 2.84 percent and that the unbiased risk premium is only 1.35 percent. However, this result applies when observations are equally weighted, as has normally been done in the extant literature. In supplementary tests, Easton and Sommers (2007) show that the optimism in analysts' forecasts increases the risk premium in a value-weighted estimate by only 1.60 percent and the unbiased value-weighted risk premium is 4.43 percent.[30] These different results from equally-weighted and value-weighted observations imply that risk premium can vary across firms with different sizes.

Therefore, we perform an additional analysis using portfolios formed based on firm size. For each sample year (1986 to 2004), observations are equally divided into three portfolios based on the market value of equity. We find the mean and the median equation (6) forecast errors for each portfolio for each of the five forecast windows (for Year +1 only through the Year +1 to Year +5 window) using imputed EPS based on a three percent long-term growth rate. Then the mean of the yearly means and medians across the sample years is calculated for each portfolio. For the high market capitalization portfolio, the untabulated results show that assuming a ten percent short-term growth rate, the averages based on yearly mean (median) forecast errors give interpolated risk premiums of 0.15 (1.20) percent, 0.17 (1.03) percent, 0.25 (0.86) percent, 0.25 (0.66) percent, and 0.28 (0.57) percent for the Year +1 through Year +1 to Year +5 forecast windows, respectively. The forecast errors are always positive or close to zero for the medium firm size portfolio. For the small firm size portfolio, the results show that assuming a ten percent short-term growth rate, the averages based on yearly mean and median forecast errors are always positive for the Year +1, the Year +1 to Year +2, and the Year +1 to Year +3 forecast windows. The average based on the yearly median (mean) forecast error gives interpolated risk premiums of 0.34 (less than 0) percent and 0.72 (0.36) percent for the forecast windows ending in years +4 and +5, respectively.[31] Therefore, the findings convey that although there may be a little variation in risk premium across firm size, the variation is clearly not close to that implied by the results in Easton and Sommers (2007).

Influence of Analyst Forecast Bias on Implied Risk Premium

In this analysis, we attempt to find the overstatement of the risk premium caused by the bias in analysts' EPS forecasts. We measure 1) implied risk premiums from forecast errors using equation (6) with actual EPS as the benchmark (as was done previously), but including only observations with analysts' forecasts available; and 2) implied risk premiums from forecast errors calculated using equation (6) with analysts' forecasts of EPS as the benchmark. In these analyses, RIMTV equation (2) with a three percent long-term growth rate is used to determine the model forecasts. Table 4, Panel A shows the results using forecast errors calculated with *actual* EPS as the benchmark. Using a 10 percent short-term growth rate, the interpolated risk premium for Year +1 from the median (mean) forecast error is (0 - -0.003)/(0.007 - -0.003) * (0.02 – 0) = 0.60 percent (less than 0 percent).[32] Additionally, the interpolated risk premiums are 0.41 (less than 0) percent, 0.47 (less than 0) percent, 0.53 (0.15) percent, and 0.46 (0.36) percent for the Year +1 to Year +2 through Year +1 to Year +5 forecast windows, respectively.

TABLE 4
CUMULATIVE SIGNED ERRORS OF IMPUTED EPS FORECASTS, WITH THREE PERCENT LONG-TERM GROWTH IN ABNORMAL EPS; SAMPLE WITH ANALYSTS' EPS FORECASTS

Panel A: Actual EPS as Benchmark

	RiskPrem0		RiskPrem2		RiskPrem4		RiskPrem7	
	Short-term Growth		Short-term Growth		Short-term Growth		Short-term Growth	
Year & Statistics	3%	10%	3%	10%	3%	10%	3%	10%
Year +1								
Mean	0.013	0.011	0.026	0.023	0.039	0.034	0.057	0.051
Median	-0.001	-0.003	0.010	0.007	0.020	0.016	0.036	0.030
Std. Dev.	0.057	0.057	0.062	0.061	0.066	0.065	0.074	0.072
N	29,984		34,041		34,213		34,235	
Years +1 to +2								
Mean	0.024	0.019	0.065	0.056	0.105	0.093	0.168	0.151
Median	-0.000	-0.007	0.037	0.027	0.075	0.061	0.133	0.115
Std. Dev.	0.115	0.115	0.130	0.130	0.143	0.141	0.169	0.164
N	22,962		25,141		25,252		25,269	
Years +1 to +3								
Mean	0.016	0.008	0.086	0.071	0.159	0.139	0.276	0.248
Median	-0.005	-0.014	0.062	0.045	0.130	0.108	0.237	0.208
Std. Dev.	0.153	0.153	0.171	0.169	0.195	0.190	0.247	0.237
N	16,312		16,726		16,717		16,712	
Years +1 to +4								
Mean	0.004	-0.007	0.107	0.088	0.218	0.191	0.400	0.363
Median	-0.011	-0.024	0.087	0.066	0.191	0.163	0.354	0.317
Std. Dev.	0.197	0.196	0.218	0.215	0.256	0.248	0.338	0.325
N	12,666		12,673		12,651		12,652	
Years +1 to +5								
Mean	-0.010	-0.024	0.132	0.109	0.289	0.258	0.555	0.513
Median	-0.014	-0.029	0.120	0.096	0.263	0.233	0.498	0.457
Std. Dev.	0.250	0.249	0.277	0.273	0.330	0.321	0.452	0.437
N	9,870		9,877		9,871		9,898	

Panel B: Analysts' EPS Forecasts as Benchmark

	RiskPrem0		RiskPrem2		RiskPrem4		RiskPrem7	
	Short-term Growth		Short-term Growth		Short-term Growth		Short-term Growth	
Year & Statistics	3%	10%	3%	10%	3%	10%	3%	10%
Year +1								
Mean	-0.007	-0.008	0.008	0.005	0.020	0.016	0.039	0.033
Median	-0.008	-0.010	0.002	-0.001	0.012	0.008	0.026	0.021
Std. Dev.	0.040	0.040	0.046	0.045	0.051	0.049	0.060	0.057
N	29,984		34,041		34,213		34,235	
Years +1 to +2								
Mean	-0.026	-0.031	0.017	0.008	0.057	0.045	0.119	0.102
Median	-0.033	-0.039	0.002	-0.007	0.038	0.026	0.092	0.076
Std. Dev.	0.081	0.080	0.099	0.097	0.113	0.109	0.142	0.135
N	23,013		25,201		25,311		25,312	
Years +1 to +3								
Mean	-0.070	-0.078	-0.000	-0.015	0.073	0.053	0.189	0.162
Median	-0.070	-0.079	-0.009	-0.023	0.056	0.037	0.160	0.133
Std. Dev.	0.102	0.101	0.122	0.117	0.150	0.142	0.207	0.195
N	16,424		16,839		16,827		16,815	
Years +1 to +4								
Mean	-0.129	-0.140	-0.027	-0.046	0.083	0.057	0.263	0.228
Median	-0.120	-0.131	-0.027	-0.046	0.071	0.046	0.233	0.200
Std. Dev.	0.135	0.132	0.154	0.148	0.193	0.182	0.282	0.265
N	12,838		12,828		12,793		12,781	
Years +1 to +5								
Mean	-0.195	-0.208	-0.054	-0.077	0.101	0.071	0.363	0.322
Median	-0.181	-0.193	-0.051	-0.072	0.090	0.061	0.328	0.287
Std. Dev.	0.177	0.174	0.200	0.193	0.251	0.240	0.381	0.363
N	10,059		10,055		10,032		10,026	

The sample used in this test includes firms with analysts' earnings per share (EPS) forecasts. The residual income valuation model from which future EPS are imputed is RIMTV assuming a terminal value based on a 3 percent annual growth in abnormal earnings beyond the sixty-month forecast horizon. RiskPrem0, RiskPrem2, RiskPrem4, and RiskPrem7 are discount rates calculated using Beta, the risk-free discount rate, and risk premiums of 0 percent, 2 percent, 4 percent, and 7 percent, respectively. Negative values of RiskPrem2, RiskPrem4, and RiskPrem7 are eliminated. The percentages are the growth rates per year of abnormal earnings assumed within the forecast horizon. Actual EPS values and analysts' EPS forecasts are from the *I/B/E/S* summary files. All EPS are basic earnings per share, adjusted for stock dividends and splits. Year +1 is the *first* year in the forecast horizon, and Year +2 through Year +5 are the years thereafter. In Panel A, signed forecast error is calculated as imputed model EPS forecast minus actual EPS, deflated by base month stock price. In Panel B, signed forecast error is calculated as model EPS forecast minus analysts' EPS forecast, deflated by base month stock price. Signed forecast errors are accumulated over time periods ranging from Year +1 only to Year +1 through Year +5.

Panel B provides the results of forecast errors using *analysts'* EPS forecasts as the benchmark. Using a 10 percent short-term growth rate, the Year +1 risk premiums conveyed by the interpolated median and mean forecast errors are 0.02 + (0 - -0.001)/(0.008 - -0.001) * (0.04 – 0.02) = 2.22 percent and (0 - -0.008)/(0.005 - -0.008) * (0.02 – 0) = 1.23 percent, respectively. Further, the median (mean) risk premiums are 2.42 (1.59) percent, 2.77 (2.44) percent, 3.00 (2.89) percent, and 3.08 (3.04) percent for the Year +1 to Year +2 through Year +1 to Year +5 forecast windows, respectively. Therefore, a comparison of the interpolated risk premiums from Panel B with those from Panel A using the median (mean) forecast errors conveys that the addition to the risk premium due to optimism in analysts' earnings forecasts is 1.62

percent (not meaningful), 2.01 percent (not meaningful), 2.30 percent (not meaningful), 2.47 percent (2.74 percent), and 2.62 percent (2.68 percent) for the Year + 1 through Year +1 to Year +5 forecast windows, respectively. Therefore, considering that the findings for the Year +1 only window are likely less reliable due to a short time frame, we conclude that the increase in the risk premium due to analysts' optimism is likely somewhere between 2 percent and 3 percent, similar to 2.84 percent found in Easton and Sommers (2007).

Implied Risk Premium from the Earnings Growth Model

We also apply our methodology by using an alternative model developed by Ohlson and Juettner-Nauroth (2005), and we obtain similar results. The model has several appealing features. First, it does not require book value and focuses on earnings, which is the most common measure forecasted by financial analysts. Second, since it does not require book value, there is no estimation of future book values and hence no assumption of clean surplus accounting. Third, the model only requires the estimation of dividends for period 1. A disadvantage of this model is that the estimation of value hinges critically on earnings growth rate assumptions since firm value is not anchored by book value. We estimate the following version of the model, which is developed in Ohlson (2005):

$$V_0 = X_1/r*(g_2 - g_1)/(r - g_1), \tag{7}$$

where g_2 is the short-term cum-dividend growth in earnings from period 1 to period 2 and g_1 is the long-term growth in earnings as $t \rightarrow \infty$. An assumption must be made as to the rate in which g_2 approaches g_1. We refer to this version of the Ohlson and Juettner-Nauroth (2005) model as the earnings growth (EG) model.

For the tests using the EG model, we estimate implied earnings only for the December base months. Assuming V_0 is equal to P_0, we re-arrange equation (7) to estimate Year +1 earnings as follows:

$$X_1 = (P_0 * r)/((g_2 - g_1)/(r - g_1)). \tag{8}$$

Since g_2 is the short-term cum-dividend growth in earnings, it is equal to $(X_2 - X_1 + r * D_1)/X_1$, where the Year +1 annual dividend per share D_1 is estimated in the same way as future dividends for the RIV model except that dividends are not converted to a monthly basis as they were in the RIV model earnings estimations. Re-arranging the equality of g_2 with the cum-dividend growth in earnings shown above, Year +2 earnings is estimated as follows:

$$X_2 = (1 + g_2) * X_1 - r * D_1. \tag{9}$$

Finally, earnings for Year +3 through Year +5 (t = 3 to 5) are estimated as:

$$X_t = X_{t-1} * (1 + g'), \tag{10}$$

where g' is a growth rate between g_2 and g_1 since g_2 asymptotically approaches g_1.

We use historical growth rates to help determine earnings growth rates in the EG model. The historical geometric growth rates in S & P earnings are calculated beginning in 1960 using information from Aswath Damodaran's website (Damodaran, 2010). For the period 1960 to 1985 (the year before the beginning of the sample period), the growth rate is 5.77 percent, whereas the growth rate between 1960 and 2004 is 7.14 percent. These percentages include earnings growth from both high growth and mature firms. Another way to estimate earnings growth is to sum up the growth in real GDP and the inflation rate. We measure the rates using the earliest years available from our sources. Growth in real GDP information is retrieved from the website of the U. S. Department of Commerce, Bureau of Economic Analysis (U. S. Department of Commerce, 2010). The geometric growth in real GDP between 1929 and 1985 (2004) is 3.25 (3.32) percent per year. Inflation rate data is retrieved from the Inflationdata.com website (Capital Professional Services, 2010). The geometric growth in the Consumer Price Index between 1914 and 1985 (2004) is 3.24 (3.20) percent per year. Therefore, the sum of the growth in real GDP and the inflation rate is approximately 6.5 percent per year. As a result of the aforementioned historical rates, we assume a 10 percent short-term cum-dividend earnings growth rate and long-term earnings growth rates of 6 percent and 3 percent. Assuming that earnings asymptotically approach a long-term earnings growth rate of 3 percent may be reasonable because a firm's earnings may be expected to grow at the inflation rate when it becomes mature. We assume that the short-term earnings growth rate g_2 asymptotically approaches the long-term earnings growth rate g_1 at a rate of 50 percent per year. For example, if g_1 is 6 percent, then earnings are assumed to grow at 10 percent between Year +1 and Year +2, 8 percent between Year +2 and Year +3, 7 percent between Year +3 and Year +4, and so on.[33]

Cumulative signed forecast errors are calculated as in equation (6). As in the case of the RIV model, any observation with the highest or lowest one percent forecast error for any year in the forecast window is eliminated. Further, equation (9) shows that in some cases, the Year +2 imputed earnings X_2 will be less than zero. This would lead to negative imputed earnings for years +3 through +5 as well. However, the growth rates in the EG model only apply to positive earnings numbers. Therefore, when X_2 is less than zero, the Year +2 through Year +5 earnings observations are dropped. As inferred from equation (8), higher short-term growth rates lead to lower imputed forecasts. Under such a circumstance, to counteract the higher short-term growth rate, a higher discount rate (and hence risk premium) is needed to increase the imputed earnings so that it equals actual earnings. In addition, higher long-term growth rates would tend to lead to higher (lower) imputed earnings when higher (lower) risk premiums are assumed.[34]

Table 5 reports the results. Since only December base months are used in these tests, the numbers of observations are less than those in the analyses using the RIV model. Also, since the discount rate must be higher than the long-term growth rate to feasibly estimate the EG model in equation (7), there are more observations using a 3 percent long-term growth rate. The results show that the interpolated risk premiums derived from median forecast errors are around one percent or less and highly robust across the forecast windows. Using a 3 percent long-term growth rate, the interpolated risk premium is the lowest at [0 --0.020]/[0.027 --0.020]*(0.02 – 0) = 0.85 percent for the Year +1 to Year +4 window and the highest at 0.93 percent for the Year +1 to Year +2 window. With a 6 percent long-term growth rate, the interpolated risk premium is the lowest at 0.96 percent for the Year +1 to Year +5 window and the highest at 1.02 percent for the Year +1 to Year +3 window.

TABLE 5
CUMULATIVE SIGNED ERRORS OF IMPUTED EPS FORECASTS, EG MODEL

	RiskPrem0		RiskPrem2		RiskPrem4		RiskPrem7	
	Long-Term Growth		Long-Term Growth		Long-Term Growth		Long-Term Growth	
Year & Statistics	3%	6%	3%	6%	3%	6%	3%	6%
Year +1								
Mean	0.005	-0.005	0.051	0.053	0.118	0.154	0.268	0.388
Median	-0.017	-0.024	0.022	0.023	0.080	0.105	0.193	0.274
Std. Dev.	0.104	0.103	0.125	0.129	0.165	0.200	0.289	0.413
N	10,466	3,757	12,152	10,011	12,207	11,190	12,202	11,659
Years +1 to +2								
Mean	-0.006	-0.012	0.040	0.042	0.112	0.148	0.269	0.393
Median	-0.019	-0.021	0.022	0.022	0.082	0.108	0.204	0.290
Std. Dev.	0.102	0.103	0.124	0.127	0.164	0.199	0.288	0.410
N	8,927	3,248	9,660	8,133	9,692	8,968	9,675	9,283
Years +1 to +3								
Mean	-0.016	-0.019	0.033	0.036	0.109	0.147	0.270	0.401
Median	-0.020	-0.023	0.025	0.022	0.086	0.112	0.211	0.304
Std. Dev.	0.110	0.108	0.123	0.129	0.162	0.199	0.279	0.405
N	7,730	2,922	7,718	6,762	7,693	7,252	7,661	7,416
Years +1 to +4								
Mean	-0.023	-0.025	0.029	0.032	0.107	0.149	0.271	0.414
Median	-0.020	-0.023	0.027	0.024	0.090	0.118	0.221	0.325
Std. Dev.	0.123	0.116	0.136	0.145	0.172	0.212	0.283	0.410
N	6,140	2,660	6,137	5,569	6,119	5,861	6,097	5,940
Years +1 to +5								
Mean	-0.029	-0.038	0.025	0.030	0.107	0.156	0.276	0.437
Median	-0.020	-0.026	0.026	0.028	0.093	0.127	0.227	0.349
Std. Dev.	0.134	0.132	0.146	0.155	0.180	0.221	0.287	0.423
N	4,890	2,389	4,888	4,479	4,874	4,685	4,858	4,736

Future earnings per share (EPS) are imputed from the EG model, which is developed in Ohlson (2005) and is a variation of the Ohlson and Juettner-Nauroth (2005) earnings growth model. RiskPrem0, RiskPrem2, RiskPrem4, and RiskPrem7 are expected rates of return calculated using Beta, the risk-free rate of return, and risk premiums of zero percent, two percent, four percent, and seven percent, respectively. Negative values of RiskPrem2, RiskPrem4, and RiskPrem7 are eliminated. Year +1 is the *first* year in the forecast horizon, and Years +2 through +5 are the years thereafter. The short-term growth rate (per year) is the cum-dividend earnings per share growth rate between Year +1 and Year +2 and is assumed to be ten percent. The long-term growth rate (per year) is the asymptotic growth rate in earnings per share and is shown in the table. We assume that the growth rate decays between the short-term rate and the long-term rate at fifty percent per year. Actual EPS numbers are from the I/B/E/S summary files. All EPS are basic earnings per share, adjusted for stock dividends and splits. Cumulative signed forecast error is calculated as imputed model EPS forecast minus actual EPS, deflated by base month stock price, accumulated over time periods ranging from Year +1 only to Year +1 through Year +5.

The Year +1 only window is not included in the discussion of mean forecast errors because one year is likely too short of a window. Using a 3 percent long-term growth rate, the mean forecast error shows interpolated risk premiums ranging from 0.26 percent for the Year +1 to Year +2 window to 1.07 percent for the Year +1 to Year +5 window. With a 6 percent long-term growth rate, the interpolated risk premium increases from 0.44 percent for the Year +1 to Year +2 window to 1.12 percent for the Year +1 to Year +5 window.

The interpolated risk premiums based on mean forecast errors increase as the forecast window increases. This is partially caused by very small EPS forecasts. Equation (8) shows that when the discount rate r is close to the long-term growth rate g_1, a small EPS forecast for Year +1 is likely to result. A small EPS forecast for Year +1 would result in small forecasts for Years +2 through +5 as shown in equations (9) and (10). Therefore, the tests are re-run by eliminating firms with Year +1 EPS forecasts of less than $0.10.[35] Untabulated results show that when the short-term growth rate is 3 (6) percent, the interpolated risk premium based on mean forecast errors increases from 0.35 (0.44) percent for the Year +1 to Year +2 window to 0.68 (0.70) percent for the Year +1 to Year +5 window. The increase in interpolated risk premium based on mean forecast errors as the forecast window increases is much less pronounced when firms with small EPS in Year +1 are excluded than that based on the sample with small EPS included. When smaller Year +1 EPS forecasts are eliminated, the interpolated risk premiums based on median forecast errors are still very stable across forecast horizons and are slightly smaller than the risk premiums based on the median forecast errors in Table 5.

To gain further insights, we also run additional sensitivity tests by using two alternative assumptions: a 7 percent short-term growth rate and a 15 percent short-term growth rate. Using a 7 percent rate, the untabulated results show only positive forecast errors, implying that the EG earnings forecasts are too high even under a zero risk premium. When a 15 percent rate is used, the implied risk premium is between 2.0 and 2.5 percent. However, based on historical data, the assumption of a 15 percent short-term growth rate appears optimistic. All in all, the results from the tests using the EG model support the finding from the RIV model tests that the risk premium is close to zero and lower than commonly believed.

CONCLUSIONS

In this study, we use stock price and book value per share of common equity and reverse engineer the RIV model to impute future EPS for firms on U.S. stock exchanges. Then the imputed EPS amount is compared with actual EPS to determine the forecast error and the forecast error is accumulated over various forecast windows. A risk premium at which the (cumulative) forecast error is zero is the implied risk premium. We find that even under growth assumptions that are likely to be slightly optimistic and hence bias the implied risk premium slightly upward, the risk premium determined by the model forecast errors is close to zero. The results clearly show that the traditionally acknowledged risk premium based on stock and bond returns of around 7 percent from Ibbotson Associates (Ibbotson SBBI, 2011) is much too high. In fact, our findings suggest that average risk premiums generated from academic papers that have used analysts' earnings forecasts and reverse engineered the RIV model are too high, at least in part due to optimism in analysts' earnings forecasts. The finding of a close to zero risk premium is in line with findings in Mehra and Prescott (1985). An additional analysis shows that the increase in the implied risk premium due to analysts' optimism is likely between 2 percent and 3 percent. For each combination of risk premium, short-term abnormal EPS growth rate, and long-term abnormal EPS growth rate in perpetuity, the average yearly imputed (model) forecast errors do not change much over the five forecast windows (the following year through the following five years) for which EPS is imputed. Therefore, survivorship bias does not appear to have a significant influence on the results. Findings from further tests using an earnings growth model based on Ohlson and Juettner-Nauroth (2005) to impute EPS forecasts also convey that the risk premium is close to zero (around 1 percent).

A possible explanation for the findings of such low risk premiums is market inefficiency. However, if the market is inefficient, it could influence the results from any study that reverse engineers the RIV model since empirical implementations of the RIV model normally use stock price. An investigation of possible market inefficiency is beyond the scope of this paper.

ENDNOTES

1. In fact, some practitioners and some in the popular press have even argued for a risk premium of close to zero (e.g., Glassman and Haslett, 1998; Wien, 1998). This is consistent with Mehra and Prescott (1985), who find that using the methodology in their academic study, the risk premium is less than half a percent.
2. The objective of this paper is to determine the average risk premium for firms in general, not for individual firms to estimate their risk premiums.
3. Papers that utilize the RIV model with analysts' earnings forecasts express the RIV model variables in a per share format because analysts' earnings forecasts are typically expressed in a per share format. To be comparable, in this paper, the RIV model variables are also expressed as per share amounts even though analysts' forecasts are not used in the primary tests. In addition, it is well known that the RIV model is derived from the equality of firm value with the present value of future dividends (less capital contributions). The theory that firm value equals the present value of future dividends stems from a per share perspective (Ohlson, 2005).
4. Assumptions about the growth rate of abnormal earnings need to be made.
5. Another paper, McGrattan and Prescott (2000), uses the value of productive assets in the U.S. corporate sector to construct a model to determine the value of corporate equity. They find that based on their valuation model, future returns on corporate debt and equity should be about equal.
6. Besides assuming analysts' earnings forecasts to be an unbiased proxy for market expectation of firms' future EPS, these studies need to make assumptions about (or estimate) the long-term growth rate of earnings beyond the analyst forecast horizon to compute firms' present values of future abnormal earnings.
7. Their long-term abnormal earnings growth estimate, which they assume to be the expected inflation rate, is derived by taking the ten-year Treasury bond yield minus 3 percent. This estimate of abnormal earnings growth would have dipped close to and even below zero if the measurement period had included the 2000s, when the ten-year Treasury bond rate has gotten down close to or even below 3 percent.
8. By utilizing the methodology in Liu et al. (2002), Gode and Mohanram (2003) find an average risk premium of only 1.3 percent over the period 1984 to 1998. The methodologies in Gebhardt et al. (2001) and Liu et al. (2002) assume that the return-on-equity (ROE) based on analysts' forecasts asymptotes to the median industry ROE. The difference lies in the fact that Gebhardt et al. (2001) determine the median industry ROE using profitable firms (based on past data) whereas Liu et al. (2002) determine the median industry ROE using all firms, including those firms with losses.
9. Nekrasov and Ogneva (2011) and Ashton and Wang (2013) also develop models to simultaneously estimate the cost of equity capital (and hence risk premium) and the long-term abnormal earnings growth rate. Nekrasov and Ogneva (2011) find that, over their sample period, their model produces an implied risk premium of just 2.50 percent compared to 4.43 percent using the Easton et al. (2002) model. For both of those models, after correcting for analyst forecast errors, the implied risk premium is approximately 2 percent lower than the aforementioned percentages. Also, over the same sample period, Nekrasov and Ogneva (2011) find a long-term abnormal earnings growth rate of 6.70 percent from their model compared to 9.70 percent from the Easton et al. (2002) model. Ashton and Wang (2013) produce an estimated risk premium of between 3.1 percent and 3.9 percent and an estimated long-term abnormal earnings growth rate of between 4.2 percent and 4.7 percent. Easton et al. (2002), Nekrasov and Ogneva (2011), and Ashton and Wang (2013) use five-year Treasury bond yields to proxy for the risk-free rate.
10. In cases where g = g*, RIMTV equation (2) breaks down to the capitalization model, which is $P_0 - B_0 = X_1^a/(r - g)$. The capitalization model is derived in Ohlson (1995).
11. Our methodology does not require the availability of analysts' earnings forecasts, because we compare the imputed future EPS with actual EPS to determine equity risk premium. However, in a supplementary test, we use the analysts' forecast data as the benchmark, and compare the results with the one that uses actual EPS as the benchmark.
12. For each firm quarter, a firm's future EPS is imputed for the sixty months after the base month. The base month (the month immediately prior to the sixty-month forecast horizon) used to impute EPS from the RIV model is the final month in each quarter: March, June, September, and December (Lacina and Ro, 2013).
13. Value-weighted betas from the CAPM are estimated from the market model using 60 (but no less than 24) prior monthly stock return observations as of the end of the base month. The *CRSP* value-weighted market returns for NYSE+AMEX+NASDAQ firms are used in the market model. Since the sample period begins in March 1986, we go as far back as March 1981 to retrieve returns information to estimate betas.

14. Please refer to Lacina and Ro (2013) for detail.
15. The base month dividend d* is estimated as $d^* = \sum_{q=0}^{-3} d_q / 12$, where d_q is the quarterly dividend.
16. To estimate a firm's future monthly dividend growth rate, we first estimate an annual growth rate (AD_g) from quarterly dividend d_q as $AD_g = \left(\sum_{q=0}^{-3} d_q - \sum_{q=-4}^{-7} d_q \right) / \sum_{q=-4}^{-7} d_q$. If any quarterly dividend in the denominator is unavailable on *Compustat*, the dividend growth rate is set to be zero. If the numerator is positive and the denominator is zero, the growth rate is assumed to be 1.0. Extreme dividend growth rates are winsorized at +1.0 and –1.0. The monthly dividend growth rate is then calculated as: $MD_g = (1 + AD_g)^{1/12} - 1$.
17. When $g_m = g_m^*$, RIMTV equation (2) collapses to the capitalization model derived in Ohlson (1995) and equation (3) becomes $x_1^a = (P_0 - B_0)(r_m - g_m)$.
18. Penman and Sougiannis (1998) also use a zero long-term perpetual growth rate in measurements of firm value using the RIV model.
19. When we assume that both g_m and g_m^* are equal to zero in equation (3), $x_1^a = (P_0 - B_0)r_m$.
20. For the June base month, the Year +1 forecast is calculated as the sum of actual EPS for the first two quarters plus the sum of the first six monthly forecasts, $\sum_{t=1}^{6} x_t$. When the base month is September, the Year +1 forecast is the sum of actual EPS for the first three quarters plus the sum of the first three monthly forecasts, $\sum_{t=1}^{3} x_t$.
21. The actual EPS values from *I/B/E/S* also reflect continuing operations.
22. For example, the June base month imputed EPS forecast would correspond to the consensus analysts' EPS forecast released between the 14th and the 20th of July.
23. In our primary tests, the derivation of imputed EPS does not require a firm to have a consensus analysts' EPS forecast.
24. *I/B/E/S* reports consensus analysts' forecasts of the preceding year's EPS after a firm releases its preceding year's actual EPS. In cases where the preceding year's actual EPS is yet to be released, the first consensus analysts' forecast would be for the prior year. We exclude analysts' forecasts associated with these observations. This exclusion primarily applies to consensus analysts' forecasts for January (which correspond to the December base month).
25. For firms with a base month stock price (P_0) greater than base month book value per share (B_0), a higher (lower) discount rate leads to a higher (lower) imputed EPS forecast. However, the opposite is true for firms with $P_0 < B_0$. Since P_0 is greater than B_0 for approximately 85 percent of the sample observations, a higher (lower) discount rate on average causes a higher (lower) imputed EPS forecast. In robustness tests which use only observations with $P_0 > B_0$, the results are very similar and the conclusions are unaltered (results untabulated).
26. For Table 2, t-tests (Wilcoxon signed rank tests) are performed to determine whether the mean (median) model forecast errors are significantly different from zero. The forecast errors are always significantly different from zero at well less than the one percent level.
27. For Table 3, t-tests (Wilcoxon signed rank tests) are performed to determine whether the mean (median) model forecast errors are significantly different from zero. In the majority of cases, the forecast errors are significantly different from zero at well less than the one percent level. However, when a zero percent risk premium is assumed, some of the average forecast errors are only significantly different from zero at the 10 percent level for the Year +1 to Year +3, Year +1 to Year +4, and Year +1 to Year +5 forecast windows.
28. The mean forecast errors are generally positive when the risk premium is zero.
29. Although a case could be made for a long-term growth rate that is less than the inflation rate.
30. Hou, van Dijk, and Zhang (2012) document in their working paper that the equally-weighted risk premium is 5.25 percent whereas the value-weighted risk premium is 1.01 percent. However, as an input into the RIV model, they use earnings derived from a pooled cross-sectional regression model.
31. The finding that the implied risk premium increases for years +4 and +5 in the small firm portfolio may indicate some survivorship bias. Firms in the smallest market capitalization portfolio that survive may tend

to have high future actual earnings relative to the current premium of stock price over book value per share, which leads to a higher implied risk premium to match imputed future earnings with actual future earnings. Therefore, survivorship bias may lead to an upward bias in the implied risk premium for small firms in years +4 and +5.

32. Mean forecast errors are positive even at a zero risk premium.
33. If the earnings are growing at 10 percent in Year +2 and g_2 = 6 percent, then earnings for Year +3 are assumed to grow at the rate of 10 percent - (10 percent - 6 percent) * 50 percent = 8 percent, with the assumption that the short-term earnings growth rate asymptotically approaches the long-term growth rate at the rate of 50 percent per year. Based on the same rationale, the earnings for Year +4 are assumed to grow at the rate of 8 percent - (8 percent - 6 percent) * 50 percent = 7 percent, and the earnings for Year +5 are assumed to grow at the rate of 7 percent - (7 percent - 6 percent) * 50 percent = 6.5 percent.
34. $\partial X_1/\partial g_2 < 0$ since the EG model assumes that $g_2 > g_1$ and $r > g_1$. $\partial X_1/\partial g_1 > 0$ if $r > g_2$ and < 0 if $r < g_2$. Equations (9) and (10) show that higher (lower) X_1 implies higher (lower) imputed earnings for subsequent years.
35. By design, EPS forecasts from the EG model for Year +1 are greater than zero.

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